

UK Greenhouse Modernisation and Expansion Programme (GMEP)

DELIVERY BLUEPRINT AND IMPLEMENTATION ROADMAP



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How to use this document

This document is intended as an operational roadmap for government and regulators. It is designed to answer six questions:

1. What problem is government trying to solve
2. Why existing policy frameworks have failed to solve it
3. What government should do differently
4. Who is responsible for delivery
5. In what sequence actions should be taken
6. How success, failure, and accountability will be measured

This is not a general strategy note. It is intended to support implementation.



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THE UK GREENHOUSE PROBLEM IN ONE PAGE

An ageing, high-cost, capital-constrained sector is limiting UK food production, increasing import exposure and undermining long-term national resilience.

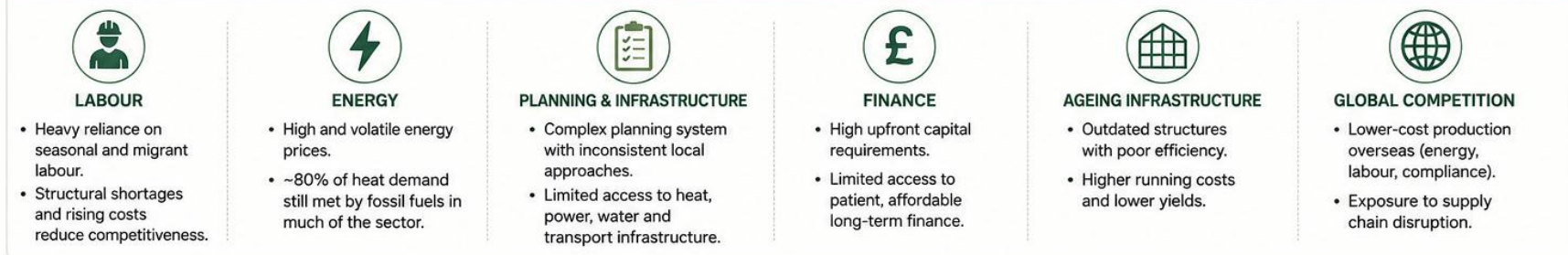


Much of the estate dates from the 1960s–1980s.

Capital intensity is a major barrier to renewal and expansion.

High costs, energy exposure and low productivity weaken investability.

KEY PRESSURES DRIVING THE PROBLEM



THE CONSEQUENCES IF NO ACTION IS TAKEN



The UK needs a coordinated, long-term programme to modernise and expand greenhouse capacity, unlock investment and build a more resilient, productive and sustainable domestic sector.

1. EXECUTIVE SUMMARY

The UK greenhouse horticulture sector is a small but strategically important component of national food production. Current infrastructure analysis identifies approximately 800–900 hectares of commercial food-producing greenhouse area, producing high-value fresh crops including tomatoes, cucumbers and peppers from a relatively small land footprint. However, approximately 70% of the greenhouse estate is estimated to be more than 40 years old, and replacement and modernisation have not occurred at the rate required to maintain a competitive and resilient domestic industry [1].

The sector now faces a structural investment problem. Modern greenhouse infrastructure requires substantial long-term capital investment, while businesses operate against volatile short-term costs, narrow margins and limited revenue certainty. Energy typically represents approximately 15–30% of turnover and labour approximately 25–45%, with operational vacancy rates of around 10–20% and shortages in specialist technical and engineering roles potentially reaching 15–25% [2]. Energy-price volatility, continued dependence on gas and CHP, rising construction and financing costs, planning uncertainty and restricted access to capital further constrain investment [2].

These pressures have implications beyond the horticulture sector. Failure to renew domestic productive capacity increases exposure to imported fresh produce and external shocks affecting energy, climate, trade and international supply chains. Conversely, modern greenhouse infrastructure can deliver high levels of food production per unit of land while integrating with renewable electricity, industrial residual heat, heat networks, water infrastructure and regional economic development [5].

The **UK Greenhouse Modernisation and Expansion Programme (UK-GMEP)** is proposed as a ten-year national programme to address this structural investment failure. Its purpose is not to subsidise routine commercial activity or guarantee grower profitability. It is to make strategically important greenhouse infrastructure investable again.

1.1 Programme scale and investment

UK-GMEP will combine capital support and blended finance with planning reform, energy-system integration, workforce development, demand stabilisation and technology deployment.

Over ten years, the Programme will target approximately 850–1,000 hectares of infrastructure intervention, comprising around 450–500 hectares of existing greenhouse modernisation or replacement and 400–500 hectares of new or substantially expanded productive capacity.

The Programme is expected to mobilise approximately £4–5 billion of combined public and private investment. Government support will be tiered according to project scale and market failure, with higher proportionate support available to smaller businesses and greater private-sector contributions required for larger commercial investments. Shared strategic infrastructure, including heat networks, geothermal systems, water infrastructure and major energy connections, will be supported separately where benefits extend across multiple businesses.

Public funding will be conditional on additionality. In practice, this means support is provided only where UK-GMEP enables investment to proceed sooner, at greater scale or to a higher specification than would otherwise occur. Projects that can proceed commercially at the same scale, specification and timetable will not receive unnecessary subsidy.

1.2 An integrated infrastructure programme

Energy transition will be central to UK-GMEP. Rather than prescribing a single replacement for gas, the Programme will support site-appropriate combinations of industrial residual heat, heat networks, geothermal energy, heat pumps, thermal storage, renewable electricity and hybrid systems. By Year 10, supported sites will target an average 25% reduction in delivered energy intensity, a 50% reduction in fossil-derived heat intensity, and at least 60% of heat demand supplied from qualifying low-carbon or recovered sources.

Planning reform will establish consistent treatment of qualifying greenhouse developments as Strategic Food Production Infrastructure and introduce a coordinated route for major projects. Strategic Greenhouse Opportunity Areas will identify locations where food production can be effectively integrated with energy, water, transport, labour and industrial infrastructure. Planning, grid, water, environmental and financing requirements will be considered in parallel rather than sequentially.

Infrastructure investment will be accompanied by workforce reform. UK-GMEP will connect migration policy with domestic recruitment, apprenticeships, technical education, automation and regional skills planning. By Year 10, the Programme aims to reduce persistent operational vacancies among participating businesses by approximately 50% and technical and engineering vacancies by around 40%.

Innovation support will focus on commercial deployment rather than repeated demonstration. Technologies will progress through commercial-scale testing, independent validation and early deployment before moving into normal commercial finance. By Year 10, at least 95% of supported operational area should meet the Programme's minimum digital monitoring standard and at least 80% of supported modernisation projects should incorporate independently evidenced productivity or resilience technologies.

Demand-side measures will complement investment. Multi-year public procurement frameworks and commercial demand partnerships will provide greater revenue visibility without guaranteeing prices or markets. Major expansion projects will also

undergo market-additionality assessment to reduce the risk that publicly financed capacity simply displaces existing UK production.

1.3 Governance, accountability and outcomes

Defra will lead UK-GMEP through a dedicated Programme Office. HM Treasury will oversee fiscal exposure and value for money; DESNZ will lead energy-system integration; MHCLG planning reform; DWP and Skills England workforce development; the Home Office migration policy; and Innovate UK and relevant business and innovation functions technology deployment. Regional GMEP Delivery Partnerships will coordinate major projects with local infrastructure and economic priorities.

Major investments will pass through formal gateways covering strategic fit, technical feasibility, infrastructure, market demand, finance and operational readiness. Funding will be released progressively, with provisions for audit, clawback and intervention where projects materially underperform.

The ten-year ambition is:

Outcome	UK-GMEP ambition
Existing estate modernised/replaced	450–500 ha
New/substantially expanded capacity	400–500 ha
Total infrastructure intervention	850–1,000 ha
Total public + private investment	£4–5bn
Delivered energy intensity	≥25% reduction
Fossil-derived heat intensity	≥50% reduction
Low-carbon/recovered heat	≥60% of supported heat demand
Persistent operational vacancies	c.50% reduction
Technical/engineering vacancies	c.40% reduction
Supported area meeting digital standard	≥95%

A verified national baseline and Greenhouse Asset Register will be established in Year 1, with independent evaluation at key points during the Programme. Success will be measured not by expenditure or hectares funded alone, but by additional investment, productive capacity, resilience, productivity, private capital mobilisation and reduced dependence on continuing public subsidy.

UK-GMEP is therefore a time-limited infrastructure and investment programme, not a permanent subsidy regime. Its long-term objective is to transform an ageing and increasingly vulnerable asset base into modern national food infrastructure, creating the conditions in which infrastructure renewal, energy transition and technology adoption become sufficiently predictable and investable to continue increasingly through normal commercial finance, while strengthening UK food security, productivity and resilience for decades to come.

2. PURPOSE, SCOPE, AND STATUTORY INTENT

2.1 Purpose

The purpose of the UK Greenhouse Modernisation and Expansion Programme (UK-GMEP) is to establish a coordinated, long-term framework for the renewal, modernisation and strategic expansion of the UK's food-producing greenhouse sector, recognising it as a critical component of national food, energy and economic infrastructure.

The Programme responds to a structural weakness that has developed over several decades. Greenhouse horticulture has historically been included within agricultural policy, but rarely treated according to its distinctive characteristics as a highly productive, capital-intensive and energy-dependent production system. Unlike many land-based agricultural sectors, greenhouse productivity depends less on the area of land occupied and more on the quality of long-lived physical infrastructure, access to affordable energy and water, environmental control, technology, specialist skills and the ability to finance periodic infrastructure renewal.

The consequences of this mismatch are increasingly visible. Britain has approximately 2,085 ha of operational greenhouse infrastructure, of which an estimated 30-40% is used for food production [1]. More than 70% of the existing greenhouse estate is over 40 years old, with much of it constructed under very different technological, economic and energy conditions. Modernisation has occurred, but not at the scale required to establish a sustained cycle of infrastructure replacement and renewal.

At the same time, the UK remains highly dependent on imported fresh produce, importing approximately 86% of its fruit and around 44% of its vegetables [3]. This creates exposure to climate impacts in overseas production regions, geopolitical disruption, energy and transport volatility, and increasingly competitive international markets.

The central challenge is therefore not simply technological capability or grower willingness to innovate, but investability. Modern greenhouse systems can deliver substantially higher productivity, improved energy and water efficiency, greater automation and more resilient year-round production, but require significant upfront capital investment against uncertain long-term operating conditions. Current estimates place substantial retrofit at approximately £850,000 per hectare, while new modern greenhouse infrastructure is typically estimated at approximately £2–2.5 million per hectare. These figures should be treated as indicative planning assumptions rather than fixed unit costs: costs vary substantially by specification, site conditions, energy and supporting infrastructure, and project scale, with larger developments potentially achieving economies of scale and costs closer to

approximately £1.8 million per hectare. Renewal of the existing estate nevertheless represents a multi-billion-pound infrastructure challenge [2].

UK-GMEP is designed to address this structural misalignment by creating the conditions for sustained public and private investment. It will:

1. enable renewal and modernisation of existing greenhouse infrastructure to improve productivity, energy efficiency and environmental performance;
2. support strategically located expansion of domestic production where this strengthens food-system resilience and reduces exposure to vulnerable international supply chains;
3. integrate greenhouse production with wider energy, heat, water and infrastructure systems;
4. improve investability through appropriate combinations of private capital, public risk-sharing, blended finance and targeted capital support;
5. accelerate commercial deployment of proven technologies, automation and digital systems;
6. strengthen workforce and specialist technical capability;
7. improve long-term market certainty, including through appropriate public-procurement mechanisms; and
8. establish governance, monitoring and accountability capable of supporting repeated cycles of investment and infrastructure renewal.

The Programme therefore represents a shift from sector support to strategic infrastructure planning. Greenhouse production is simultaneously a food-production system, a built infrastructure asset, a major energy user, a potential user of residual heat and resources, a technology platform and an important component of regional economies.

This approach is increasingly aligned with wider national policy. The Land Use Framework now explicitly recognises the opportunity to integrate food production with energy and infrastructure planning, including the role of glasshouse horticulture [5]. Recent horticulture policy proposals similarly emphasise spatial planning, modern glasshouse expansion, clean and affordable energy, waste-heat and CO₂ co-location, and mechanisms to de-risk long-term investment.

The purpose of UK-GMEP is therefore not to permanently subsidise greenhouse production, but to establish the conditions under which a modern, productive and increasingly low-carbon greenhouse sector can attract long-term investment, renew its infrastructure and contribute reliably to UK food security.

2.2 Scope

UK-GMEP applies to the design, delivery and governance of interventions supporting commercial protected edible production within permanent greenhouse and glasshouse systems in the United Kingdom, together with the enabling infrastructure required for their effective operation.

For the purposes of the Programme, greenhouse horticulture refers to commercial production of edible crops within permanent engineered structures in which the

growing environment can be actively managed to enable extended-season or year-round production.

The Programme adopts a systems boundary rather than a structure-only boundary. Greenhouse infrastructure cannot be considered independently from the energy, water, workforce, technology, logistics, financial and market systems required to operate it.

2.3 What is included

The Programme covers interventions directly required to renew, expand and sustain commercial protected edible production.

a. Physical infrastructure

- Retrofit, refurbishment and replacement of existing commercial greenhouse structures.
- New-build greenhouse developments and regional clusters.
- Packhouses, cold storage and directly associated post-harvest infrastructure.
- Water capture, storage, treatment and recycling infrastructure.
- Shared infrastructure supporting multiple greenhouse businesses or production sites.

b. Energy and resource integration

- Heating, cooling and climate-control infrastructure.
- Renewable electricity, heat pumps, geothermal and appropriate bioenergy systems.
- Industrial and commercial residual or waste heat.
- Heat networks and shared energy infrastructure.
- Energy storage and electricity-grid connections.
- CO₂ recovery and other resource-sharing systems where directly linked to production.

Particular emphasis will be placed on co-location and industrial symbiosis, where greenhouse production can utilise heat, energy, CO₂, water or other resources that would otherwise be wasted.

c. Production technology

- Environmental and climate control.
- Irrigation, fertigation, rainwater collection and storage, water treatment and sanitisation, and water recycling.
- LED and hybrid lighting.
- Advanced glazing and greenhouse materials.
- Sensors, robotics and automation.
- Digital and AI-supported production systems.

d. Finance and investment

- Capital grants and targeted public investment.
- Concessional finance and government-backed loans.
- Loan guarantees and blended finance.
- Risk-sharing mechanisms.

- Financing of shared enabling infrastructure.

Support will be differentiated according to project type, scale, commercial risk and public benefit rather than delivered through a single uniform funding mechanism.

e. Planning and spatial integration

- Strategic spatial planning for greenhouse development.
- Identification of locations suitable for expansion, redevelopment and clustering.
- Planning classification and guidance.
- Integration with regional and local spatial strategies.
- Co-location with energy, water, industrial, logistics and other infrastructure.

The Programme will seek to direct investment towards locations where productive potential, infrastructure availability, environmental constraints and regional economic opportunities align, rather than treating greenhouse development as an isolated land-use decision.

f. Workforce and skills

- Seasonal and permanent workforce requirements.
- Specialist crop, engineering, energy, automation and data skills.
- Apprenticeships and FE/HE training pathways.
- Workforce development and retraining.
- Labour and migration arrangements where directly relevant to sector resilience.

g. Markets and procurement

- Public-sector and anchor-institution procurement.
- Long-term supply arrangements.
- Producer cooperation and aggregation.
- Regional logistics and distribution.
- Mechanisms capable of improving revenue certainty without insulating producers from normal commercial competition.

h. Innovation and deployment

- Commercial demonstration and technology validation.
- Deployment trials and innovation vouchers.
- Industry–academic partnerships.
- Interoperability and technical standards.
- Independent performance verification.

The emphasis will be on commercial deployment and diffusion, rather than research for its own sake.

2.4 What is excluded

To maintain a clear delivery focus, the core Programme does not include:

- open-field agriculture;
- ornamental and other non-edible horticulture as a primary funding objective;

- temporary or low-capital protected structures such as conventional polytunnels, except within defined transition or innovation pathways;
- fundamental research without a credible route to commercial deployment;
- upstream agricultural-input industries unless directly integrated with greenhouse infrastructure; or
- general retail and consumer activity unrelated to production, resilience or procurement.

These boundaries define the operational remit of UK-GMEP rather than the wider strategic importance of these sectors. Shared infrastructure may remain eligible where a clear and measurable benefit to protected edible production can be demonstrated.

2.5 System boundary and policy interface

Greenhouse horticulture sits at the intersection of multiple policy systems. UK-GMEP will therefore explicitly interface with:

1. food security and agricultural policy;
2. energy security and decarbonisation;
3. industrial strategy and infrastructure investment;
4. spatial planning and land-use policy;
5. water security and infrastructure;
6. climate mitigation and adaptation;
7. workforce, skills and migration policy;
8. public health and nutrition;
9. public procurement; and
10. regional economic development.

This cross-system approach is fundamental to the Programme. The current condition of the greenhouse estate reflects, in part, the historical fragmentation of these policy domains. UK-GMEP is specifically intended to prevent the same fragmentation from determining the next generation of greenhouse infrastructure.

2.6 Statutory intent

The statutory intent of UK-GMEP is to establish a durable national framework for the renewal, expansion and resilience of protected edible production, capable of operating across political and investment cycles.

The Programme should use existing statutory, regulatory and financial powers wherever these are sufficient, with targeted legislative or regulatory reform introduced where existing powers cannot provide the coordination, investment mechanisms or long-term certainty required.

The framework should:

1. recognise food-producing greenhouse horticulture as a strategically important component of national food and economic infrastructure;
2. establish UK-GMEP, or an equivalent successor mechanism, as a long-term vehicle for infrastructure renewal and strategic expansion;

3. enable grants, guarantees, concessional finance, blended finance and other appropriate risk-sharing mechanisms;
4. enable investment in shared energy, water and other enabling infrastructure;
5. provide mechanisms for coordination across food, energy, planning, infrastructure, health and industrial policy;
6. enable appropriate planning and regulatory guidance;
7. facilitate appropriate long-term public-procurement mechanisms; and
8. establish proportionate data, monitoring, evaluation and reporting requirements.

The intention is to move beyond a succession of short-duration funding schemes towards a policy environment capable of supporting assets with 30–50-year operational lifetimes [2,11].

2.6.1 Basis for public intervention

Public intervention under UK-GMEP should address identifiable market or policy failures and should not substitute unnecessarily for commercially viable private investment.

Intervention is justified where:

- substantial public benefits, including food security, emissions reduction and regional economic resilience, are not fully captured within private investment returns;
- long asset lifetimes are poorly matched with prevailing finance or contracting conditions;
- energy, water or other infrastructure integration requires coordination between multiple organisations;
- individual businesses cannot efficiently bear system-level risks;
- strategically important domestic production capacity would otherwise be lost or underprovided; or
- limited public intervention can mobilise substantially greater private investment.
-

The scale of the infrastructure challenge makes this distinction important. Modernisation of the existing food-producing estate alone represents several billion pounds of potential investment. Expansion is substantially larger: modelling indicates that supplying 50% of UK demand for greenhouse-grown fruit and vegetables could require approximately 9,400 ha of protected production, while 100% would require approximately 18,800 ha. These should be regarded as long-term scenarios rather than immediate construction targets, but they demonstrate the scale of the infrastructure gap.

UK-GMEP should therefore use public funding strategically to crowd in private capital rather than crowd it out, with support proportionate to the public benefit and market failure associated with individual investments.

2.6.2 Governance and accountability

The Programme will require transparent governance, defined ministerial responsibility, independent evaluation and regular reporting against measurable food-security, economic, investment, energy and environmental outcomes. Public support will be conditional on proportionate monitoring and verification, allowing government to assess both individual project performance and the cumulative effect of UK-GMEP on national productive capacity.

Delivery mechanisms should be reviewed periodically to reflect changes in technology, markets, energy systems and sector requirements.

The objective is not to create permanent dependence on public support. The long-term measure of success will be whether UK-GMEP establishes a self-sustaining cycle of investment, renewal and innovation, in which the greenhouse sector can progressively attract greater private capital, replace ageing infrastructure and maintain strategically important domestic production without repeated emergency intervention.

3. STRATEGIC DIAGNOSIS OF THE UK GREENHOUSE SECTOR

3.1 Sector profile

The UK food-producing greenhouse sector is small in physical footprint but disproportionately important to domestic fresh-produce production. Commercial food-producing glasshouses occupy approximately 800–900 hectares nationally, with recent infrastructure mapping identifying approximately 835 hectares in Britain [1]. This represents less than 0.1% of UK land area, yet supports intensive production of high-value crops including tomatoes, cucumbers, peppers, berries, herbs and other fresh produce.

The sector is particularly important because these are crops for which the UK has substantial import dependence and where protected production can extend the domestic growing season, provide more predictable yields and reduce direct exposure to weather variability.

The sector's physical footprint also understates its productive potential. Modern glasshouse systems can produce approximately 10–20 times more food per unit area than conventional open-field production, while using up to 90% less water in appropriate recirculating systems [4]. This combination of high productivity and small land requirement gives protected horticulture particular strategic value as competition increases between food production, housing, energy infrastructure, nature recovery and other land uses.

3.1.1 Sector structure and concentration

The commercial grower population is small. Approximately 48–50 active companies (sometimes composed of grower-cooperation's) account for much of UK commercial food-producing glasshouse production [2].

Although the number of active businesses has increased from approximately 22 in 2006 to 48 in 2024, growth has been slow and uneven. Between 2016 and 2024, only 17 new companies were identified, while 2022 and 2023 recorded no new company formations. Sector growth has therefore occurred predominantly through expansion and consolidation of established businesses rather than through a continuous pipeline of new entrants.

Production and turnover are highly concentrated. A small number of large operators have annual revenues exceeding £100 million, with the largest approaching approximately £200 million. Beneath these businesses is a commercially important mid-tier, typically turning over approximately £20–70 million, followed by a longer tail of smaller operators, many with turnover in the £10–22 million range [2].

Physical capacity is similarly concentrated. A relatively small number of sites exceeding 25 hectares account for a substantial share of national production, while many smaller growers operate sites below five hectares, often within established greenhouse regions and using older infrastructure.

This concentration has two implications. First, investment by a relatively small number of businesses can materially affect national productive capacity. Second, closure or contraction of a small number of strategically important sites can similarly result in significant loss of domestic production.

The sector should therefore be regarded as concentrated but not necessarily resilient.

3.1.2 Ageing infrastructure

The physical condition of the greenhouse estate is one of the most significant constraints on its future development. Approximately 70% of UK greenhouse infrastructure is estimated to be more than 40 years old [1].

Many older sites were designed around lower energy costs, lower levels of environmental control and different production systems. They may lack the height, thermal performance, structural loading capacity, electrical infrastructure or configuration required to accommodate modern technologies efficiently.

This matters because greenhouse design and specification directly affect biological as well as economic performance. Modern structures can improve light transmission and distribution, environmental control, water and nutrient-use efficiency, energy performance and crop protection, while providing a platform for automation and digital technologies. Modernisation is therefore an investment in productive capability and resilience, rather than simply replacement of a depreciated physical asset.

The age of the estate also creates a significant retrofit-versus-replacement dilemma. Incremental upgrades can extend asset life and may be financially preferable in the short term, but repeated retrofit can ultimately lock businesses into structures that constrain productivity and technology deployment.

Full replacement is expensive. Major retrofit is estimated to cost approximately £850,000 per hectare, while new modern greenhouse infrastructure is typically estimated at approximately £2–2.5 million per hectare, although larger developments may achieve lower per-hectare costs through economies of scale.

A 20-hectare development could therefore represent an investment of approximately £36–50 million depending on scale, specification and associated infrastructure, while larger developments can still readily require investment exceeding £100 million [2].

3.1.3 Cost base and profitability

Greenhouse production combines high turnover with a structurally demanding cost base.

Labour is generally the largest recurring cost. It typically represents approximately 25–35% of turnover in large modern operations, rising to approximately 30–45% in mid-scale or legacy facilities.

Energy typically represents a further 15–30% of turnover, depending on crop, season, lighting requirements and energy system. During periods of severe energy-price volatility, this proportion can exceed 30%, rapidly eroding margins.

Depreciation and amortisation commonly absorb approximately 5–10% of turnover, while finance costs account for a further 1–4%. These costs reflect the capital-intensive nature of greenhouse production and are relatively difficult to reduce in response to short-term market conditions.

Retail contracting adds another constraint. Growers commonly operate under seasonal or relatively short-term supply agreements with limited ability to pass unexpected increases in energy, labour or finance costs through to customers. Consequently, gross margins of 10–20% can translate into operating margins in the low single digits, with otherwise productive businesses capable of moving rapidly into loss following energy, labour or other cost shocks.

High turnover should therefore not be interpreted as evidence of high profitability or financial security.

3.1.4 Debt and investment capacity

The sector is simultaneously highly leveraged and under-invested.

Large greenhouse businesses commonly carry total borrowings of approximately £20–60 million, with debt-to-turnover ratios typically around 0.4–0.8. Mid-sized growers commonly carry borrowings of approximately £5–20 million, with some operating at net-debt levels approaching or exceeding annual turnover [2].

Smaller businesses face a different problem: many have limited access to conventional long-term debt and consequently rely more heavily on retained earnings, shareholder finance or shorter-term borrowing.

This creates a structural financing gap. The businesses most capable of undertaking major investment may already carry substantial leverage, while businesses with lower absolute debt may lack the balance-sheet strength required to finance transformational investment.

Traditional agricultural lending is not well suited to this structure. Greenhouses contain highly specialised assets, require large upfront investments and are exposed to energy and labour risks that conventional agricultural finance models do not always accommodate effectively.

The result is a sector in which technically viable investment may nevertheless be financially difficult to deliver.

3.1.5 Labour and skills exposure

The sector is also highly labour intensive. Greenhouse operations typically employ five to ten times more workers per hectare than open-field horticulture, with harvesting, crop management, grading, packing and logistics remaining labour-intensive even in technologically advanced facilities.

Growers report workforce vacancy rates of approximately 10–20%, with shortages increasing during periods of peak demand. In severe years, labour shortages can result in losses of approximately 5–15% of potential crop output through delayed harvesting, quality downgrading, crops remaining unharvested or deliberate reductions in planting [2,20].

Non-UK nationals commonly represent approximately 50–70% of the operational workforce in larger and mid-sized greenhouse businesses.

Automation can reduce some labour requirements, but current technology cannot remove the underlying workforce requirement. Existing automation may substitute perhaps 20–30% of total labour demand under typical conditions and often shifts demand towards different skills rather than eliminating it.

Technical skills are becoming an additional constraint. Reported vacancy rates for specialist engineering and technical positions can reach 15–25%, particularly in climate control, electrical and mechanical engineering, irrigation, energy systems and data-driven crop management.

3.1.6 Strategic position

The overall picture is therefore not of a failing industry. It is a productive but structurally fragile industry.

The sector has strong demand, established growers, high productivity and considerable technical capability. Its weakness lies in the relationship between its capital structure, ageing infrastructure and exposure to costs and risks that individual businesses have limited ability to control.

This condition can be summarised as “*scale without security*”: commercially significant businesses operating strategically important infrastructure, but without sufficient long-term certainty to support the scale and pace of investment required for renewal.

3.2 Problem statement

The fundamental problem facing UK greenhouse horticulture is a structural mismatch between long-lived productive assets and a short-term, volatile operating and policy environment.

Greenhouses are infrastructure assets with operational lives commonly extending over 30–50 years. Decisions about structures, heating systems, energy connections,

water infrastructure and site location can therefore determine production economics for several decades [2,11].

Yet the conditions against which those investments must be made operate over much shorter timescales.

Energy prices can change rapidly. Retail contracts may last a season or a small number of years. Labour and migration arrangements can change within individual production cycles. Interest rates and lending conditions fluctuate. Planning decisions can be uncertain and slow. Grid connections and energy infrastructure may require long lead times. Government funding programmes commonly operate over only a few years.

The sector is consequently expected to make multi-decadal investment decisions against short-term commercial and policy signals.

This mismatch encourages businesses to minimise immediate capital exposure. Repairing or incrementally upgrading an existing greenhouse is frequently less risky than replacing it, even where replacement would deliver superior productivity and energy performance.

This produces a self-reinforcing cycle:

Ageing infrastructure → reduced efficiency and higher operating exposure → weaker margins → reduced borrowing and investment capacity → incremental life-extension → further ageing.

The same dynamic affects innovation. The UK does not primarily suffer from an absence of greenhouse technology. Advanced glazing, lighting, sensors, automation, environmental control, heat pumps and energy-management systems already exist. The problem is deployability at commercial scale.

Older structures may not accommodate these systems effectively, while narrow margins and existing debt make businesses reluctant to invest in technologies with uncertain payback periods. Innovation therefore tends to concentrate within a small number of businesses with sufficient balance-sheet strength, potentially widening the gap between modern and legacy operators.

Finance does not resolve the problem by itself. Conventional lenders cannot readily price food-security value, avoided emissions, infrastructure integration or wider regional economic benefits into the return from an individual greenhouse investment. Similarly, individual growers cannot coordinate grid infrastructure, industrial waste-heat sources, planning authorities, water systems and regional skills provision independently.

The central market failure is therefore one of risk allocation and coordination. Too much system-level risk currently sits with individual growers, while many of the benefits of successful investment accrue to the wider food, energy, health and economic system.

3.3 Why this is a public policy issue

The vulnerability of UK greenhouse horticulture is not solely a commercial issue. It has direct implications for food security, public health, energy policy, land use and regional economic resilience.

3.3.1 Food security and external exposure

The UK currently imports approximately 86% of its fruit and 44% of its vegetables, while domestic fruit and vegetable production has fallen by approximately 16% since 2015 [3].

Importing food is neither inherently undesirable nor something UK-GMEP should seek to eliminate. International trade provides diversity, seasonality and access to crops that cannot realistically be produced domestically.

The strategic issue is over-dependence in crops for which viable domestic production capacity exists.

Many important sources of UK fresh produce are increasingly exposed to drought, heatwaves, water scarcity and other climate pressures. These risks interact with geopolitical disruption, transport interruptions, energy costs and growing demand within exporting countries.

Protected production cannot eliminate these risks, but it can provide domestic capacity that is substantially less exposed to short-term weather variability.

Food security and public health are increasingly connected

The policy case extends beyond the quantity of food available.

Only around one third of adults in England consume the recommended five or more portions of fruit and vegetables per day, while recent analysis estimates the economic cost of diet-related ill health at approximately £126 billion per year. Meeting dietary guidelines would require fruit and vegetable consumption to increase substantially, by approximately 86% from current average levels [3].

This creates an important policy contradiction. The UK seeks to increase consumption of fruit and vegetables while domestic production of these foods has been declining.

If successful public-health policy increases consumption without corresponding investment in productive capacity, the additional demand will largely be met through imports. Food-production and public-health policy therefore need to be considered together.

3.3.2 The potential economic return is significant

Recent modelling suggests that replacing approximately half of currently imported fruit and vegetables that could feasibly be produced domestically (incl. but not limited to greenhouses) could raise UK food self-sufficiency to approximately 66%, a level

last achieved around 2000, while adding approximately £1.9 billion per year in domestic farmgate value [3].

Significantly, approximately 68% of the additional farmgate value in that scenario would come from new indoor production.

This does not mean that UK-GMEP should adopt these figures as construction targets. It demonstrates, however, that controlled-environment production could make a disproportionately large contribution to increased domestic horticultural value.

3.3.3 Energy and infrastructure

Greenhouses are large energy consumers, but their energy profile also creates an infrastructure opportunity.

Their relatively predictable demand for heat makes them suitable potential users of industrial residual heat, wastewater-treatment heat, data-centre heat, geothermal resources, heat networks and renewable electricity [24].

Future greenhouse capacity can therefore be designed as part of the UK's energy system rather than simply as an additional energy load.

This changes the policy question from: *“How should growers pay for energy?”* to: *“Where should food-production infrastructure be located so that energy, heat, water and food systems work efficiently together?”*

That requires strategic spatial planning and coordination that individual businesses cannot deliver independently.

3.3.4 Land-use efficiency

Protected horticulture also offers unusually high productive output from limited land. Modern glasshouses can produce approximately 10–20 times more food per unit area than conventional open-field systems, while recirculating systems can use up to 90% less water [4].

This does not make glasshouses a substitute for field agriculture. It means they can complement it by concentrating production of suitable high-value crops onto relatively small areas.

At a time when land is simultaneously required for food, housing, renewable energy, infrastructure, nature recovery and climate adaptation, this productive intensity has strategic value.

3.3.5 Regional growth

Modern greenhouse development also supports economic activity beyond primary agriculture.

Investment creates demand for construction, engineering, energy services, automation, logistics, crop science, digital technology and technical maintenance. Greenhouse clusters can provide anchor demand for local energy infrastructure and create employment and training opportunities in rural and peri-urban areas.

The sector therefore sits at the intersection of several national priorities:
food security + public health + energy transition + efficient land use + infrastructure investment + regional growth.

That combination creates a clear public-policy interest in maintaining and renewing domestic productive capacity.

3.4 Why action is needed now

The need for intervention is not only structural; it is time-sensitive. Several long-term pressures are now converging, and decisions taken during the next few years are likely to shape UK greenhouse production for decades.

International experience demonstrates that greenhouse modernisation can be approached as a long-term sectoral transition rather than through isolated capital interventions. In the Netherlands, government and industry have used multi-year programmes combining research and demonstration, investment support, energy infrastructure and public-private collaboration, including a stated focus on modernising 300 ha of greenhouse infrastructure per year [25]. The Dutch context is not directly transferable to the UK, but it demonstrates the value of sustained coordination between government, industry, research and infrastructure investment. UK-GMEP seeks to establish an equivalent long-term framework adapted to UK conditions.

3.4.1 The existing estate is reaching a critical renewal point

With approximately 70% of greenhouse infrastructure more than 40 years old, much of the estate is already at an age at which substantial refurbishment or replacement decisions cannot be deferred indefinitely.

Continued maintenance can extend operating life, but every further cycle of investment into legacy infrastructure can also increase lock-in.

The question is increasingly not whether investment will be required, but whether that investment is directed towards extending yesterday's infrastructure or building the production systems required for the next 30–50 years.

3.4.2 The energy transition is happening simultaneously

The greenhouse sector remains significantly exposed to natural gas and electricity prices.

The urgency of diversification has increased further. In early 2026, indoor growers faced an approximately 62% increase in electricity network charges, while recent energy-price shocks have already caused some businesses to delay or reduce planting [33].

At the same time, substantial investment is occurring nationally in renewable electricity, electricity networks, heat networks, data centres, wastewater infrastructure and industrial decarbonisation.

These developments create opportunities for greenhouse integration, but only if food production is considered during infrastructure planning.

A data centre, industrial site or heat network constructed without provision for productive use of residual heat may operate for decades. A greenhouse built in the wrong location may similarly remain dependent on high-cost energy for 40–50 years.

Co-location opportunities are easiest and cheapest to capture at the planning stage, not retrospectively.

3.4.3 Labour pressure is becoming structural

Workforce shortages are already constraining production, with vacancy rates of 10–20% and severe shortages capable of reducing crop output by 5–15% [2,20].

The existing Seasonal Worker framework is also imperfectly aligned with greenhouse production, where labour may be required for nine to twelve months rather than during a short harvest window.

Meanwhile, modernisation is increasing demand for engineers, technicians, energy specialists and data skills at precisely the point when these occupations are also in high demand elsewhere in the economy.

Workforce planning and infrastructure modernisation therefore need to proceed together.

3.4.4 Import exposure is increasing rather than decreasing

Domestic fruit and vegetable production has declined by approximately 16% since 2015.

Without intervention, continued ageing, consolidation and constrained investment risk further reducing domestic productive capacity at the same time that climate and resource pressures are increasing in important overseas production regions.

Once greenhouse sites close, recovery is difficult. Land may be redeveloped, energy connections removed, businesses dissolved and specialist skills dispersed. The loss of productive capacity is therefore considerably easier than its reconstruction.

3.4.5 There is a finite investment window

The greatest risk is that the UK continues to make a series of individually rational but collectively suboptimal decisions.

Growers extend the life of ageing structures because replacement is too risky.
Energy infrastructure is developed without considering food production.
Planning authorities make decisions without a national view of future greenhouse requirements.

Training provision responds to today's workforce rather than the technical requirements of future facilities.

Public procurement purchases food without considering whether demand could help underpin domestic investment.

Each decision may be reasonable in isolation. Together they risk locking the UK into another generation of underinvestment.

The opportunity presented by UK-GMEP is therefore to intervene before these decisions become irreversible.

The sector's relatively small footprint and concentrated company structure make this achievable. Government does not need to transform millions of hectares or coordinate hundreds of thousands of businesses. Approximately 800–900 hectares of existing commercial food-producing glasshouse capacity and around 50 principal grower businesses represent the core starting point [1,2].

This creates an unusual opportunity for targeted intervention to have national-scale effects.

The strategic choice is therefore between continuing a pattern of reactive life-extension and gradual capacity erosion, or establishing a managed renewal cycle in which existing assets are assessed systematically, viable sites are modernised, obsolete infrastructure is replaced, and future expansion is directed towards locations capable of supporting efficient, low-carbon and resilient production.

The next decade should be treated as the UK's greenhouse infrastructure renewal window. Decisions taken within it will determine whether domestic protected horticulture enters the middle of this century as a modern component of national food infrastructure, or as a progressively smaller legacy sector operating assets inherited from the previous century.

4. HISTORICAL POLICY LESSONS AND MISTAKES TO AVOID

4.1 Why this section is included

The current condition of the UK greenhouse sector is not the result of a single policy failure, nor can it be explained solely by market conditions, technological change or grower behaviour.

It is the cumulative outcome of several decades in which greenhouse horticulture was formally included within agricultural policy, but rarely treated as a distinct capital- and energy-intensive infrastructure system.

This distinction matters because the physical greenhouse estate reflects policy decisions made over very long timescales. Infrastructure constructed during earlier periods of policy alignment has remained in use for decades, while the mechanisms required to support systematic replacement and renewal have weakened or disappeared.

The historical record therefore provides an important design lesson for UK-GMEP: greenhouse infrastructure responds to long-term policy conditions, not short-term policy announcements.

The purpose of this section is consequently not to assign responsibility for past decisions. It is to identify recurring policy patterns that must not be reproduced within a future modernisation and expansion programme.

The central lesson is that greenhouse horticulture performs best when food policy, capital investment, energy conditions and infrastructure planning are aligned. When these elements become fragmented, investment slows, replacement is deferred and the effects accumulate gradually in the physical condition of the sector. UK-GMEP should therefore be designed around the causes of historical underinvestment rather than simply its visible symptoms.

4.2 Historical context: from alignment to underinvestment

4.2.1 Post-war recognition of domestic production

Greenhouse horticulture formed part of the post-war policy settlement aimed at rebuilding and maintaining domestic food-production capacity.

The Agriculture Act 1947 formally incorporated horticulture, fruit growing and market gardening within agricultural policy [6]. However, the sector's distinctive characteristics were only partly reflected in subsequent support mechanisms.

A more direct infrastructure approach emerged during the 1960s. The Horticulture Act 1960 introduced the Horticulture Improvement Scheme, which provided capital grants covering approximately one third of eligible investment costs for structural improvement and modernisation [7,8].

This was followed by the Agriculture and Horticulture Act 1964 and related measures supporting horticultural production and marketing [9].

These policies reduced the financial barriers associated with constructing and upgrading greenhouse infrastructure.

The significance of this period is visible today. A substantial proportion of greenhouse infrastructure still operating in the UK originated during or shortly after the period in which public policy actively supported capital formation and domestic food-production capacity.

The historical lesson is therefore not that the sector requires permanent subsidy. It is that large-scale infrastructure investment occurred when public policy reduced structural investment barriers and provided sufficient confidence for private capital to follow.

4.2.2 Declining alignment from the 1980s onwards

From the late twentieth century onwards, this alignment weakened. Capital support for greenhouse infrastructure was progressively reduced, while wider agricultural policy increasingly relied on mechanisms designed around land area and conventional agricultural production. This created a growing structural mismatch.

Greenhouse horticulture is not primarily land constrained. Its productivity depends on capital infrastructure, energy, technology, specialist labour and continuous reinvestment. Area-based agricultural support therefore offered relatively little assistance to businesses whose principal constraint was the cost of replacing or modernising long-lived structures [11,12].

The result was not immediate sector collapse. Instead, growers continued operating existing assets. Maintenance replaced replacement. Incremental improvement replaced structural renewal.

Over time, this produced the ageing estate visible today, with more than 70% of commercial greenhouse infrastructure estimated to be over 40 years old. This is an important policy lesson in itself.

Infrastructure decline is often gradual and initially invisible. A sector can continue producing, businesses can continue trading and aggregate output can appear relatively stable while the underlying asset base becomes progressively less resilient.

Policy should therefore not wait for obvious failure before intervening.

4.2.3 Energy became increasingly detached from food policy

Energy has always been central to heated greenhouse production. Parliamentary debates during the 1960s and 1970s already recognised the importance of heating costs to commercial glasshouse viability [10]. However, energy subsequently developed primarily as a separate policy domain.

This separation became increasingly problematic as greenhouse production became more technically sophisticated and energy intensive.

By the 2020s, growers were operating within an energy system that could expose them to extreme price volatility while providing limited routes into strategically planned heat networks, residual-heat systems or other energy infrastructure. The energy shocks of 2021–2023 demonstrated the consequences. Some growers reduced cropping or temporarily suspended production because energy costs made otherwise viable production uneconomic [2,24].

The mistake was not simply dependence on gas. The deeper failure was treating energy supply and food production as separate systems.

A future programme must therefore avoid designing greenhouse energy policy as a collection of isolated on-farm technologies. Energy availability, network capacity, heat sources, greenhouse location and long-term energy contracts need to be considered together.

4.2.4 Planning evolved without a greenhouse infrastructure strategy

Planning represents a similar historical disconnect. Greenhouse developments have frequently been assessed primarily as individual agricultural or development proposals rather than as components of strategic food infrastructure.

The result has been variable treatment between planning authorities, uncertainty over classification and potentially lengthy approval processes.

These barriers have greater consequences for greenhouse production than for many less capital-intensive agricultural activities because new greenhouse developments require coordination across land, energy, water, transport and logistics. Delays therefore affect not only construction schedules but also financing, energy contracts and commercial supply arrangements.

The historical lesson is that planning policy cannot simply determine whether individual greenhouse projects are acceptable.

It must also help identify where future greenhouse production should be located. Policy increasingly recognised the problem, but delivery remained fragmented. Recent years have brought greater recognition of these issues [18,34].

Controlled-environment horticulture has re-entered national food policy, parliamentary reviews have highlighted fragmented horticultural governance, and

recent policy developments have increasingly considered greenhouse production alongside energy, infrastructure and spatial planning [18,34].

The 2026 Land Use Framework represents an important shift towards multifunctional land-use planning, including explicit recognition of opportunities to integrate glasshouse horticulture with future energy infrastructure. These developments are positive [5].

However, recognition is not the same as delivery. The historical experience of the sector demonstrates that strategy without sustained investment mechanisms, clear institutional ownership and implementation pathways is unlikely to change infrastructure outcomes.

UK-GMEP must therefore convert emerging policy recognition into delivery architecture.

4.3 Historical mistakes to avoid

Mistake 1: Including horticulture in policy without designing policy for horticulture

The most persistent historical mistake has been to formally include horticulture within agricultural policy while designing the principal mechanisms around other types of farming.

Greenhouse production differs materially from land-extensive agriculture. It has:

- very high capital intensity;
- long asset lives;
- high and continuous energy requirements;
- high labour intensity;
- specialised infrastructure;
- limited ability to temporarily reduce production without destroying crop value; and
- substantial dependence on technology and environmental control.

Applying generic agricultural support mechanisms to this system risks repeating the historic mismatch.

GMEP design response: *greenhouse horticulture should be treated as a distinct infrastructure-based production system, with policy mechanisms designed around capital renewal, energy integration and long investment horizons.*

Mistake 2: Supporting construction without creating a renewal cycle

The infrastructure built during earlier periods of capital support demonstrates that investment intervention can work.

The failure came later. The UK developed greenhouse capacity but did not establish a durable mechanism through which those assets could be systematically renewed.

As a result, infrastructure that was originally productive and modern remained in operation long beyond the period in which major replacement would normally have been expected.

A programme focused only on constructing new greenhouse capacity could recreate exactly the same problem several decades from now.

GMEP design response: *every supported investment should sit within a long-term renewal framework. Monitoring should consider asset condition, expected replacement cycles and future capital requirements, not simply initial construction.*

Mistake 3: Treating food, energy and planning as separate policy systems

Greenhouse production sits directly at the intersection of these systems. Historically, however, food production, energy policy, land-use planning and infrastructure development have largely evolved independently.

The consequence is that growers have been required to manage system-level coordination themselves. This creates avoidable risk and can result in greenhouse sites being located without optimal access to heat, electricity, water, transport or future infrastructure.

GMEP design response: *spatial planning, energy infrastructure and food-production strategy should be developed together. Strategic greenhouse zones and clusters should be assessed against energy, water, logistics, workforce and market infrastructure rather than land suitability alone.*

Mistake 4: Assuming that commercially successful firms can finance renewal unaided

High turnover has historically been interpreted as evidence that the sector can finance its own modernisation.

The current financial structure demonstrates why this assumption is misleading. Large greenhouse businesses can generate turnover exceeding £100 million while simultaneously carrying tens of millions of pounds of debt and operating on low single-digit margins [2].

High turnover therefore does not necessarily produce sufficient free capital for £40–100 million infrastructure replacement programmes.

GMEP design response: *finance should be assessed against risk, leverage, asset life and public value rather than firm turnover alone. Public intervention should focus on reducing structural risk and leveraging private investment rather than assuming that commercial scale automatically implies investment capacity.*

Mistake 5: Using short-term funding to solve long-term infrastructure problems

Greenhouses typically operate for 30–50 years, while many grant programmes operate for only several years [2,11].

Short funding windows encourage opportunistic investment rather than strategic infrastructure planning. They also create uncertainty for businesses that must coordinate finance, planning, construction and energy infrastructure over long development periods.

GMEP design response: *the Programme should operate on a long-term statutory and financial horizon, even where individual funding rounds are shorter. Growers and investors should have visibility of the broad direction of support over multiple investment cycles.*

Mistake 6: Treating technology availability as equivalent to technology adoption

UK growers have access to advanced glazing, environmental controls, automation, robotics, LEDs, heat pumps, sensors and digital systems. Yet adoption remains uneven [21-23].

The historical mistake is assuming that providing research funding or demonstrating new technology will automatically result in commercial deployment. Technology adoption is constrained by capital cost, compatibility with existing structures, skills, operational risk and uncertain returns.

GMEP design response: *innovation policy should focus on deployability, including commercial-scale demonstration, capital support, independent validation and mechanisms that reduce adoption risk.*

Mistake 7: Designing policy around the strongest incumbents

Large operators are often best equipped to engage with government programmes because they possess specialist staff, stronger balance sheets and greater administrative capacity.

Without safeguards, funding mechanisms can therefore disproportionately benefit businesses already best placed to invest. This could accelerate consolidation while leaving mid-sized, smaller and legacy growers unable to modernise.

GMEP design response: *support should be tiered by project and grower type, with simplified application pathways, proportionate match-funding requirements, cooperative models and shared infrastructure options.*

Mistake 8: Treating labour as a temporary operational issue

Labour shortages have repeatedly been addressed as seasonal or migration-related problems.

Greenhouse production increasingly requires both reliable operational labour and specialist technical expertise across much of the year [20,31].

An infrastructure-modernisation programme that does not simultaneously address workforce requirements risks creating modern facilities without the people required to operate them.

GMEP design response: *workforce planning should form part of infrastructure planning, including migration pathways, technical apprenticeships, FE/HE partnerships and regional skills strategies.*

Mistake 9: Assuming market demand alone will drive strategic capacity

Demand for fresh produce is strong, yet domestic greenhouse infrastructure has still aged.

This demonstrates that market demand alone does not necessarily produce investment where margins are constrained and systemic risks remain high. Private markets also do not fully value wider benefits such as food security, public health, resilience, regional employment and reduced exposure to international shocks.

GMEP design response: *market mechanisms should be supplemented by targeted public intervention where wider public value justifies it. Long-term procurement, risk-sharing and infrastructure coordination should be used to improve investability rather than replacing competitive markets.*

Mistake 10: Waiting for crisis before acting

Historically, major changes in UK food policy have often followed major disruption. This creates a particular danger for greenhouse infrastructure.

Once a grower exits, a greenhouse site is demolished, land changes use or specialist knowledge is lost, productive capacity can be difficult and expensive to recreate. The current ageing estate provides advance warning.

GMEP design response: *intervention should be preventative rather than reactive, prioritising infrastructure renewal while productive capacity and specialist expertise still exist.*

4.4 What history means for programme design

The historical record points to a clear conclusion. The UK does not need to recreate the greenhouse policies of the 1960s.

The economic, technological and environmental context is fundamentally different. However, the principle that enabled earlier investment remains relevant: private investment occurs when policy provides sufficient long-term confidence and reduces risks that individual businesses cannot efficiently manage alone.

UK-GMEP should therefore retain six historical lessons as permanent design tests:

1. **Recognise the system correctly.** Greenhouse horticulture must be treated as capital-intensive food infrastructure rather than simply another land-based agricultural activity.
2. **Design for renewal, not just construction.** The Programme must create a repeatable investment cycle rather than a one-off period of expansion.
3. **Integrate food, energy and spatial planning.** Infrastructure decisions should be coordinated before investments are locked in.
4. **Match policy timescales to asset timescales.** Businesses investing in 30–50-year infrastructure require more than short-term policy signals.
5. **Share systemic risk without replacing commercial discipline.** Government should intervene where risks or public benefits cannot be efficiently managed through private markets alone.
6. **Build delivery and accountability into policy from the outset.** Every strategic objective must have a responsible body, implementation route, timetable and measurable outcome.

These principles should be applied across every subsequent pillar of UK-GMEP.

4.5 Historical lesson summary

Historical lesson	How it appeared previously	Risk if repeated under UK-GMEP	Programme safeguard
Inclusion without recognition	Horticulture included within agriculture but support mechanisms designed largely around land-based systems	Greenhouse-specific capital and energy constraints remain unresolved	Treat protected edible production as a distinct infrastructure system
Build without renewal	Earlier capital programmes enabled construction but no durable replacement cycle followed	New assets eventually reproduce today's ageing-estate problem	Long-term renewal planning and asset-condition monitoring
Fragmented governance	Food, energy, planning and labour developed separately	Conflicting policy signals and delayed projects	Cross-government governance and shared delivery metrics
Short policy horizons	Temporary schemes applied to long-lived assets	Investment postponed because future support and policy conditions remain uncertain	Long-term programme horizon and predictable funding architecture
Assumption of self-financing	High turnover interpreted as financial strength	Leveraged firms unable to undertake transformational investment	Risk-sharing and blended finance linked to additionality

Technology-first innovation	Research and demonstration without sufficient deployment support	Proven technologies remain concentrated among a small number of firms	Commercial deployment and adoption finance
Incumbent capture	Larger organisations better able to access support	Further consolidation and exclusion of smaller growers	Tiered support, cooperative routes and proportionality safeguards
Labour treated separately	Workforce managed primarily as seasonal migration issue	Infrastructure expands without adequate workforce or specialist skills	Integrated workforce and skills planning
Reliance on market demand	Strong demand assumed to generate investment	Public benefits remain underprovided and infrastructure continues ageing	Procurement, finance and coordination mechanisms
Crisis-led intervention	Policy response occurs after capacity has already declined	Recovery becomes more expensive or impossible	Early-warning monitoring and preventative renewal

4.6 Core principle

The most important lesson from the history of UK greenhouse horticulture is that infrastructure reflects the policy environment in which investment decisions were made decades earlier.

The ageing estate visible today is therefore not simply evidence of old structures. It is evidence of a prolonged failure to create conditions for replacement. UK-GMEP must avoid reproducing that pattern.

Its success should ultimately be judged not only by how many hectares are modernised or constructed during the Programme, but by whether it establishes a durable system in which investment, replacement and technological renewal continue after the initial intervention has ended.

5. POLICY OBJECTIVES AND SUCCESS CRITERIA

5.1 Primary objective

The primary objective of UK-GMEP is:

To establish, over a ten-year period, a resilient, investable and progressively lower-carbon UK food-producing greenhouse sector with a sustained infrastructure-renewal cycle, increased productive capacity, reduced exposure to systemic energy and workforce risks, and a measurable contribution to domestic food security.

Success will not be defined solely by the amount of public funding committed, the number of projects supported or the number of hectares constructed. The Programme will be considered successful only where intervention produces additional, measurable and durable changes in productive capacity, infrastructure condition, investment behaviour, energy resilience and sector capability.

The Programme therefore distinguishes between:

- **Outputs:** what UK-GMEP directly funds or delivers;
- **Outcomes:** measurable changes in the greenhouse sector resulting from those interventions; and
- **system impacts:** wider changes in food security, investment, energy integration, public health and regional development to which UK-GMEP contributes but does not control independently.

This distinction is important for accountability. A programme can deliver its spending commitments without resolving the structural problem it was established to address. UK-GMEP will therefore be evaluated primarily against outcomes rather than expenditure.

5.2 Secondary objectives

The primary objective will be delivered through eight linked objectives.

Objective 1: Renew the existing productive asset base

Establish a systematic replacement and modernisation cycle for ageing commercial food-producing greenhouse infrastructure.

The Programme will prioritise investment where infrastructure age, condition or configuration is materially constraining productivity, energy performance, technology deployment or commercial resilience.

The intended outcome is a shift away from repeated life-extension of obsolete infrastructure towards planned asset renewal.

Objective 2: Increase strategically valuable domestic productive capacity

Enable net expansion of UK food-producing greenhouse capacity where there is a credible long-term market, appropriate infrastructure and demonstrable contribution to food-system resilience.

Expansion will not be pursued as an aggregate hectare target irrespective of location or crop.

New capacity should be directed towards sites where land suitability, energy, water, workforce, logistics, demand and environmental constraints have been considered together.

Objective 3: Reduce structural energy exposure

Reduce dependence on volatile fossil-fuel energy and increase the proportion of greenhouse heat and power supplied through lower-carbon, recoverable and more predictable energy systems.

The objective is not simply decarbonisation. It is to improve energy resilience, affordability and predictability while reducing emissions.

This includes energy efficiency, heat recovery, heat networks, heat pumps, geothermal systems, renewable electricity, storage, appropriate bioenergy, long-term energy contracts and other technically viable pathways.

Objective 4: Improve sector investability and mobilise private capital

Correct financing barriers that prevent commercially and strategically viable greenhouse investments from proceeding.

Public finance will be used principally to reduce risks that private investors or individual growers cannot efficiently carry alone.

The long-term objective is to increase the proportion of greenhouse infrastructure investment financed through commercial, institutional and infrastructure capital, with public support becoming increasingly targeted rather than structurally necessary.

Objective 5: Strengthen domestic supply resilience and demand certainty

Increase the contribution of UK greenhouse production to resilient domestic fresh-produce supply, particularly for crops where import exposure is high and additional domestic production is technically and economically credible.

The Programme will also seek to create stronger long-term demand signals through appropriate public procurement, institutional purchasing and commercial contracting mechanisms.

The objective is not national self-sufficiency in all fruit and vegetables. It is strategic diversification of supply and retention of sufficient domestic productive capability to reduce vulnerability to external disruption.

Objective 6: Build the workforce and technical capability required by a modern sector

Reduce persistent workforce constraints while developing the engineering, energy, automation, crop-management and digital skills required by increasingly sophisticated greenhouse systems.

Workforce policy will be treated as an integral component of infrastructure delivery.

Objective 7: Accelerate commercial deployment of proven innovation

Increase the rate at which technically proven technologies move from demonstration into normal commercial use.

The focus will be on reducing deployment risk, improving interoperability and accelerating diffusion between businesses rather than funding innovation activity without a credible route to adoption.

Objective 8: Ensure equitable and regionally balanced access to transformation

Ensure that UK-GMEP does not unintentionally accelerate concentration by making support accessible only to the largest and best-capitalised operators.

Delivery pathways will therefore accommodate large strategic projects, mid-sized and legacy businesses, smaller growers, cooperatives and shared-infrastructure models.

Regional distribution will be determined by productive potential, infrastructure opportunity and public value rather than historic concentration alone.

5.3 Principles for measuring success

All UK-GMEP performance measures will comply with six requirements.

1. **Additionality:** Only activity that would not have occurred at the same scale, quality or timeframe without UK-GMEP support will count towards programme additionality.
2. **Operational delivery:** New or modernised capacity will count when it becomes operational, not when planning permission is granted, funding is awarded or construction begins.
3. **Net rather than gross capacity:** Expansion will be reported as both gross new area and net change in operational food-producing greenhouse area, accounting for supported sites that close, are demolished or leave commercial production.
4. **Normalised environmental performance:** Energy and emissions performance will be reported using metrics that account for productive output and greenhouse area. Absolute energy consumption alone is insufficient because increased domestic production may increase total energy demand while substantially improving efficiency.
5. **Independent verification:** Material claims relating to area, energy performance, emissions, private investment and productive capacity will be independently auditable.

- 6. No double counting:** The same investment, greenhouse area, emissions saving or private capital contribution may not be counted more than once across programme instruments or funding bodies.

5.4 Baseline and target-setting framework

A verified national baseline will be established during the first 12 months of UK-GMEP.

This is necessary because current evidence provides a strong estimate of sector scale and condition but does not yet provide a complete asset-level dataset covering infrastructure condition, energy use, productive area, workforce, output and investment requirements.

Current evidence provides the starting position:

- approximately 800–900 hectares of commercial food-producing glasshouse capacity;
- approximately 70% of existing greenhouse infrastructure more than 40 years old;
- approximately 50 active commercial food-producing greenhouse businesses;
- labour costs commonly equivalent to 25–45% of turnover;
- energy commonly equivalent to 15–30% of turnover;
- workforce vacancy rates commonly around 10–20%;
- technical and engineering vacancies in some areas around 15–25%; and
- substantial leverage across parts of the sector, with large growers commonly carrying borrowings of £20–60 million.

The Year 1 baseline will verify:

- operational greenhouse area;
- crop and production profile;
- infrastructure age and condition;
- energy systems and fuel mix;
- annual delivered energy;
- low-carbon and recovered heat share;
- water systems;
- productive output;
- workforce structure and vacancies;
- existing debt and investment capacity at an aggregated level;
- technology deployment;
- planning pipeline;
- public procurement exposure; and
- regional distribution.

This baseline will become the denominator against which subsequent programme performance is measured.

5.5 Initial ten-year programme targets

The following targets establish the minimum level of ambition expected from UK-GMEP.

Absolute hectare targets will be formally confirmed at the end of Year 1 following completion of the national baseline, spatial assessment and agreed funding envelope. Percentage targets will remain the principal measure where current baseline uncertainty makes absolute targets less reliable.

Objective	Core metric	Starting position	Year 3	Year 5	Year 10
National baseline	Share of commercial food-producing greenhouse area captured within verified national asset register	No complete national asset register	≥90%	≥95%	Maintained ≥95%
Modernisation	Share of verified baseline area substantially modernised or replaced through or alongside UK-GMEP	>70% of infrastructure >40 years old	≥10%	≥30%	≥60%
Ageing stock	Operational area >40 years old that has not undergone qualifying major modernisation	>70% estimated	Baseline established	<60%	<35%
Expansion	Net operational food-producing greenhouse area relative to verified baseline	~800–900 ha estimated	≥5% increase	≥10% increase	≥25% increase
Energy efficiency	Reduction in delivered energy intensity at supported modernisation sites	Site specific	≥15% average	≥20% average	≥25% average
Fossil-energy exposure	Reduction in delivered fossil-derived heat intensity at supported sites	Baseline to establish	≥15%	≥30%	≥50%

Low-carbon/recovered heat	Share of heat supplied from qualifying low-carbon, renewable or recovered sources across supported heated area	Baseline to establish	≥20%	≥35%	≥60%
Investment leverage	Private capital mobilised per £1 of programme capital support	No programme baseline	≥£1.50	≥£2.00	≥£2.00 cumulative
Procurement	Value and volume of fresh produce supplied through qualifying multi-year anchor-demand arrangements	Baseline to establish	Demonstration frameworks operational	Material multi-region coverage	Established national/regional pathway
Workforce	Persistent unfilled vacancies among participating businesses relative to Year 1 baseline	General vacancies ~10–20%	–15%	–30%	–50%
Technical skills	Persistent unfilled technical/engineering roles among participating businesses	Some roles ~15–25%	–10%	–25%	–40%
Innovation deployment	Share of supported modernisation projects incorporating independently verified productivity, resource-efficiency or resilience technology	Baseline to establish	≥50%	≥70%	≥80%

Digital measurement	Supported operational area with standardised monitoring of energy, water and productive output	Low/variable	≥60%	≥85%	≥95%
Inclusive access	Representation of smaller, mid-sized, cooperative or shared-infrastructure projects within funded portfolio	No programme baseline	Reported annually	Demonstrable participation across all routes	Sustained participation without material concentration
Regional delivery	Number of regions with operational UK-GMEP projects or shared infrastructure	None	≥3	≥5	Broad national coverage based on suitability

5.5.1 Interpretation of the headline targets

The 60% modernisation target means that by Year 10 a majority of the productive estate existing at programme commencement should either have undergone qualifying substantial modernisation or have been replaced.

If the verified baseline remains approximately 800–900 hectares, this would correspond to roughly 480–540 hectares of existing productive area.

The 25% expansion target would correspond to approximately 200–225 hectares of net additional operational capacity if the current estimate of 800–900 hectares.

These figures should not be interpreted as limits. They represent an initial minimum programme ambition against which financing requirements and delivery capacity can be tested.

5.6 Definition of a qualifying modernisation

A hectare will not be classified as “modernised” simply because public money has been spent on it.

To qualify as substantial modernisation, a project must materially improve the productive or infrastructure performance of the site and meet defined technical criteria.

Qualifying interventions may include combinations of:

- major structural refurbishment;
- replacement glazing or envelope improvement;
- heating-system replacement;
- substantial energy-efficiency improvement;
- heat-network or low-carbon heat connection;
- major climate-control replacement;
- electrical infrastructure improvement;
- water-recovery or recycling systems;
- significant automation;
- lighting-system replacement;
- digital control and monitoring infrastructure; or
- other interventions with equivalent measurable impact.

Routine maintenance and like-for-like replacement of minor equipment will not count as infrastructure modernisation.

The detailed technical threshold will be set through programme guidance. As a general principle, qualifying modernisation should demonstrate a material improvement in *at least two* of the following:

1. productive efficiency;
2. energy efficiency;
3. fossil-energy exposure;
4. water efficiency;
5. labour productivity;
6. environmental performance;
7. climate resilience; or
8. infrastructure capability for future technology deployment.

5.7 Energy and carbon measurement

Energy metrics require particular care because greenhouse production cannot be assessed simply by comparing absolute energy consumption between sites.

A modern greenhouse may use more total energy than an obsolete structure while producing substantially more food, extending the production season or replacing imported produce.

UK-GMEP will therefore report at least three separate energy indicators:

1. **energy per unit greenhouse area:** kWh/m² of productive greenhouse area per year;
2. **energy per unit saleable output:** kWh/kg or an appropriate crop-specific unit; and
3. **fossil-energy share:** proportion of delivered energy derived from fossil sources.

Carbon performance will similarly be measured using both (*Note, there is currently no agreed carbon accounting tool for UK greenhouse horticulture!*):

- absolute greenhouse-gas emissions; and
- emissions intensity per unit of saleable production.

This prevents the Programme from rewarding reduced production as an apparent energy or carbon saving. A standard UK-GMEP energy and carbon accounting methodology will be established before the first major funding round.

5.8 Defining low-carbon and recovered heat

For programme reporting, “low-carbon heat” will not be used as an undefined catch-all category. Eligible heat sources will be classified according to a published methodology and may include:

- heat pumps;
- geothermal heat (currently only one greenhouse in the UK has this);
- qualifying renewable thermal systems;
- recovered industrial heat;
- recovered heat from wastewater infrastructure;
- heat recovered from data centres or other commercial infrastructure;
- qualifying heat-network supply; and
- other technologies meeting defined lifecycle carbon criteria.

Natural-gas CHP will not automatically be classified as low-carbon heat solely because it provides high overall energy efficiency.

Recovered heat will be accounted for using a methodology that avoids assigning the same emissions benefit simultaneously to the heat producer and greenhouse user.

5.9 Productive capacity and food-security contribution

UK-GMEP will distinguish greenhouse area from productive capacity. Hectares alone are insufficient because crop choice, production intensity, lighting, season length, technology and yield can materially alter output.

The Programme will therefore report:

- operational greenhouse area;
- crop area;
- annual saleable output;
- yield per square metre;
- production season;
- domestic share of supply for selected strategic crops; and
- estimated import displacement or supply diversification where robust attribution is possible.

Food-security impact will not be assessed using a single national self-sufficiency percentage. The Programme will instead assess whether additional capacity:

- increases domestic availability of strategically relevant crops;
- reduces concentration of supply risk;
- extends seasonal domestic availability;
- increases the ability to respond to external supply disruption; and
- maintains productive capacity that would otherwise have been at material risk of loss.

This reflects the objective of resilience rather than autarky.

5.10 Investment and additionality metrics

Public funding will be evaluated according to the private investment and infrastructure activity it unlocks.

For each project, UK-GMEP will record:

- total project capital expenditure;
- UK-GMEP grant or public capital contribution;
- concessional and guaranteed lending;
- commercial debt;
- grower equity;
- institutional or infrastructure investment;
- third-party energy investment; and
- other public funding.

Leverage will be reported transparently and will distinguish between private capital mobilised and other forms of public funding.

The core leverage ratio will be:

Private capital committed as a direct consequence of the supported project ÷ UK-GMEP capital support.

The Programme will target a portfolio-level leverage ratio of at least £2 of private investment for every £1 of UK-GMEP capital support by Year 5.

This target will apply at portfolio level rather than to every project. Smaller growers, first-of-a-kind infrastructure and projects delivering substantial public goods may legitimately require higher public intervention rates.

5.11 Public procurement and demand-stabilisation metrics

Success in procurement will not be measured simply by the proportion of public food described as “British”. Procurement arrangements must remain compliant with applicable procurement and competition requirements and should use objective criteria linked to outcomes such as:

- supply resilience;
- seasonality;
- freshness;
- environmental performance;
- nutritional quality;
- delivery reliability;
- supply-chain transparency; and
- ability to meet institutional demand.

UK-GMEP will measure:

- number of qualifying multi-year contracts or frameworks;
- annual contract value;
- annual volume supplied;
- contract duration;
- number and diversity of participating growers;
- proportion supplied through cooperative or aggregated routes; and
- degree to which contracts provide bankable demand certainty.

The key test is whether procurement arrangements improve the predictability of revenue sufficiently to influence investment decisions.

5.12 Workforce success criteria

Workforce success will be measured through outcomes rather than training activity alone.

The Programme will report:

- general vacancy rate;
- technical vacancy rate;
- workforce retention;
- recruitment lead time;
- employee turnover;
- use of seasonal and temporary labour;
- number completing recognised technical training;
- progression into permanent and higher-skilled roles; and
- reported crop losses attributable to labour shortages.

The principal outcome target is a 50% reduction in persistent unfilled vacancies among participating businesses by Year 10 relative to the Year 1 baseline, accompanied by a measurable reduction in crop losses attributable to workforce shortages.

Training places will therefore count as programme outputs, while reduced skills shortages and improved retention will constitute the outcome.

5.13 Equity and concentration safeguards

Programme success cannot be achieved by modernising only a small number of already well-capitalised businesses.

Performance reporting will therefore include:

- funding distribution by business size;
- funding distribution by region;
- number of independent businesses supported;
- cooperative and shared-infrastructure participation;
- average public support rate by business type;
- concentration of programme funding among the largest recipients; and
- unsuccessful application rates by business category.

An annual concentration assessment will identify whether programme design is unintentionally excluding smaller or mid-sized growers. Where material access disparities emerge, eligibility rules, match-funding requirements or technical-support mechanisms will be adjusted.

5.14 Gateway reviews

Programme targets will be subject to formal review at defined decision points.

Gateway 1: End of Year 1: Baseline confirmation

Government will approve:

- the verified national asset baseline;
- final hectare targets;
- energy and carbon methodologies;
- regional opportunity mapping;
- programme financial envelope; and
- final KPI definitions.

Changes from the initial targets in this section must be explained publicly and supported by evidence.

Gateway 2: End of Year 3: Delivery test

The review will determine whether:

- projects are progressing from award to construction;
- private capital is being mobilised;
- planning and energy barriers are being reduced;
- smaller growers can access the Programme; and
- initial infrastructure projects are delivering expected outcomes.

Failure to demonstrate progress will trigger corrective action rather than automatic continuation of existing delivery mechanisms.

Gateway 3: End of Year 5: Mid-programme evaluation

An independent evaluation will assess:

- value for money;
- additionality;
- modernisation rate;
- net capacity change;
- private capital leverage;
- energy transition;
- workforce outcomes;
- regional distribution;
- procurement impact; and
- unintended market effects.

The Year 5 review will determine the design and scale of Years 6–10.

Gateway 4: Year 10: Statutory programme evaluation

The final evaluation will determine whether UK-GMEP has created a durable infrastructure-renewal system or whether material structural barriers remain.

The central question will be:

Can commercially viable UK greenhouse businesses now invest, modernise and replace infrastructure at the rate required to sustain national productive capacity without repeated exceptional government intervention?

If the answer is yes, public intervention should progressively shift towards strategic infrastructure, market failure and emerging technology rather than routine capital renewal.

If the answer is no, the evaluation must identify which structural barriers remain and why the Programme failed to remove them.

5.15 Overall test of programme success

UK-GMEP will be considered successful if, by the end of the ten-year programme:

- the majority of the existing productive estate has entered a credible renewal cycle;
- ageing, unmodernised infrastructure has substantially reduced;
- net domestic greenhouse productive capacity has increased;
- energy efficiency has improved and exposure to fossil-fuel volatility has materially declined;
- private investment in greenhouse infrastructure has increased;
- workforce and technical constraints have reduced;
- proven technologies are diffusing beyond a small number of leading firms;
- public procurement and other demand mechanisms provide greater long-term revenue certainty;
- smaller and mid-sized growers remain capable of participating in sector transformation; and
- government no longer needs to rely on reactive intervention following energy, supply or infrastructure crises.

The ultimate success criterion is therefore not the scale of UK-GMEP itself. It is whether the Programme creates the conditions for a *self-sustaining cycle of private investment, infrastructure renewal and productive growth* that persists beyond the Programme's initial ten-year horizon.

6. PROGRAMME DESIGN PRINCIPLES

UK-GMEP should be designed as a national infrastructure transition programme, rather than as a conventional agricultural grant scheme.

Its purpose is not to fund a predetermined list of technologies or distribute capital across the sector. It is to correct the structural conditions identified in Sections 3 and 4: an ageing productive asset base, weak infrastructure-renewal cycles, fragmented responsibility across government, exposure to volatile energy and labour markets, and insufficient mechanisms for sharing risks associated with long-lived investment. The Programme should therefore operate through a combination of strategic coordination, targeted risk-sharing, infrastructure planning and market development.

The following principles define how that intervention should operate.

6.1 Operate as a portfolio, not a funding scheme

UK-GMEP should be managed as a portfolio of interdependent investments and reforms. The required transition cannot be delivered through a single grant competition because the principal constraints differ between places and businesses. One project may primarily require capital finance; another a heat-network connection; another planning certainty; another shared water infrastructure; and another a credible long-term market.

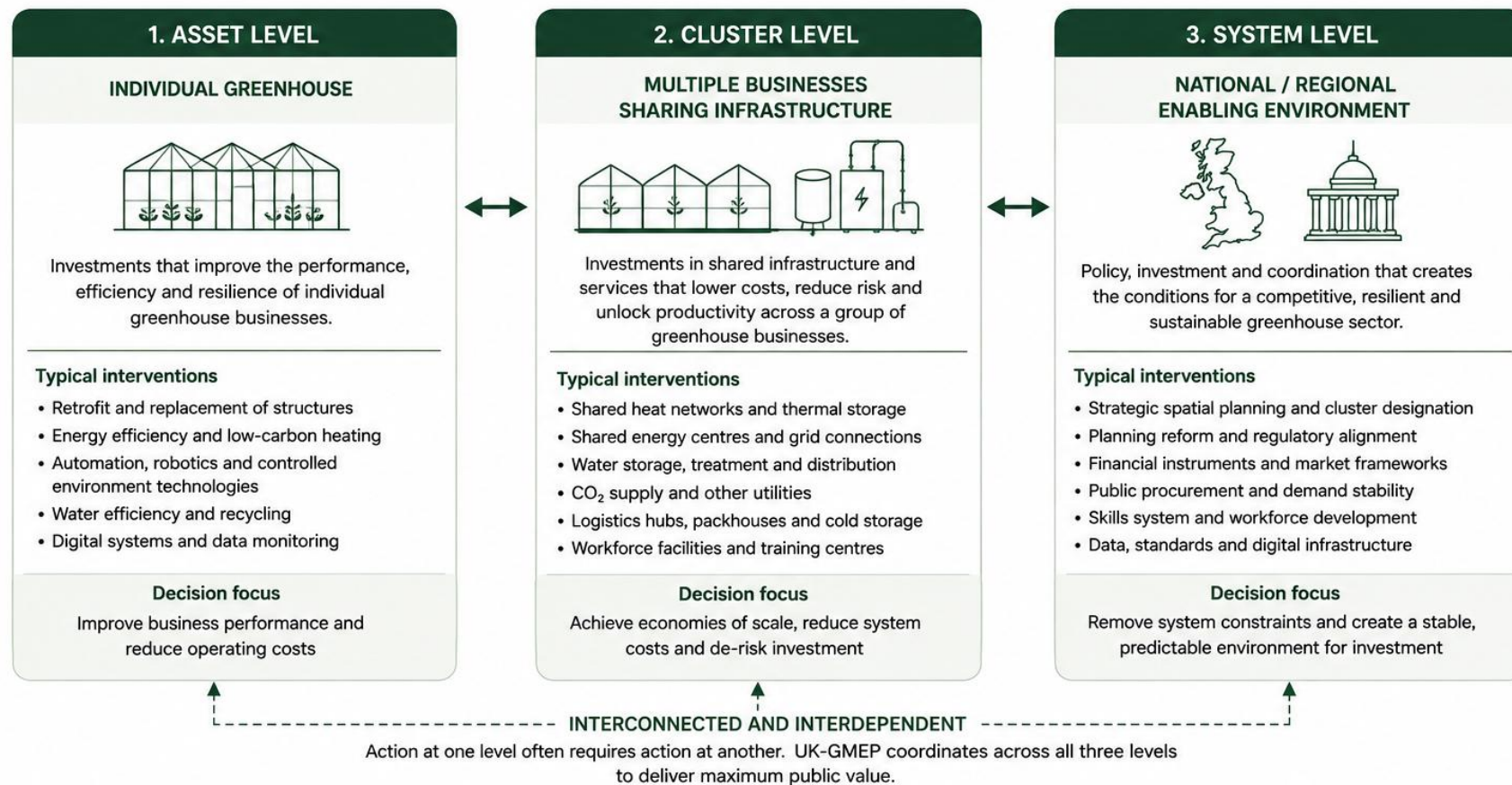
The unit of intervention should therefore not automatically be the individual greenhouse.

UK-GMEP should be capable of operating at three interconnected levels:

1. **Asset level:** retrofit, replacement and technology deployment within individual businesses.
2. **Cluster level:** shared energy, water, logistics, workforce or other infrastructure serving multiple producers.
3. **System level:** planning reform, finance, procurement, workforce policy, data infrastructure and national coordination.

Programme appraisal should identify the lowest level at which the underlying constraint can efficiently be solved.

A system-level problem should not be pushed down onto individual growers, while an individual commercial problem should not automatically become a responsibility of government. This principle is fundamental to both value for money and effective risk allocation.



GUIDING PRINCIPLE

Intervene at the lowest level at which the constraint can be efficiently and effectively addressed, while considering spill-over benefits and wider system impacts.

6.2 Follow an intervention hierarchy

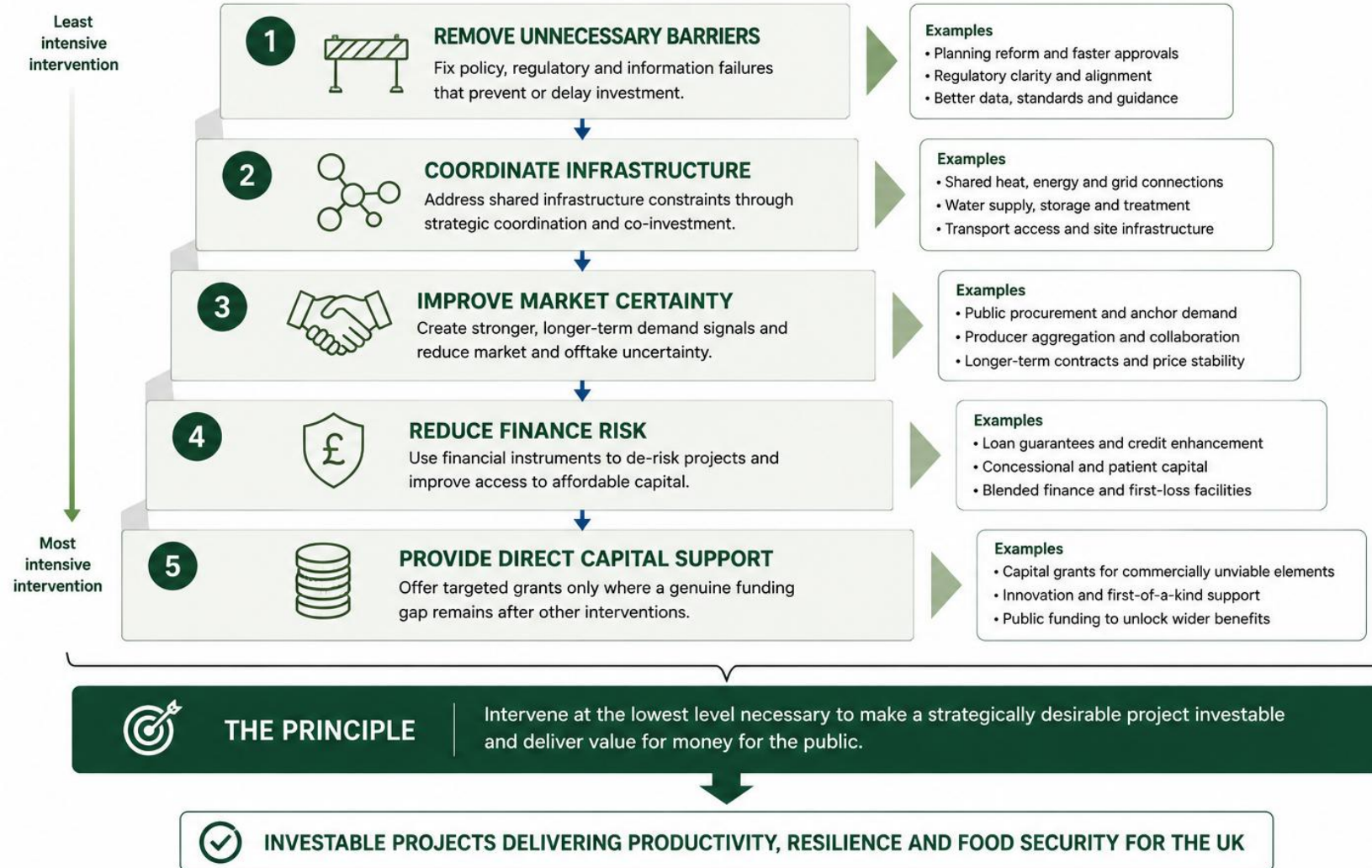
Public intervention should follow a defined hierarchy rather than defaulting immediately to grant funding. Government should first determine why an otherwise desirable investment is not proceeding. The preferred order of intervention should be:

1. **Remove unnecessary barriers.** Where planning, regulation, information gaps or coordination failures are preventing investment, these should be addressed before financial support is considered.
2. **Coordinate infrastructure.** Where the constraint arises from electricity, heat, water, transport or shared infrastructure, government should facilitate coordination between the relevant parties.
3. **Improve market certainty.** Where investment is constrained by insufficient revenue visibility, mechanisms such as longer-term contracting, aggregation or procurement may be appropriate.
4. **Reduce finance risk.** Where projects are commercially credible but conventional finance cannot accommodate their risk profile, guarantees, concessional lending or blended finance should be considered.
5. **Provide direct capital support.** Grant funding should be used where a clearly defined funding gap remains and where the resulting public benefit justifies direct expenditure.

This hierarchy prevents UK-GMEP from using public capital to compensate for problems that could be solved more efficiently through regulation, coordination or market design.

It also establishes an important principle: *the programme should fund the minimum intervention necessary to make a strategically desirable project investable.*

Use the minimum intervention necessary to make a strategically desirable project investable



6.3 Separate commercial risk from system risk

UK-GMEP should make an explicit distinction between risks that businesses should reasonably bear and risks that arise from the wider system.

Growers should normally retain responsibility for:

- crop performance;
- routine operating efficiency;
- commercial management;
- customer relationships;
- normal fluctuations in market prices;
- technology operation once established; and
- business execution risk.

Government intervention may be justified where risk arises from:

- planning uncertainty;
- major network connections;
- shared infrastructure;
- long-term energy-system transition;
- first-of-a-kind deployment;
- fragmented public decision-making;
- infrastructure dependencies outside the grower's control; or
- public benefits that cannot be monetised by the project.

The appropriate question is therefore not: *“How much risk should government remove?”* It is: *“Which organisation is actually capable of managing each risk?”*

Risk should sit with the party best able to control, diversify or absorb it. Where government assumes risk, the rationale and maximum public exposure should be explicit.

6.4 Appraise the whole production system, not the greenhouse structure

A greenhouse should not be considered investable simply because the structure itself can be financed. Major projects should be assessed as complete production systems over their expected operating life.

Appraisal should therefore include, where relevant:

- land and planning;
- energy demand and supply;
- grid capacity;
- heat availability;
- water availability and resilience;
- CO₂ supply;
- workforce requirements;
- technical skills;
- logistics;

- packhouse and cold-chain requirements;
- market access;
- environmental constraints;
- financing;
- asset replacement; and
- future adaptability.

For projects involving substantial public support, these components should form a single integrated investment case. This is particularly important for energy.

A greenhouse designed around an energy source that becomes prohibitively expensive, unavailable or incompatible with future regulation is not a successful infrastructure investment irrespective of the quality of the greenhouse itself.

UK-GMEP should therefore use whole-life system cost and performance, rather than lowest initial capital cost, as a central appraisal criterion.

6.5 Optimise the portfolio for public value, not hectares alone

The Programme should not seek to maximise greenhouse area irrespective of what that area produces, where it is located or how it operates. Additional hectares are an output. They are not, by themselves, the policy objective.

Investment should instead be assessed against a basket of outcomes including:

- retained or additional productive capacity;
- contribution to supply resilience;
- productivity;
- private investment mobilised;
- energy resilience;
- emissions performance;
- water efficiency;
- infrastructure utilisation;
- workforce effects;
- regional economic value;
- technology diffusion; and
- long-term commercial viability.

This creates an important distinction between projects. A hectare of greenhouse infrastructure connected to recovered heat and producing a highly import-dependent crop may generate different public value from a hectare requiring significant new energy infrastructure and serving a market with little strategic supply exposure.

UK-GMEP should be capable of recognising that difference.

However, public-value appraisal must remain disciplined. Wider benefits should be quantified conservatively and should not be used to make fundamentally uncommercial production projects appear viable.

6.6 Use spatial prioritisation, not blanket national expansion

Greenhouse production is unusually sensitive to surrounding infrastructure. The economics of an otherwise identical greenhouse can differ substantially depending on access to:

- heat;
- electricity;
- water;
- labour;
- logistics;
- markets; and
- existing industrial infrastructure.

UK-GMEP should therefore move away from a model in which greenhouse sites emerge primarily through individual land and development decisions. National analysis should identify strategic opportunity areas where multiple conditions align.

This should combine greenhouse suitability with:

- electricity-network capacity and planned reinforcement;
- existing and prospective heat sources;
- data centres and industrial clusters;
- wastewater-treatment infrastructure;
- water availability;
- transport networks;
- labour markets;
- existing horticultural clusters;
- regional economic priorities; and
- environmental and land-use constraints.

These areas should guide, but not rigidly determine, investment. The principle is *spatial prioritisation rather than spatial prescription*. This approach allows government to identify where relatively modest public intervention could unlock significantly greater combined food, energy and regional-economic value.

6.7 Apply conditionality and reciprocity to public support

Public support should create a reciprocal obligation. Businesses receiving material UK-GMEP assistance should be expected to deliver the outcomes for which that support was justified.

Depending on the intervention, conditions could include:

- maintaining productive use for an agreed period;
- providing defined performance data;
- meeting agreed energy or environmental outcomes;
- maintaining infrastructure appropriately;
- participating in programme evaluation;
- allowing anonymised performance benchmarking;
- meeting agreed delivery milestones; and

- repayment or clawback where assets are disposed of or commitments materially breached.

Conditionality should be proportionate. It should not create administrative burdens that prevent participation, particularly by smaller growers. However, where taxpayers share investment risk, government should have a reasonable mechanism for ensuring that the intended public value is delivered.

UK-GMEP should therefore move away from a simple grant-award model towards a public-private investment compact.

6.8 Design for different business and infrastructure models

There should be no assumption that the future sector will consist only of individual businesses owning all of their own infrastructure. Different assets may be most efficiently owned and financed by different parties.

Possible structures include:

- grower-owned greenhouse assets;
- landlord or property-company structures;
- grower cooperatives;
- energy-service companies;
- infrastructure joint ventures;
- local or regional heat-network operators;
- special-purpose vehicles;
- institutional infrastructure investors; and
- shared grower facilities.

For example, a grower may be best placed to operate a crop-production business but not necessarily to finance and operate a £20 million heat network.

Separating infrastructure ownership from operating businesses may, in some circumstances, reduce financing risk and improve access to long-term institutional capital. UK-GMEP should therefore remain business-model neutral provided that governance, risk allocation and public value are clear.

This flexibility will be particularly important for shared infrastructure and regional greenhouse clusters.

6.9 Preserve competition while enabling coordination

The small and concentrated structure of UK protected horticulture creates both an opportunity and a risk.

Coordination across approximately 50 principal commercial businesses is feasible in a way that would be considerably more difficult across much larger agricultural sectors.

However, intervention could also inadvertently reinforce concentration. UK-GMEP should therefore distinguish between coordination that improves system efficiency and support that simply strengthens existing market dominance.

Programme design should monitor:

- concentration of funding;
- concentration of productive capacity;
- access by mid-sized and smaller businesses;
- barriers to new entrants;
- cooperative participation;
- regional distribution; and
- competition for retail and institutional markets.

Shared infrastructure should, where practicable, be designed on transparent and non-discriminatory access principles. Support to strategically important large operators may be entirely justified, but scale alone should not determine eligibility or priority. The objective is a sector that is investable without becoming unnecessarily concentrated.

6.10 Build information infrastructure alongside physical infrastructure

One of the current weaknesses of the sector is the absence of a consistent national asset-level evidence base.

UK-GMEP should therefore create a common data architecture from the beginning. The Programme should progressively establish information on:

- greenhouse location and operational status;
- productive area;
- infrastructure age and condition;
- crop production;
- energy systems;
- energy and water intensity;
- infrastructure connections;
- technology deployment;
- workforce requirements; and
- investment activity.

This should not require disclosure of commercially sensitive data to the public. Government should establish clear rules separating: regulatory/programme data, commercially confidential information, and aggregated public reporting.

The objective is to create sufficient information to support investment planning, infrastructure coordination and evaluation without creating an unnecessary reporting burden. A modern greenhouse programme should therefore create both physical capital and information capital.

6.11 Manage transformation as a staged transition

UK-GMEP should not attempt to transform the entire sector simultaneously.

A ten-year programme should move through progressively larger stages:

1. **Stage 1: establish the system:** baseline, governance, spatial analysis, finance instruments, standards and initial projects.
2. **Stage 2: prove delivery:** modernisation projects, early clusters, energy integration, procurement demonstrations and new finance structures.
3. **Stage 3: scale:** replicate successful models, mobilise institutional capital and expand priority infrastructure.
4. **Stage 4: normalise:** move successful mechanisms into mainstream finance, planning, procurement and infrastructure systems.

Each stage should have explicit gateway criteria. Progression should depend on evidence that delivery mechanisms work rather than simply on elapsed time. This makes UK-GMEP an adaptive programme, but avoids the instability associated with frequently changing policy.

6.12 Design for institutionalisation rather than permanent programme dependence

The long-term purpose of UK-GMEP is not to become a permanent funding body for greenhouse horticulture. It is to change the conditions under which the sector operates. By the end of the initial programme period, successful mechanisms should increasingly be embedded within normal systems.

For example:

- greenhouse spatial considerations should become part of normal infrastructure planning;
- commercially proven energy models should attract routine private finance;
- planning guidance should no longer require programme intervention;
- workforce pathways should sit within established education and skills provision;
- procurement mechanisms should operate through normal purchasing frameworks;
- technology deployment should increasingly be commercially financed; and
- infrastructure renewal should become part of normal grower investment cycles.

The programme should therefore distinguish between temporary intervention mechanisms and permanent institutional reforms. This distinction should be made at programme commencement rather than at programme closure.

6.13 Programme-level decision rule

Taken together, these principles create a simple decision rule for UK-GMEP.

A proposed intervention should proceed only where government can demonstrate that:

1. there is a clearly defined strategic problem or opportunity;
2. the private market cannot deliver the desired outcome at the required scale or timeframe without intervention;
3. the proposed intervention addresses the underlying constraint rather than merely its symptoms;
4. risks are allocated to the parties best able to manage them;
5. the project remains commercially credible after intervention;
6. measurable public value exceeds the public cost and risk assumed;
7. a lower-cost regulatory, coordination or market intervention would not achieve the same outcome; and
8. the intervention contributes to a system that can ultimately operate with less public support.

This decision rule should apply across the finance, planning, procurement, energy, workforce and innovation mechanisms developed in the sections that follow.

The intention is to ensure that UK-GMEP does not become a collection of independent initiatives.

It should operate as one coordinated infrastructure-transition programme, with individual interventions selected according to a common economic and strategic logic.

7. GOVERNANCE AND INSTITUTIONAL ARCHITECTURE

7.1 Governance model

UK-GMEP is a Defra-led, cross-government national programme. Defra is the accountable department, reflecting the Programme's primary purpose of strengthening domestic food production and greenhouse-sector resilience. Delivery, however, is distributed across the departments and public bodies that already hold responsibility for energy, planning, finance, skills, innovation, migration, water and public procurement.

The Programme therefore operates through a hub-and-spoke model. A dedicated UK-GMEP Programme Office within Defra acts as the central coordinating hub. It maintains the national project pipeline, monitors performance, coordinates departments and delivery bodies, manages programme risk, and provides a single point of entry for strategically significant projects. Specialist functions remain with the organisations that already possess the relevant expertise and statutory powers. Overall governance is provided through a named Senior Responsible Owner, a cross-government UK-GMEP Programme Board, and a Ministerial Oversight Group. Industry and technical expertise is incorporated through an advisory council, while major projects are subject to independent investment and technical assurance.

The structure is based on one principle: *one programme, one accountable department, one SRO, one integrated delivery pipeline and one escalation route.*

7.2 Lead department and senior accountability

The Department for Environment, Food and Rural Affairs (Defra) is the sponsoring department and accountable owner of UK-GMEP. Defra holds responsibility for the overall programme strategy, greenhouse-sector policy, food-security outcomes, the national greenhouse baseline, programme monitoring and the coordination of activity across government. It also owns the core programme business case and the main relationship with HM Treasury.

A single Defra Senior Responsible Owner (SRO) is accountable for delivery of the Programme. The SRO chairs the UK-GMEP Programme Board, oversees the Programme Office and is responsible for ensuring that the Programme delivers the objectives and success criteria set out in Section 5.

The SRO also owns escalation. Where projects are delayed by conflicting requirements between departments, regulators or infrastructure providers, the issue moves through the UK-GMEP governance structure rather than being left to individual growers or investors to resolve.

7.3 Ministerial Oversight Group

Political oversight is provided through a UK-GMEP Ministerial Oversight Group, chaired by the responsible Defra minister.

Permanent membership includes ministerial representation from Defra, HM Treasury, the Department for Energy Security and Net Zero, the Department for Business, Innovation, Science and Trade, the Ministry of Housing, Communities and Local Government, the Department for Work and Pensions, the Department of Health and Social Care, and the Home Office.

The Group meets at least twice annually and following major Gateway Reviews. Its role is strategic rather than operational. It resolves cross-government policy conflicts, approves significant changes to programme direction, reviews major delivery risks and ensures that wider government policy does not undermine UK-GMEP objectives. It does not routinely approve individual projects.

7.4 UK-GMEP Programme Office

The UK-GMEP Programme Office is established within Defra for the duration of the initial ten-year programme.

Its central role is to integrate activity that would otherwise sit across multiple organisations. The Programme Office maintains the national pipeline of greenhouse retrofit, replacement, expansion and shared-infrastructure projects. It also maintains the national greenhouse asset register, the integrated delivery plan, the programme risk register and the performance framework.

For strategically significant projects, it provides a single government interface. A project entering UK-GMEP is assigned a defined route through planning, finance, energy, water, skills and other relevant systems. The Programme Office identifies which public bodies need to be involved, which approvals are required and where barriers must be escalated.

The Programme Office does not replace statutory regulators, planning authorities, finance institutions or delivery bodies. Its function is to ensure that they operate as part of a coordinated programme rather than as isolated institutions.

7.5 UK-GMEP Programme Board

The UK-GMEP Programme Board is the principal executive governance body and is chaired by the Defra SRO.

Its permanent membership comprises senior officials from Defra, HM Treasury, the Department for Energy Security and Net Zero, the Department for Business, Innovation, Science and Trade, the Ministry of Housing, Communities and Local Government, the Department for Work and Pensions, the Department of Health and Social Care and the Home Office.

The Programme Board meets quarterly. It approves the annual delivery plan, oversees expenditure and the investment pipeline, reviews programme-level risk, monitors progress against the Section 5 targets, and agrees corrective action where delivery is falling behind.

The Board also acts as the first formal cross-government decision point for barriers that cannot be resolved through the Programme Office. This is intended to address a recurrent weakness of fragmented policy delivery: issues spanning finance, planning, energy, water, workforce or infrastructure are escalated through a single governance structure rather than referred independently between departments.

7.6 Departmental delivery responsibilities

The Programme uses existing institutions rather than creating a new delivery authority. Defra leads on greenhouse-sector policy, food security, the national asset baseline, infrastructure renewal and programme monitoring. Where standardised capital grants are used, administration can be undertaken through the Rural Payments Agency.

HM Treasury controls the fiscal framework. It approves the programme business case, overall spending envelope, treatment of guarantees and contingent liabilities, and any novel financial instruments requiring central approval.

The Department for Energy Security and Net Zero (DESNZ) leads the energy transition element of UK-GMEP. This includes low-carbon heat, heat networks, industrial residual heat, renewable electricity, energy storage and wider energy-system integration. The National Energy System Operator (NESO) supports strategic electricity-system planning and major greenhouse cluster assessments, while Ofgem provides regulatory input where projects interact with regulated networks, heat networks or network charging.

The Department for Business, Innovation, Science and Trade (BIST) leads on industrial investment, greenhouse supply chains, technology deployment, inward investment and industrial co-location. Innovate UK delivers commercial demonstration and technology-deployment programmes, while UKRI, including BBSRC, supports underpinning research and evidence.

The Ministry of Housing, Communities and Local Government (MHCLG) leads planning and place-based delivery in England. It is responsible for national planning-policy alignment, strategic development guidance and coordination with local government. Local planning authorities retain their statutory planning functions, while Mayoral Strategic Authorities and Combined Authorities act as regional partners where appropriate.

The Department for Work and Pensions, working through Skills England, leads workforce development and adult skills in England. This includes technical apprenticeships, occupational standards, regional skills planning and training

pathways for engineering, climate control, energy systems, automation, robotics and data-led production.

The Home Office retains responsibility for migration policy, including the Seasonal Worker route and other immigration pathways relevant to greenhouse production. The Department of Health and Social Care leads the public-health interface, including alignment with institutional food demand. Procurement delivery involves NHS bodies, Crown Commercial Service, local authorities and other public-sector purchasers.

Water governance is coordinated through Defra, the Environment Agency, Ofwat, regional water-resource groups and water companies.

7.7 Finance and investment institutions

UK-GMEP uses different finance institutions for different types of investment. Routine and smaller capital support is delivered through Defra and the Rural Payments Agency where appropriate.

The British Business Bank provides the principal route for business lending, guarantees and co-investment where viable growers cannot access sufficient conventional finance.

The National Wealth Fund supports larger strategic infrastructure, including heat networks, shared energy assets, water infrastructure and major regional greenhouse clusters.

This separation is intentional. UK-GMEP does not use one funding instrument for every project.

Policy eligibility is determined through UK-GMEP. Credit and investment decisions are then undertaken by the appropriate professional finance institution. This avoids turning programme officials or ministers into project lenders.

7.8 Devolved governance

UK-GMEP operates through a common strategic framework but recognises the constitutional distribution of responsibilities across the UK.

The Scottish Government, Welsh Government and Northern Ireland Executive/DAERA participate through a permanent UK-GMEP Intergovernmental Forum.

The Forum coordinates areas where UK-wide consistency is beneficial, including data standards, investment principles, research and innovation, common metrics and UK-wide finance mechanisms. Agriculture, planning, environmental regulation, skills and economic development remain subject to the relevant devolved arrangements.

England-specific frameworks, including the Land Use Framework for England, apply only to English delivery.

7.9 Regional delivery

Strategic greenhouse clusters are delivered through Regional GMEP Delivery Partnerships. These are established where projects require coordinated development of multiple assets, such as greenhouse capacity, heat networks, grid infrastructure, water infrastructure or shared logistics.

Each partnership is led by one named regional body, normally the relevant Mayoral Strategic Authority, Combined Authority or local authority.

Membership is project-specific and includes the organisations required for delivery, such as growers, landowners, energy providers, water companies, local planning authorities, network operators, FE and HE providers, investors and infrastructure partners. The purpose of the partnership is not consultation. It is delivery.

7.10 Industry and technical advice

The UK-GMEP Industry and Technical Advisory Council provides independent commercial and technical advice to the Programme Board.

Membership includes a balanced representation of large, medium and smaller growers, producer organisations, greenhouse engineering, energy, water, automation, digital technology, finance, supply chains, public procurement, skills and plant science.

Members are appointed for fixed terms and operate under formal declarations of interest. The Council advises on sector conditions, technical standards, emerging risks, investment barriers and programme design. It does not approve funding.

7.11 Independent Investment and Assurance Panel

Major UK-GMEP projects are reviewed by an Independent Investment and Assurance Panel before final approval. The Panel includes independent expertise in infrastructure finance, commercial horticulture, greenhouse engineering, energy systems, project finance, economics, planning and major-project delivery. It assesses whether major investments are technically feasible, commercially credible, additional, deliverable and proportionate to the level of public support requested.

The Panel provides an independent recommendation to the Programme Board and relevant funding body. This creates separation between political priority, industry advice and investment appraisal.

7.12 Project approval structure

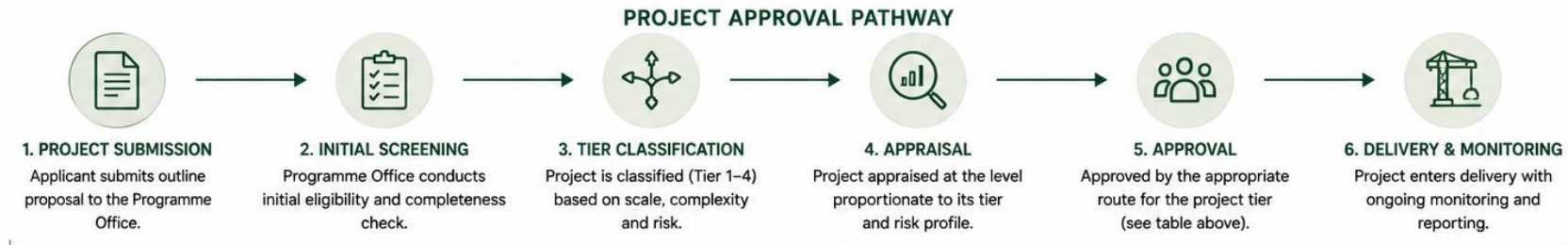
UK-GMEP operates through three project tiers.

1. **Tier 1** covers standard retrofit, smaller capital investment and established technologies. These projects use standardised criteria and delegated approval.
2. **Tier 2** covers major retrofit, full replacement, new-build greenhouse developments and substantial energy investments. These require a full business case, financial appraisal and independent technical assessment.
3. **Tier 3** covers strategic infrastructure projects such as major greenhouse clusters, shared heat networks, large co-location schemes, substantial water or grid infrastructure, or projects involving significant public financial exposure. These require Independent Investment and Assurance Panel review and Programme Board approval, with HM Treasury or ministerial approval where required.

Financial thresholds are defined in later Sections.

Projects are classified by scale and complexity to match the level of appraisal, approval and financial intervention.

	 TIER 1 Standard Retrofit / Smaller Investment	 TIER 2 Major Retrofit / Replacement / New Build	 TIER 3 Strategic Infrastructure / Cluster Projects	 TIER 4 Major Infrastructure / Enabling Projects
 PROJECT TYPE	Individual greenhouse retrofit, efficiency or automation projects.	Substantial retrofit, replacement or new-build greenhouse projects.	Shared infrastructure serving multiple businesses (e.g. heat network, water scheme, energy centre).	Large-scale enabling infrastructure (e.g. grid reinforcement, strategic water resource, major CO ₂ network).
 APPRAISAL REQUIREMENT	Standardised assessment using GILF templates.	Full business case and technical assessment.	Full strategic appraisal including value for money and system impacts.	Strategic business case, economic appraisal and distributional assessment.
 APPROVAL ROUTE	Delegated approval by Programme Office.	Enhanced approval by Programme Leadership Board.	Approval by Independent Investment Panel then Programme Board.	Approval by Cabinet-level Programme Board (with Treasury engagement).
 COMPLEXITY INDICATOR	●	● ●	● ● ●	● ● ● ●
 TYPICAL PUBLIC INTERVENTION	Lower grant intensity; standard terms.	Higher grant intensity and/or blended finance.	Blended finance; infrastructure support mechanisms.	Project finance, guarantees and long-term contracts.



PROPORTIONALITY AND OVERSIGHT: Tiered classification ensures that higher-risk, higher-impact projects receive appropriate scrutiny and that public support is targeted, accountable and effective.

7.13 Single government entry point and escalation

Strategically significant projects enter UK-GMEP through the Programme Office. The Programme Office registers the project, determines its tier, identifies the required public bodies and establishes an agreed route through appraisal and approvals.

Where a project becomes blocked, the escalation route is:

Project or Regional Delivery Partnership → UK-GMEP Programme Office → UK-GMEP Programme Board → Ministerial Oversight Group.

At each stage, the outcome must be resolution, a defined action, further escalation or a formal decision not to proceed. The purpose is not to guarantee approval. It is to ensure that projects do not remain indefinitely unresolved between institutions.

7.14 Institutional structure

The governance architecture can therefore be summarised as follows:

Level	Body	Function
Political ownership	Defra Lead Minister	Overall ministerial accountability
Cross-government oversight	Ministerial Oversight Group	Resolves strategic conflicts
Programme accountability	Defra SRO	Accountable for delivery
Executive governance	UK-GMEP Programme Board	Controls programme delivery
Programme coordination	UK-GMEP Programme Office	Pipeline, data, coordination and escalation
Finance	RPA / BBB / NWF	Grants, business finance and strategic infrastructure
Energy	DESNZ / NESO	Energy transition and system integration
Planning	MHCLG / local authorities	Planning and spatial delivery
Innovation	BIST / Innovate UK	Commercial technology deployment
Skills	DWP / Skills England	Workforce and technical skills
Migration	Home Office	Labour migration policy
Health and demand	DHSC / NHS / CCS	Public-health and procurement interface
Regional delivery	Regional GMEP Delivery Partnerships	Cluster and infrastructure delivery
Advice	Industry and Technical Advisory Council	Sector and technical challenge
Assurance	Independent Investment and Assurance Panel	Major-project scrutiny

7.15 Accountability principle

UK-GMEP operates under one overriding governance rule: *coordination is shared; accountability is not.*

Every programme objective, workstream and strategic project has one named accountable owner. This is the principal institutional change created by UK-GMEP. The UK already has departments, regulators, finance institutions and delivery bodies capable of delivering most of the individual components required for greenhouse renewal.

What has been missing is an architecture that makes those organisations operate as one coordinated system around a defined national objective. UK-GMEP provides that architecture.

8. LEGISLATIVE AND REGULATORY FRAMEWORK

8.1 Legislative approach

UK-GMEP is designed to begin delivery without waiting for a new Act of Parliament.

A substantial proportion of the Programme can be established using existing statutory powers, departmental spending authority, existing public finance institutions, planning policy, procurement legislation and the regulatory frameworks already governing energy, water and infrastructure.

The legislative approach therefore follows three stages:

1. First, existing powers are used wherever they provide an adequate legal basis for delivery. This includes initial capital-support schemes, innovation programmes, project development, data collection attached to funding agreements, strategic spatial analysis, public-procurement pilots and coordination of energy and infrastructure projects.
2. Second, secondary legislation, statutory guidance and amendments to existing regulatory frameworks are used where greater legal certainty or consistency is required. This is particularly relevant to planning, heat-network integration, programme reporting and technical requirements attached to public support.
3. Third, targeted primary legislation is introduced only where existing powers cannot provide the permanence, statutory duties or cross-government authority required for long-term delivery.

This approach allows UK-GMEP to commence during the first year of the Programme while the case for any longer-term statutory changes is developed. The legal architecture is therefore based on minimum necessary legislation rather than creation of a new standalone regulatory regime for greenhouse horticulture.

8.2 Existing statutory foundations

GMEP does not begin from a legislative vacuum. The Agriculture Act 2020 already provides powers for the Secretary of State to give financial assistance for productivity outcomes in agriculture and horticulture, alongside environmental and climate-related purposes [12]. These powers provide an important existing basis for elements of greenhouse modernisation and productivity support in England.

The Procurement Act 2023, in force since February 2025, provides a substantially more flexible framework for public procurement while retaining requirements around transparency, competition and international obligations [27]. It also explicitly seeks to improve access for SMEs and new entrants. This provides the starting framework for

the demand-stabilisation mechanisms developed in Section 13; a separate horticultural procurement regime is therefore neither necessary nor desirable.

Energy integration similarly operates within an increasingly developed statutory framework. The Energy Act 2023 provides the basis for heat-network regulation and heat-network zoning in England [28,29]. Ofgem assumed its regulatory role for heat networks in Great Britain in January 2026, with operators and suppliers now subject to authorisation and registration requirements.

Planning in England remains principally governed through the existing planning Acts and the National Planning Policy Framework (NPPF) [30]. The NPPF establishes government planning policy and already allows other statements of government policy to become material considerations in plan-making and development decisions.

GMEP therefore builds on existing legal systems rather than attempting to replace them.

8.3 Primary legislation

Primary legislation is reserved for provisions that require permanence or statutory authority beyond that available through existing powers.

The core legislative proposal is a targeted Greenhouse Modernisation and Food Production Infrastructure provision, introduced through the most appropriate future Agriculture, Planning, Infrastructure or Food Security Bill rather than necessarily requiring a standalone GMEP Act.

Its principal purpose is to establish statutory recognition of strategically important controlled-environment food-production infrastructure and provide a durable basis for long-term government coordination.

Primary legislation provides, where existing powers are insufficient, for:

1. **Strategic recognition.** Commercial greenhouse infrastructure used for food production can be formally recognised as strategically important food-production infrastructure for specified government functions.
2. **Long-term programme authority.** The Secretary of State has an enduring power to establish, modify and finance programmes supporting greenhouse renewal, replacement, expansion and associated infrastructure.
3. **Cross-system infrastructure.** Powers allow assistance to extend beyond the greenhouse structure itself where energy, water, storage or other shared infrastructure is necessary to deliver the supported food-production outcome.
4. **Reporting.** Government is required to report periodically on the condition, capacity and resilience of the national greenhouse production base and progress against programme objectives.
5. **Information.** Proportionate powers allow information to be required from recipients of substantial public support for monitoring, evaluation and audit purposes, subject to commercial-confidentiality protections.

Primary legislation does not prescribe individual technologies, crops, grant rates or technical standards. These remain matters for secondary legislation, programme rules and guidance so that GMEP can adapt without repeated amendment of primary legislation.

8.4 Strategic infrastructure status

GMEP establishes a formal policy category of Strategic Food Production Infrastructure (SFPI).

This category encompasses commercial greenhouse infrastructure and directly associated systems where they make a material contribution to domestic food production, food-system resilience or strategically important regional production capacity.

Strategic recognition does not mean that every greenhouse becomes a nationally significant infrastructure project, nor does it remove normal planning, environmental or regulatory requirements.

Instead, SFPI status provides a common basis for government decision-making across planning, infrastructure, investment and resilience policy. Designation is based on defined criteria including productive scale, contribution to strategically important supply, infrastructure dependencies, regional significance and resilience value.

This distinction is important. A 0.5 ha commercial glasshouse and a 40 ha integrated greenhouse-energy cluster should not automatically receive identical treatment simply because both are greenhouse developments.

8.5 Planning reform

Planning reform is delivered primarily through national policy and statutory guidance rather than creation of a separate greenhouse planning system.

For England, MHCLG incorporates Strategic Food Production Infrastructure into the National Planning Policy Framework and associated Planning Practice Guidance.

The revised framework establishes that planning authorities should give appropriate weight to:

- domestic food-production capacity;
- replacement of obsolete greenhouse infrastructure;
- efficient use of agricultural and previously developed land;
- access to energy and water;
- opportunities for industrial co-location;
- low-carbon heat;
- shared infrastructure; and
- the long operational life of greenhouse assets.

The objective is not to establish a presumption that greenhouse applications are automatically approved. It is to ensure that the strategic food-production value of a proposal is explicitly considered within the planning balance.

The existing NPPF is an England-only framework, so equivalent approaches are developed separately with Scotland, Wales and Northern Ireland.

8.6 Energy and shared infrastructure

GMEP projects use existing electricity, heat and energy regulation wherever possible. The Programme does not create a separate energy-regulatory regime for horticulture. Instead, DESNZ, NESO and relevant network operators incorporate designated strategic greenhouse clusters into appropriate infrastructure and spatial-energy planning processes.

Heat integration operates within the regulatory framework established under the Energy Act 2023. Heat-network regulation is already live in Great Britain, and England's heat-network zoning framework is being developed using powers contained in that Act [28,29].

Where a GMEP project constitutes a regulated heat network, the operator complies with the same Ofgem authorisation, registration, financial-resilience, pricing and other applicable requirements as other regulated networks.

GMEP does not create regulatory exemptions simply because heat is used for food production. Instead, the Programme ensures that greenhouse demand is recognised during the planning and development of heat infrastructure, particularly where greenhouse clusters can provide stable demand for industrial residual heat, data-centre heat, wastewater heat or other low-carbon heat sources.

8.7 Finance and subsidy powers

The Programme uses existing spending and financial-assistance powers wherever these are sufficient. Defra establishes eligible capital-support schemes under applicable financial-assistance powers, including the Agriculture Act 2020 where relevant [12].

Financial instruments delivered through the British Business Bank and National Wealth Fund operate under their respective statutory and governance frameworks. Every GMEP financial instrument is assessed for compliance with the UK's subsidy-control regime and any applicable international obligations.

The Programme does not create a blanket entitlement to public funding. Legislation provides the authority to support eligible activity; the Programme's funding rules determine whether an individual project qualifies.

8.8 Reporting, data and audit

Receipt of material GMEP financial support carries proportionate reporting obligations.

Funding agreements require recipients to provide the information necessary to verify delivery and assess programme outcomes. Depending on the project, this can include information on productive area, capital investment, output, energy consumption, water use, technology deployment and other agreed performance measures. Commercially sensitive company information remains protected.

Government publishes aggregated programme information through the annual UK-GMEP report, including expenditure, private capital mobilised, productive capacity modernised or created, energy-system changes and progress against the success criteria in Section 5.

Higher-value Tier 2 and Tier 3 projects are subject to enhanced financial and technical audit proportionate to the level of public exposure.

The objective is *accountability for public support without creating a new general regulatory reporting burden for businesses that do not participate in GMEP*.

8.9 Public procurement

GMEP public-procurement mechanisms operate within the Procurement Act 2023 rather than through a separate purchasing regime [27]. The Act provides greater commercial flexibility while retaining transparency and competition requirements.

GMEP procurement policy therefore focuses on designing lawful specifications, frameworks, aggregation mechanisms and longer-term contracting approaches that can recognise relevant outcomes such as resilience, quality, environmental performance and supply-chain value where legally permissible. GMEP does not establish an automatic preference for UK produce solely on the basis of national origin.

This distinction is important for compliance with procurement and trade obligations. The detailed demand-stabilisation model is set out in Section 13.

8.10 Regulatory requirements

The principal regulatory changes required for GMEP are therefore targeted rather than wholesale.

Area	GMEP action	Primary mechanism	Lead
Strategic status	Establish Strategic Food Production Infrastructure category	Government policy initially; statutory underpinning subsequently	Defra
Planning	Incorporate greenhouse infrastructure and food resilience into national planning policy	NPPF / Planning Practice Guidance	MHCLG
Finance	Establish GMEP financial-support instruments	Existing powers + scheme rules; additional powers only if required	Defra / HMT
Energy	Integrate strategic greenhouse demand into infrastructure planning	Existing energy framework + guidance	DESNZ / NESO
Heat	Integrate greenhouse clusters with heat-network development	Existing Energy Act framework	DESNZ / Ofgem
Water	Incorporate strategic greenhouse demand into water-resource planning	Existing framework + guidance	Defra / EA
Procurement	Establish GMEP-compatible public purchasing frameworks	Procurement Act framework + guidance	Cabinet Office / contracting authorities
Reporting	Require programme recipients to provide performance data	Funding conditions initially	Defra
Audit	Establish proportionate assurance requirements	Funding agreements / programme rules	Defra / delivery bodies
Long-term statutory reporting	Establish national greenhouse-resilience reporting duty	Primary legislation	Defra

8.11 Legislative clauses

Where primary legislation is introduced, it is limited to a small number of enabling provisions.

1) **Clause 1: Strategic Food Production Infrastructure**

Purpose: Establish legal recognition of strategically important food-production infrastructure, including qualifying greenhouse infrastructure.

Mechanism: Statutory definition and power for the Secretary of State to designate qualifying infrastructure or categories of infrastructure.

Lead: Defra.

Timing: Legislative opportunity during Programme Years 1–3.

Dependency: Final designation criteria developed through GMEP Phase 1.

2) Clause 2: Financial assistance and infrastructure

Purpose: Ensure government can support not only greenhouse structures but directly enabling shared infrastructure where existing powers prove insufficient.

Mechanism: Explicit financial-assistance power covering qualifying energy, water and shared infrastructure associated with strategic food production.

Lead: Defra/HMT.

Timing: Years 1–3 if the legal review identifies a gap.

Dependency: Detailed finance architecture in Section 9.

3) Clause 3: National greenhouse resilience reporting

Purpose: Prevent deterioration of the productive asset base from again becoming effectively invisible to government.

Mechanism: Duty on the Secretary of State to publish a periodic assessment of greenhouse productive capacity, infrastructure condition, investment and resilience.

Lead: Defra.

Timing: Years 1–3.

4) Clause 4: Information and evaluation

Purpose: Enable robust evaluation of substantial publicly supported investments.

Mechanism: Proportionate information powers linked to specified GMEP support, with statutory protection for commercially sensitive information.

Lead: Defra.

Timing: Introduced alongside any primary GMEP provisions.

8.12 What can be delivered without primary legislation

This distinction is critical to the implementation timetable. GMEP does not wait for legislation before beginning.

During the first 12 months, government can establish the Programme Office and Programme Board, undertake the national greenhouse asset assessment, establish the strategic project pipeline, launch initial retrofit and demonstration programmes under existing powers, develop spatial opportunity mapping, establish Regional Delivery Partnerships, and commence investor engagement. Defra can develop financial-assistance schemes using existing powers where appropriate.

MHCLG can amend planning policy and guidance in England without waiting for a dedicated GMEP Act. The NPPF already forms the central expression of government planning policy, while other government policy statements can also be material considerations.

DESNZ can begin integrating greenhouse demand into heat-network and energy-planning work using existing Energy Act powers and the developing heat-network framework.

Public bodies can develop GMEP procurement pilots within the Procurement Act 2023 framework [27].

Innovate UK can launch targeted technology-deployment competitions, while the British Business Bank and National Wealth Fund can assess appropriate financing mechanisms within their existing mandates.

Reporting and audit requirements can initially be imposed contractually as conditions of receiving public support rather than through universal statutory obligations. Consequently, primary legislation is not on the critical path to programme mobilisation.

8.13 Legislative implementation sequence

The legal programme is therefore delivered in parallel with operational implementation:

Period	Legal/regulatory action
0–6 months	Legal powers audit; establish GMEP governance; issue initial cross-government policy direction; develop planning and procurement guidance; design initial funding schemes
6–12 months	Launch initial programmes under existing powers; publish planning guidance; establish reporting conditions; begin procurement and infrastructure pilots
Year 1–2	Evaluate statutory gaps identified through live delivery; develop targeted secondary legislation where required
Year 2–3	Introduce limited primary provisions where existing powers are demonstrably insufficient
Year 3 onward	Consolidate successful mechanisms into normal planning, finance, energy and procurement systems

This sequencing avoids a common programme failure: spending several years constructing a legislative framework before testing whether the proposed delivery mechanisms actually work.

UK-GMEP begins using existing powers, identifies legal barriers through implementation, and legislates selectively where experience demonstrates that statutory change is necessary. That makes the legal framework an enabler of delivery rather than a prerequisite for it.

9. FUNDING AND FINANCE

ARCHITECTURE

9.1 Purpose and funding model

UK-GMEP operates as a *blended public-private investment programme*, rather than as a conventional capital grant scheme. Its purpose is to overcome identifiable barriers to greenhouse renewal, replacement and strategic expansion while maintaining commercial discipline and maximising the amount of private investment mobilised by public intervention.

This approach reflects the particular economics of greenhouse horticulture. Modern greenhouse infrastructure is capital intensive, has a long operational life and requires substantial upfront investment, while businesses remain exposed to volatile energy, labour and input costs and comparatively short-term commercial contracts. Recent analysis of the wider horticulture sector similarly identifies high upfront costs and long payback periods as major constraints on investment, alongside energy-price volatility and uncertainty over labour and planning.

For established growers, the investment barrier is greater than the capital cost alone. Major retrofit or replacement may require productive greenhouse area to be taken out of commercial use during demolition, construction, commissioning and crop establishment. Businesses can therefore face a period of substantial capital expenditure alongside reduced crop revenue. This foregone production can materially affect cash flow and helps explain why otherwise rational whole-site replacement may be deferred in favour of incremental investment in ageing infrastructure.

Public support is therefore differentiated according to project scale, business capacity, strategic value, additionality and the extent to which benefits extend beyond the individual recipient. The Programme combines direct capital grants, long-term and concessional finance, loan guarantees, strategic infrastructure investment and commercial or institutional capital.

Capital grants are used where an investment generates identifiable public benefits or where a capital constraint would otherwise prevent strategically desirable renewal. Concessional and long-term lending is used where a project is commercially viable but conventional financing terms are poorly aligned with the long life of the asset. Guarantees are used where lender risk, rather than underlying project viability, is the principal constraint. Strategic infrastructure investment is used where energy, water or other shared assets serve multiple businesses or generate wider regional benefits that cannot reasonably be captured on the balance sheet of a single grower.

The central financial principle is that public money closes the viability or risk gap; it does not replace private investment that a project can reasonably support.

9.2 Ten-year programme funding requirement

UK-GMEP is established with an indicative ten-year government financial capacity of up to £3 billion. This represents the total financial capacity available across direct expenditure, infrastructure investment, repayable finance and government-backed guarantees. It does not represent £3 billion of grant expenditure.

Under the central planning scenario, approximately £1.0–1.3 billion represents direct public expenditure and capital provision over ten years. A further £750 million–£1.0 billion is provided as repayable or recyclable financing capacity, with up to £500–750 million available as guarantee or other contingent capacity. The precise composition can be adjusted through successive Spending Reviews as the project pipeline develops and evidence accumulates on the relative effectiveness of grants, lending and infrastructure investment.

The scale of the programme reflects both the condition of the existing greenhouse estate and the opportunity for strategic expansion. The current UK food-producing greenhouse estate is relatively small, at approximately 800–900 ha, yet a substantial proportion of the wider greenhouse infrastructure base is more than 40 years old [1]. UK-GMEP must therefore address a renewal challenge measured in hundreds of hectares while simultaneously enabling new capacity and the energy, water and other infrastructure required to support it.

The case for allowing expansion alongside renewal is strengthened by recent analysis of the wider horticulture sector. Green Alliance estimates that replacing approximately half of imports for crops considered suitable for increased UK production could add around £1.9 billion to annual domestic farmgate value [3]. Importantly for UK-GMEP, it estimates that 68% of the additional farmgate value would arise from new indoor production, highlighting the potentially disproportionate role of controlled-environment production within wider horticultural expansion.

UK-GMEP therefore finances three activities simultaneously: (i) renewal of the existing productive estate, (ii) strategic expansion of domestic greenhouse production, and (iii) development of the shared infrastructure required to support both.

9.3 Central investment assumptions

For programme-planning purposes, UK-GMEP uses an indicative substantial retrofit cost of approximately £0.85 million per hectare and an indicative full replacement or new-build cost of approximately £2.0–2.5 million per hectare, with £2.25 million per hectare retained as a prudent central modelling assumption. Actual unit costs vary by specification, site conditions, supporting infrastructure and project scale, and larger developments may achieve economies of scale that reduce greenhouse construction costs towards approximately £1.8 million per hectare. The central assumption deliberately does not presume that these scale efficiencies will be achieved across all supported projects. These figures are used for programme

planning only; actual awards are based on evidenced eligible project costs and independent appraisal rather than standard payments per hectare.

The following figures are programme-planning scenarios rather than forecasts of market behaviour. They are intended to test the scale of intervention, public expenditure and private capital mobilisation that would be required to alter the investment trajectory of the sector. Actual delivery will depend on project demand, commercial viability, additionality, market conditions and the investment pipeline developed during the first years of UK-GMEP.

The central ten-year scenario assumes that approximately 450–500 ha of existing commercial greenhouse capacity undergoes material modernisation or replacement through UK-GMEP. This represents a substantial intervention in the ageing productive estate while recognising that some existing infrastructure will remain economically serviceable and that some businesses will undertake investment without government support.

For modelling purposes, approximately 60% of this area is assumed to undergo substantial retrofit or technology-led modernisation and approximately 40% full or near-full replacement. At the central assumptions above, renewal of approximately 475 ha represents around £650–700 million of underlying capital investment before major shared infrastructure is included.

The Programme also assumes approximately 400–500 ha of strategic new or substantially expanded greenhouse capacity over ten years. At an average capital requirement of approximately £2.25 million per hectare, this represents a further £0.9–1.1 billion of underlying investment.

The central scenario therefore involves approximately 850–1,000 ha of greenhouse infrastructure being substantially modernised, replaced or added during the first ten years of UK-GMEP. This is deliberately ambitious: the purpose of the Programme is to alter the investment trajectory of the sector rather than subsidise a small number of incremental improvements.

It nevertheless remains modest relative to the scale of potential horticultural expansion identified in wider food-security modelling. Green Alliance estimates that its scenario for replacing approximately half of imports across suitable fruit and vegetable crops would require 46,509 ha of additional horticultural land across multiple production systems [3]. UK-GMEP should therefore be regarded as a strategic first phase in rebuilding protected horticultural capacity, rather than as a claim that one ten-year investment programme can remove UK dependence on imported produce.

9.4 Expected project pipeline

For financial planning, UK-GMEP assumes approximately 100–135 funded investment projects over ten years. Individual businesses may undertake more than one project, particularly where investment is phased, while some Tier 4 projects may incorporate multiple growers and infrastructure providers.

The indicative project pipeline is:

Funding tier	Indicative awards over 10 years	Typical project scale	Indicative aggregate investment
Tier 1: Small Grower & Cooperative	25–35	£0.2–0.8m	£15–20m
Tier 2: Commercial Modernisation	45–60	£1–6m	£180–250m
Tier 3: Strategic Commercial Investment	25–30	£10–50m+	£900m–£1.2bn
Tier 4: Strategic Cluster & Shared Infrastructure	6–10	£20–100m+	£500–750m
Total	101–135		c. £1.6–2.2bn directly supported investment

These numbers are planning assumptions rather than quotas. Funding is not allocated simply because a particular tier has not reached an assumed number of projects. Actual awards depend on project quality, additionality, strategic contribution, deliverability and value for money.

The relatively small number of Tier 3 projects accounts for a large proportion of total investment because major commercial greenhouse developments can involve tens of millions of pounds of capital. Tier 1, by contrast, supports a larger number of smaller interventions while representing a relatively small proportion of total programme expenditure.

9.5 Funding tiers and intervention rates

Every project entering UK-GMEP is assigned to one of four funding tiers. The tier determines the maximum direct capital contribution available, rather than an automatic grant entitlement.

Funding tier	Principal purpose	Indicative scale	Maximum capital grant
Tier 1 – Small Grower & Cooperative	Retrofit, technology adoption, resilience and small replacement projects	<1 ha individual; up to 2 ha collective	Up to 70%
Tier 2 – Commercial Modernisation	Commercial retrofit, replacement and productivity investment	Normally 1–5 ha	Up to 50%
Tier 3 – Strategic Commercial Investment	Large retrofit, replacement, new build and integrated systems	Normally >5 ha	Up to 30%

Tier 4 – Strategic Cluster & Shared Infrastructure	Heat, energy, water and other shared infrastructure	Normally ≥ 20 ha cluster or strategically significant infrastructure	Up to 40% of eligible shared-infrastructure cost
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The thresholds provide consistency but are not applied mechanically. Project characteristics, ownership structure and strategic significance are considered alongside physical area so that marginal differences in project size do not produce arbitrary changes in support.

9.6 Tier 1: Small Grower and Cooperative Fund

Tier 1 ensures that UK-GMEP remains accessible to smaller and independent businesses that often face the greatest financing barriers and have the least capacity to develop complex investment propositions. It applies principally to individual businesses operating below approximately 1 ha of protected production and qualifying cooperative or collective investments covering up to approximately 2 ha. Eligible investment includes greenhouse-envelope improvement, glazing, screens, heating, irrigation, water storage and treatment, environmental controls, lighting where justified, sensors, automation and replacement of obsolete structures.

The maximum direct capital contribution is 70% of eligible expenditure. This ceiling is reserved for projects demonstrating strong additionality, resilience or wider public value. It is not an automatic rate, and businesses capable of supporting a larger private contribution receive a lower grant percentage.

For programme modelling, the expected average Tier 1 intervention rate is approximately **55–60%**. Applications use simplified business cases, proportionate appraisal and standardised technical requirements where possible, reducing the risk that administrative costs make small investments uneconomic.

Higher Tier 1 intervention rates are principally directed towards modernisation, resilience and shared or cooperative assets rather than unrestricted commercial expansion.

9.7 Tier 2: Commercial Modernisation Fund

Tier 2 is the principal mechanism for accelerating renewal of the existing commercial greenhouse estate. It broadly covers investments between 1 and 5 ha, including substantial retrofit, replacement of obsolete structures, energy-efficiency improvements, water infrastructure, automation and integrated technology upgrades.

Tier 2 provides a maximum capital contribution of 50% of eligible investment cost, with an expected average intervention rate of approximately 35–40%. The remaining investment is financed through applicant equity, retained earnings, commercial lending, GMEP-supported finance or an appropriate combination of these sources.

The maximum rate is not routinely awarded. If financial appraisal determines that a project can proceed with a 30% public contribution, UK-GMEP provides 30% rather than 50%. Where debt affordability rather than capital cost is the principal barrier, part of the support can instead be delivered through longer-duration or lower-cost finance. This allows limited grant funding to support a larger overall investment portfolio.

9.8 Tier 3: Strategic Commercial Investment

Tier 3 covers larger commercial investments, normally above 5 ha, including substantial greenhouse replacement, major new-build developments and integrated energy or resource systems.

The maximum direct capital grant is 30% of eligible investment, with an expected average intervention rate of approximately 20–25%. Tier 3 projects are expected to mobilise significantly greater private capital than projects in Tiers 1 and 2.

Projects seeking support towards the upper end of the range must demonstrate a strong public-value case. This may include retention or creation of strategically significant domestic productive capacity, substantial reductions in energy exposure, regional economic benefits, significant productivity improvements or infrastructure benefits extending beyond the recipient business.

Commercial expansion that is demonstrably financeable without public intervention receives little or no direct grant support. Tier 3 therefore rewards additionality and strategic value, rather than business size itself.

9.9 Tier 4: Strategic Cluster and Shared Infrastructure Fund

Tier 4 addresses infrastructure that cannot efficiently be delivered through individual grower balance sheets. It includes major greenhouse clusters and qualifying shared infrastructure, normally associated with developments of approximately 20 ha or more, although smaller projects can qualify where the shared infrastructure is demonstrably strategic.

Eligible assets can include heat networks and heat-recovery infrastructure, thermal storage, strategic electricity connections, shared renewable-energy systems, major water storage, treatment and distribution systems, and other enabling infrastructure serving multiple producers.

Recent sector analysis specifically identifies access to reliable and affordable clean energy, industrial co-location, waste heat, power purchase agreements and capital support for transition away from natural gas as important requirements for future glasshouse expansion. This reinforces the need for UK-GMEP to finance infrastructure beyond the greenhouse structure itself.

Tier 4 provides public capital support of up to 40% of eligible shared-infrastructure cost. This rate does not apply to the entire value of a greenhouse cluster. Greenhouse production assets within the development remain subject to the Tier 2 or Tier 3 rules applicable to the individual businesses.

For example, a 30 ha development comprising £67.5 million of privately developed greenhouse assets and £20 million of qualifying shared heat and water infrastructure would not receive a 40% grant against £87.5 million. The Tier 4 ceiling would apply to the £20 million shared-infrastructure component, giving a maximum Tier 4 contribution of £8 million. Any support for individual greenhouse assets would be assessed separately.

9.10 Eligible expenditure

Grant calculations are based on eligible capital expenditure rather than total project value. Eligible costs include assets directly required to deliver the approved investment, including greenhouse structures, glazing, environmental-control systems, heating and cooling systems, thermal screens, irrigation and water infrastructure, including rainwater capture, on-site storage, treatment, recirculation and recycling systems, lighting where technically and commercially justified, automation, sensors, storage, qualifying energy infrastructure and directly associated installation and commissioning.

Reasonable project-development and professional costs may also qualify within defined limits, particularly for Tier 3 and Tier 4 investments.

Routine operating expenditure is not normally eligible. This includes routine labour, energy bills, fertiliser, growing media, seed, crop-protection products, rent, routine maintenance, marketing and general working capital. Land purchase is not normally grant funded, while financing costs, recoverable VAT, fines, penalties and expenditure incurred before formal programme approval are excluded unless explicitly authorised. The Programme therefore maintains a clear distinction between investment in productive capacity and subsidy of routine business operations.

9.11 Determining the actual grant award

The relevant tier establishes the maximum intervention rate, but the actual award is determined through project appraisal.

Five factors are considered: *additionality*, *financial need*, *public value*, *strategic contribution* and *the applicant's capacity to provide private investment*. The assessment determines the minimum intervention required to make the project deliverable while achieving the Programme's objectives.

Applicants are required to disclose the complete proposed capital structure and all other relevant public support. Where a project requesting 50% grant support is demonstrably viable with 35%, the award is reduced accordingly.

For programme-level financial modelling, average intervention rates are assumed to be approximately 55–60% for Tier 1, 35–40% for Tier 2 and 20–25% for Tier 3. This produces a more realistic estimate of government expenditure than assuming every successful applicant receives the maximum permissible rate.

9.12 Payment structure

Capital support is not paid in full when a project is approved. Payments are linked to financial close, evidenced expenditure, delivery milestones and completion. For most Tier 1–3 investments, the standard structure is 20% mobilisation, up to 60% during delivery, and 20% retained to completion and performance verification.

The initial mobilisation payment is released only after the funding agreement has been executed and evidence is provided that the applicant's remaining finance is committed. The delivery component is paid through one or more drawdowns against verified expenditure and agreed construction or installation milestones. For larger projects, multiple staged claims are used rather than a single 60% payment. The final 20% is retained until the supported assets have been installed and commissioned and the agreed outputs verified. Where appropriate, part of the retention can remain payable after an initial operating period of up to 12 months to verify specified performance outcomes.

Tier 4 infrastructure projects use project-finance drawdowns against independently certified construction milestones rather than the standard 20:60:20 structure. If actual eligible expenditure is lower than the approved project cost, the public contribution is recalculated against actual expenditure and cannot exceed the approved intervention percentage.

9.13 Worked payment example

A 2 ha Tier 2 greenhouse modernisation project has an eligible investment cost of £2 million. Following appraisal, it is awarded the maximum 50% intervention rate.

Funding source	Amount
UK-GMEP capital grant	£1,000,000
Grower/private finance	£1,000,000
Total investment	£2,000,000

The £1 million grant is then released according to delivery:

Payment stage	Payment
Financial close and mobilisation – 20%	£200,000
Verified construction and installation – 60%	£600,000
Completion/performance – 20%	£200,000
Total	£1,000,000

If actual eligible project expenditure subsequently falls to £1.8 million, the maximum grant falls to £900,000. The original £1 million award does not become an entitlement simply because it was approved at the beginning of the project.

9.14 Expected direct grant expenditure

Applying the assumed project pipeline and expected average intervention rates, direct capital support to Tier 1–3 businesses are expected to require approximately £500–650 million over ten years.

A further £250–350 million is allocated to Tier 4 strategic infrastructure grants and public capital contributions. This provides capacity for heat networks, energy connections, water infrastructure, thermal storage and other assets whose benefits extend across multiple businesses or a wider region.

The central ten-year provision for direct capital and strategic infrastructure support is therefore approximately £750 million–£1.0 billion. The programme additionally requires funding for project development, technical assistance, programme administration and contingency, bringing expected direct government expenditure and capital provision to approximately £1.0–1.3 billion over ten years.

9.15 GMEP Finance Facility

Grants alone cannot deliver the required scale of investment. UK-GMEP therefore establishes a GMEP Finance Facility with approximately £750 million–£1.0 billion of financing capacity over the initial programme period.

The Facility supports commercially viable investments through longer-duration loans, co-investment, lender partnerships and other repayable financial instruments. Delivery is principally through the British Business Bank and participating commercial lenders, with the National Wealth Fund involved where projects fall within its strategic infrastructure mandate.

The objective is to correct the mismatch between long-lived greenhouse infrastructure and financing arrangements that may be too short, expensive or inflexible for major capital renewal. GMEP-supported finance can therefore provide longer repayment periods, repayment profiles aligned with project cash flow, partial guarantees and, where justified, interest support during construction or transition. The Programme does not hard-code permanently subsidised interest rates such as 1% or 2%. Concessionality is assessed relative to an appropriate reference or commercial rate, and its subsidy equivalent is recorded as part of the project's total public support. This prevents the generosity and fiscal cost of the programme changing unintentionally as wider interest rates change.

Because much of the Finance Facility is repayable, gross financing capacity is not equivalent to net Exchequer expenditure. Repayments can be recycled into

subsequent projects, increasing the amount of investment supported by the original public capitalisation.

9.16 Guarantees and risk sharing

Where a project is commercially viable but lenders remain unwilling to provide sufficient finance because of perceived sector, technology or asset risk, UK-GMEP can provide a partial loan guarantee rather than increasing the capital grant. The Programme establishes £500–750 million of guarantee capacity over ten years. This represents the maximum qualifying lender exposure covered by the mechanism rather than an assumption that government will incur losses of this amount.

The originating lender retains meaningful exposure and remains responsible for normal credit assessment. Guarantees are priced and structured according to risk, with the expected fiscal cost and contingent liability recorded transparently. This ensures that private lenders retain an incentive to assess projects properly rather than transferring commercial risk wholesale to government.

9.17 Total public support

Every Tier 2–4 project receives an assessment of its total public support equivalent. This combines the value of direct grant, interest subsidy, guarantee support, publicly funded development assistance and other project-specific financial advantages.

This prevents apparently low grant rates from obscuring high overall levels of public support. A Tier 3 project receiving a 25% grant, heavily subsidised debt and a substantial government guarantee may represent greater public intervention than the headline grant percentage suggests.

UK-GMEP therefore monitors both cash expenditure and total public financial exposure. This provides a consistent basis for value-for-money assessment, subsidy-control compliance and comparison between alternative financing structures.

9.18 Private capital requirement

Except for limited project-development and technical-assistance activity, every commercially operated project requires a meaningful private contribution. Private capital can consist of business equity, retained earnings, investor equity, commercial debt or qualifying GMEP-supported lending. Applicants must demonstrate that the remainder of the project finance is committed before material public capital is released.

For major Tier 3 and Tier 4 investments, financial close is a formal condition precedent to the first substantial drawdown. This prevents public funds being committed to projects that have secured a grant award but cannot assemble the remaining capital required for delivery.

9.19 Strategic infrastructure ownership

Tier 4 infrastructure does not have to be owned directly by growers. Shared assets can be developed through infrastructure companies, energy-service companies, grower cooperatives, joint ventures, institutional investors, regional infrastructure vehicles or special-purpose companies.

For example, a heat network serving several greenhouse businesses could be owned and financed by an infrastructure investor over 20–30 years, with growers purchasing heat through long-term contracts. Public funding would support the qualifying infrastructure where necessary to close the viability gap, rather than requiring individual greenhouse businesses to carry the entire asset on their own balance sheets.

Where public capital contributes materially to an infrastructure asset, agreements include appropriate provisions governing asset use, access, disposal, refinancing and recovery of public value.

9.20 Project Development and Technical Assistance Fund

UK-GMEP allocates approximately £75–100 million over ten years to project development, technical assistance and investment readiness.

This funding supports feasibility studies, engineering design, energy and heat studies, water assessments, planning work, commercial modelling and investment-case preparation. It is particularly important for complex multi-party projects where substantial expenditure can be required before an investable proposition exists. For Tier 1 applicants, technical support can be heavily subsidised or delivered centrally. Tier 2 support is normally matched by the applicant. For larger Tier 3 and Tier 4 projects, development funding can be recoverable at financial close or incorporated into the final financing structure where the project proceeds.

The purpose is to address genuine project-development failure without creating an indefinite public subsidy for the development costs of commercially attractive investments.

9.21 Funding allocation and application routes

UK-GMEP uses two principal routes to investment. Tier 1 and most Tier 2 projects enter through standard programme windows, using published eligibility requirements, standardised appraisal and either periodic funding rounds or rolling application windows.

Tier 3 and Tier 4 investments enter a Strategic Project Pipeline managed by the Programme Office. These projects frequently require several years of development and interaction with planning authorities, network operators, energy suppliers, water

companies and investors, making conventional short-duration grant competitions inappropriate.

Admission to the Strategic Project Pipeline does not guarantee funding. Projects must still pass technical, commercial, financial, additionality and public-value appraisal before an investment decision is made.

9.22 Clawback and protection of public investment

Funding agreements contain proportionate mechanisms to protect public money. Support can be withheld, reduced or recovered where expenditure is materially below that approved, information has been misrepresented, agreed project milestones are not delivered, supported assets are disposed of prematurely, productive use ceases without reasonable justification, reporting obligations are persistently breached or duplicate public funding is identified.

Clawback periods are proportionate to asset life and the scale of public contribution. Major infrastructure investments therefore carry longer obligations than small technology grants. Where a supported business or asset changes ownership during the relevant obligation period, funding conditions should normally transfer with the asset where productive use continues. A change of ownership does not in itself constitute failure, but it should not provide a route through which obligations attached to public investment can be avoided.

The Programme distinguishes between commercial underperformance and contractual failure. A genuine crop-price downturn, energy shock or business difficulty does not automatically trigger recovery of grant funding. Deliberate disposal of a publicly supported asset shortly after completion or material misuse of funds does.

Where a business operating strategically important supported infrastructure fails, UK-GMEP follows a hierarchy of remediation, restructuring, transfer and recovery. Where appropriate, funding agreements allow viable productive assets to transfer to another qualifying operator rather than being lost simply because the original business fails.

9.23 Illustrative funding examples

The tier structure produces substantially different financing arrangements depending on the nature and scale of the project.

Example	Eligible project cost	Maximum grant ceiling	Maximum direct grant
0.5 ha small-grower retrofit	£400,000	70%	£280,000
2 ha commercial modernisation	£2m	50%	£1m
4 ha major replacement	£6m	50%	£3m
10 ha strategic new build	£25m	30%	£7.5m
Shared heat/water infrastructure	£15m	40%	£6m
30 ha cluster: £90m greenhouse + £20m shared infrastructure	£20m Tier 4 eligible infrastructure	40%	£8m Tier 4 support, with greenhouse assets assessed separately

These are maximum potential contributions, not expected awards. Actual intervention is determined through the funding-gap and public-value assessment described above.

9.24 Ten-year government financial envelope

The central ten-year planning envelope is:

Government financial commitment	Ten-year provision
Tier 1–3 capital grants	£500–650m
Tier 4/shared infrastructure public capital	£250–350m
Project development, technical assistance and programme delivery	£75–100m
Strategic reserve and programme contingency	£150–200m
Indicative direct public expenditure/capital provision	£975m–£1.30bn
Repayable GMEP Finance Facility capacity	£750m–£1.0bn
Guarantee/contingent capacity	£500–750m
Total government financial capacity	c. £2.25–3.05bn

For strategic and Spending Review purposes, UK-GMEP is therefore presented as a £3 billion ten-year programme. This figure must be clearly distinguished from direct grant expenditure. Approximately £1.0–1.3 billion represents expected direct public expenditure and capital provision. The remainder comprises repayable finance and contingent financial capacity intended to mobilise substantially greater private investment.

9.25 Private investment and leverage

The Programme is designed to mobilise significantly more capital than the direct government contribution.

Under the central scenario, approximately £750 million–£1.0 billion of direct greenhouse and infrastructure capital support is associated with around £1.6–2.2 billion of directly supported investment. The addition of repayable finance, guarantees, institutional investment and infrastructure capital increases the potential investment mobilisation further.

The ten-year programme therefore adopts an indicative ambition to enable approximately £4–5 billion of total public and private investment in greenhouse structures, technology, energy, water and associated infrastructure. This is a programme-level mobilisation target rather than an assumption that every £1 of public expenditure mechanically generates a fixed amount of private investment. Leverage is reported only where private capital is demonstrably committed to a supported project.

9.26 Funding profile over ten years

Direct government expenditure is deliberately phased rather than evenly distributed. Major greenhouse and infrastructure projects require feasibility work, planning, finance and engineering before construction, meaning expenditure is expected to peak in the middle and later years of the Programme.

Programme period	Indicative direct public allocation	Principal activity
Years 1–2	£100–150m	Programme mobilisation, early retrofit, project development and Tier 1/2 launch
Years 3–5	£300–400m	Accelerated renewal, Tier 3 projects and first strategic infrastructure
Years 6–8	£350–450m	Peak replacement, expansion and Tier 4 cluster delivery
Years 9–10	£225–300m	Completion of strategic projects and transition to successor arrangements
Total	c. £1.0–1.3bn	

The Finance Facility and guarantee capacity operate alongside this expenditure profile rather than being treated as annual grant allocations. Government therefore does not need to provide the entire £3 billion as cash at programme commencement. It needs to establish sufficient multi-year financial authority and credible forward capacity for businesses, lenders and infrastructure investors to make long-term investment decisions.

9.27 Financial governance and decision-making

The UK-GMEP Programme Office manages the overall investment pipeline but does not act as a bank. Defra and the Rural Payments Agency administer eligible grant programmes, while the British Business Bank and participating lenders undertake professional credit assessment. The National Wealth Fund assesses strategic infrastructure investments within its mandate, and major Tier 3 and Tier 4 investments are subject to the independent assurance arrangements established in Section 8.

This separates four decisions that should not be conflated. Policy appraisal determines whether government should support the proposed outcome. Technical appraisal determines whether the project is capable of delivering it. Credit appraisal determines whether the borrower can service the proposed finance. Investment appraisal determines whether the complete public-private financing package represents value for money.

HM Treasury retains oversight of the overall fiscal envelope, material guarantees and contingent liabilities, and novel or unusually large financing arrangements.

9.28 Core funding principles

The UK-GMEP financial architecture is governed by five principles. No project receives more public support than is necessary to make it deliverable; direct grant intensity generally reduces as projects become larger and more commercially financeable; higher public contributions are justified where benefits are shared, strategic or cannot be captured by an individual business; public funding is released against verified delivery rather than simply on award; and repayable finance is used wherever it can achieve the same outcome with a lower long-term cost to government.

The objective is not to create a greenhouse sector permanently dependent on capital grants. UK-GMEP uses a time-limited period of coordinated public intervention to address the investment backlog, reduce structural risks, establish shared infrastructure and improve the investability of the sector.

Success is therefore not measured by how much of the £3 billion capacity is spent. It is measured by whether public intervention *unlocks renewal and expansion that would otherwise not occur, mobilises substantially greater private capital, improves the resilience and productivity of UK food production, and leaves the sector progressively less dependent on public support at the end of the ten-year programme.*

10. PROGRAMME PILLARS

UK-GMEP is delivered through seven integrated pillars. These are not separate programmes or funding streams; they are the principal delivery functions through which projects move from identification to operational delivery.

Pillar	Purpose	Lead
1. Infrastructure Renewal and Productive Capacity	Modernise, replace and strategically expand the food-producing greenhouse estate.	Defra
2. Investment and Finance	Mobilise private capital through grants, long-term finance, guarantees and strategic infrastructure investment.	Defra / HM Treasury
3. Energy, Water and Resource Integration	Reduce energy and resource risk through low-carbon heat, electricity, water infrastructure and industrial co-location.	DESNZ / Defra
4. Planning, Spatial Development and Regional Clusters	Identify suitable locations, reduce planning uncertainty and coordinate regional infrastructure.	MHCLG / Defra
5. Markets, Procurement and Supply-Chain Resilience	Improve revenue certainty, market access and resilient routes to market.	Defra
6. Workforce and Skills	Secure operational labour and build the technical capability required for modern greenhouse systems.	DWP / Skills England
7. Innovation, Digitalisation and Technology Deployment	Accelerate commercial adoption of proven technologies and improve sector-wide performance.	BIST / Innovate UK

Small-grower, cooperative and regional inclusion operates across all seven pillars rather than as a separate delivery silo.

The pillars are deliberately interdependent. A major UK-GMEP project may require several of them simultaneously. For example, a new regional greenhouse cluster may combine greenhouse investment under Pillar 1, blended finance under Pillar 2, shared heat and water infrastructure under Pillar 3, spatial coordination under Pillar 4, long-term market arrangements under Pillar 5, workforce development under Pillar 6 and commercial technology deployment under Pillar 7.

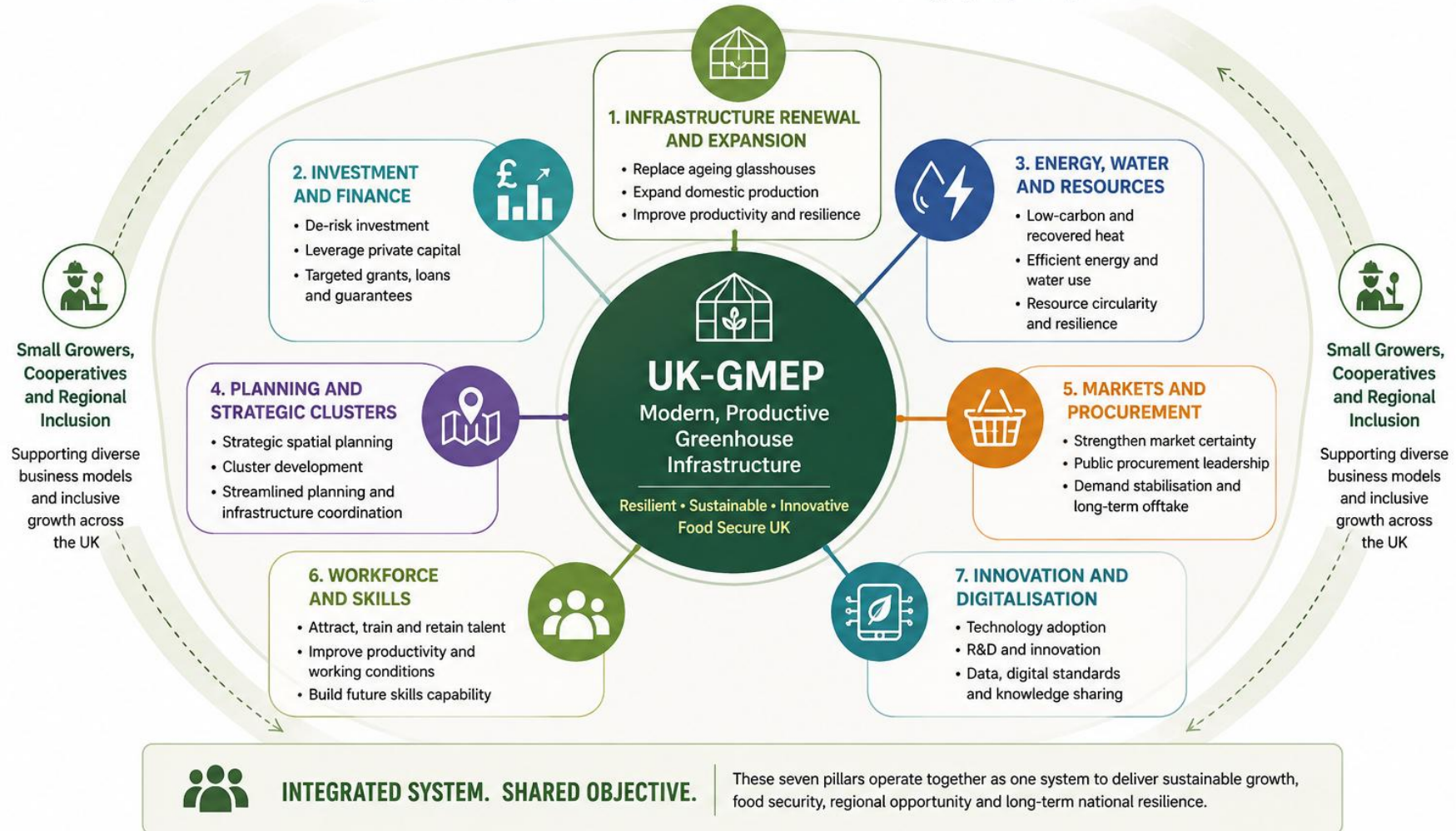
The UK-GMEP Programme Office provides the single coordinating route across these pillars, so that a project is developed as one integrated investment proposition rather than through multiple disconnected government schemes. Detailed delivery arrangements for each pillar are set out in the sections that follow.

For smaller and medium-sized businesses, this function also provides a proportionate navigation and project-development service. Applicants should not be expected to identify and coordinate separate government routes for finance, energy, planning, water, skills and innovation before approaching UK-GMEP. The

Programme Office should identify the relevant pathway and coordinate specialist input according to project scale and complexity.

UK-GMEP SYSTEM ARCHITECTURE

Seven integrated pillars working together to deliver modern, productive greenhouse infrastructure and a resilient domestic supply of fresh produce



11. DELIVERY ROADMAP

11.1 Delivery approach

UK-GMEP is delivered over an initial ten-year programme period, with implementation divided into four phases:

Phase 1 – Mobilise and Launch (Years 0–2)

Phase 2 – Accelerate (Years 3–5)

Phase 3 – Scale (Years 6–8)

Phase 4 – Consolidate and Transition (Years 9–10)

These phases describe the maturity and evolution of UK-GMEP rather than fixed application windows. Businesses and projects can enter the Programme throughout the ten-year period as commercial investment cycles, project readiness and market conditions allow. A project entering in Year 6 is therefore not excluded from forms of support first established during Years 0–2.

The Programme begins using existing government powers and delivery mechanisms rather than waiting for completion of all legislative or regulatory reform. Early investment in greenhouse modernisation therefore runs in parallel with development of the longer-term planning, energy, finance and infrastructure architecture.

The first two years focus on establishing the programme, creating the national evidence base, opening Tier 1 and Tier 2 support, developing the strategic investment pipeline and preparing the first major Tier 3 and Tier 4 projects. Years 3–8 represent the principal capital-delivery period. The final two years complete major investments, evaluate programme outcomes and establish the successor arrangements required to maintain a sustainable cycle of private investment.

11.2 Phase 1 – Mobilise and Launch: Years 0–2

The first objective is to move quickly from policy commitment to an operational investment programme.

Within the first three months, Defra appoints the UK-GMEP Senior Responsible Owner and establishes the Programme Office and cross-government Programme Board. HM Treasury and Defra confirm the initial programme envelope and the expenditure available for the first Spending Review period. The Industry and Technical Advisory Council and Independent Investment and Assurance Panel are also established.

At the same time, the Programme Office begins construction of the national greenhouse asset register and investment baseline. Existing evidence is consolidated with industry and government data to establish productive area, infrastructure age and condition, crop production, energy systems, water

requirements, major investment needs and regional concentration. This provides the baseline against which the ten-year Programme is measured.

By Month 6, the first UK-GMEP prospectus is published. This sets out eligibility, the four funding tiers, eligible expenditure, appraisal requirements, payment structures and application routes. The Project Development and Technical Assistance Fund opens at the same time, allowing projects requiring feasibility, engineering, planning or financial-development work to begin immediately.

The first Tier 1 and Tier 2 funding window opens within 6–9 months. These projects provide the fastest route to physical delivery because they predominantly involve existing sites, established technologies and smaller capital requirements. Initial awards are made within Year 1, with construction and installation beginning shortly afterwards.

In parallel, the Programme Office opens the Strategic Project Pipeline for Tier 3 and Tier 4 proposals. Rather than waiting for fully developed applications, government works with growers, regional authorities, energy providers and investors to identify projects capable of delivering substantial productive capacity or shared infrastructure.

During Year 1, Defra and MHCLG complete the first national spatial assessment of greenhouse opportunity, combining existing production clusters with land, energy, residual heat, electricity networks, water, transport, workforce and environmental constraints. This identifies an initial group of Strategic Greenhouse Opportunity Areas for detailed development.

DESNZ, NESO, Defra, the Environment Agency and relevant infrastructure providers undertake corresponding energy and water assessments for the highest-priority locations. Regional GMEP Delivery Partnerships are then established for the first areas progressing towards major cluster development.

By the end of Year 2, UK-GMEP is fully operational. Tier 1 and Tier 2 investments are under construction or completed, the first major Tier 3 projects have reached financial close, Tier 4 infrastructure projects are progressing through development and planning, and the Programme has a visible multi-year investment pipeline.

11.3 Phase 2 – Accelerate: Years 3–5

Years 3–5 represent the transition from programme establishment to large-scale infrastructure renewal.

Tier 1 and Tier 2 investment continues through regular funding windows, creating a predictable rather than episodic route to capital support. This allows businesses to plan renewal rather than restructure investment decisions around occasional government competitions.

The first wave of Tier 3 replacement and new-build projects moves into construction. Projects developed through the Strategic Project Pipeline during Years 1–2 begin generating substantial physical changes in the greenhouse estate.

The first Tier 4 projects also move from development into construction. These include shared heat, energy and water infrastructure and the first integrated regional greenhouse clusters.

Planning reforms, spatial-development mechanisms and energy-system integration developed during Phase 1 are embedded into routine delivery. Lessons from early projects are used to identify recurring regulatory barriers and determine whether targeted legislative or regulatory changes are required.

Public-procurement pilots and other demand-stabilisation mechanisms are evaluated during this period and expanded where they demonstrate value for money and measurable effects on investment confidence.

Workforce planning moves from national assessment into regional delivery, with skills provision aligned to areas receiving significant greenhouse investment. By the end of Year 5, UK-GMEP should have established a functioning national renewal market rather than a collection of isolated projects. A substantial proportion of the planned 450–500 ha renewal programme should be complete or contractually committed, new productive capacity should be under construction, and multiple strategic infrastructure projects should have reached financial close.

Year 5 also acts as the Programme's principal mid-point review. Government assesses progress against the Section 5 success criteria, private capital mobilisation, geographic distribution, technology performance, demand for each funding tier and evidence of additionality. The review also considers material changes in market conditions, climate and weather risk, technology, infrastructure constraints and the wider policy environment. Funding rates, programme targets and delivery mechanisms can then be adjusted for the second half of the Programme.

11.4 Phase 3 – Scale: Years 6–8

Years 6–8 represent the period of maximum physical delivery. By this stage, the objective is no longer primarily to demonstrate that the model works. Proven mechanisms are deployed at scale.

Capital investment focuses increasingly on major replacement, strategic expansion and Tier 4 infrastructure. Regional clusters developed during the earlier phases move through construction and commissioning, while additional locations enter the strategic pipeline where the evidence supports further development.

The role of direct grant begins to evolve. Where early programme intervention has improved lender confidence and demonstrated the performance of modern greenhouse assets, commercially stronger investments move increasingly towards repayable finance, guarantees and conventional private capital.

Innovation support similarly shifts away from repeated demonstration of established technologies and towards rapid commercial diffusion. Technologies that have been independently validated through earlier UK-GMEP projects become part of mainstream investment rather than remaining dependent on innovation grants.

By the end of Year 8, the majority of the Programme's planned infrastructure renewal should be complete or under construction, substantial new productive capacity should be operational, and the first strategic greenhouse clusters should be demonstrating integrated energy, water, production and regional-development models at commercial scale.

11.5 Phase 4 – Consolidate and Transition: Years 9–10

The final phase completes outstanding strategic investments and determines which elements of UK-GMEP remain necessary beyond the initial ten-year intervention. The Programme does not assume that all support mechanisms should automatically continue. Each is evaluated against additionality, value for money and evidence of continuing market failure.

Where commercial lending and private investment can now support greenhouse renewal without direct capital assistance, grant intensity is reduced or withdrawn. Where structural barriers remain, particularly around shared infrastructure, small-grower access or strategic energy systems, successor mechanisms are developed. The national greenhouse asset register is updated to establish the condition and productive capacity of the sector at the end of the Programme against the Year 1 baseline.

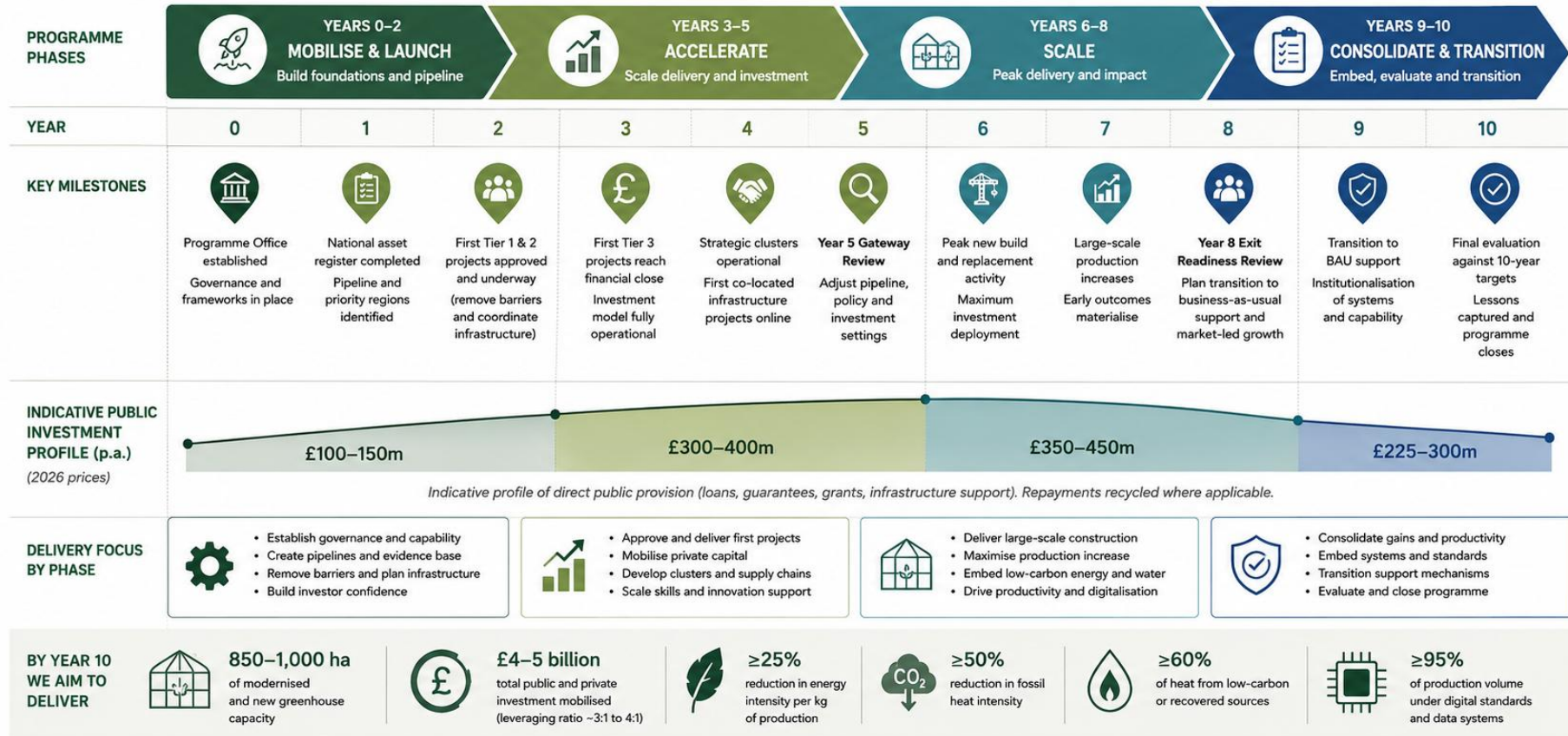
A full independent evaluation assesses public expenditure, private investment mobilised, infrastructure renewed, new capacity created, productivity, energy and water outcomes, regional impacts, business survival and the extent to which UK-GMEP investment would have occurred without government intervention.

By the end of Year 10, government determines whether remaining functions are transferred into mainstream Defra, finance, planning, energy and skills programmes; retained through a smaller successor programme; or closed because the original market failure has been sufficiently addressed.

The intended endpoint is not a permanently subsidised greenhouse sector. It is a sector in which routine infrastructure renewal has again become commercially investable and strategically important shared infrastructure can be delivered through established public-private mechanisms.

UK-GMEP 10-YEAR DELIVERY ROADMAP

A phased programme to modernise and expand UK greenhouse infrastructure at scale



Phasing is indicative. Annual plans and investment profiles will be reviewed and updated through gateway reviews.

11.6 Delivery milestones

The principal programme milestones are summarised below.

Timing	Programme milestone
0–3 months	Ministerial approval; SRO appointed; Programme Office and Programme Board established
3–6 months	Initial funding settlement confirmed; advisory and assurance bodies established; asset register and spatial analysis commenced
6 months	UK-GMEP prospectus published; Technical Assistance Fund opens
6–9 months	First Tier 1 and Tier 2 application window opens
9–12 months	First awards made; Strategic Project Pipeline established
End Year 1	Initial Strategic Greenhouse Opportunity Areas identified; first Regional Delivery Partnerships established
Year 2	First retrofit projects completed; first Tier 3 projects reach financial close; Tier 4 pipeline established
Years 3–4	Major replacement/new-build construction accelerates; first strategic infrastructure projects enter construction
Year 5	Programme mid-point review; funding and delivery mechanisms recalibrated
Years 6–8	Peak infrastructure delivery; regional clusters commissioned; increasing transition towards private/recyclable finance
Year 8	Majority of planned ten-year investment committed or delivered
Year 9	Successor-finance and post-GMEP options developed
Year 10	Final programme evaluation; asset baseline repeated; transition to successor arrangements

11.7 Indicative investment profile

The financial profile follows the delivery roadmap rather than distributing expenditure evenly across ten years.

Phase	Years	Indicative direct public provision	Primary investment activity
Mobilise and Launch	1–2	£100–150m	Technical assistance, early retrofit, programme establishment
Accelerate	3–5	£300–400m	Estate renewal, major replacement, first Tier 3/4 projects
Scale	6–8	£350–450m	Peak capital delivery, expansion and strategic clusters
Consolidate and Transition	9–10	£225–300m	Completion, final strategic projects and transition
Total	10 years	c. £1.0–1.3bn	

Repayable finance and guarantee capacity operate alongside these allocations and are deployed according to project demand rather than treated as annual expenditure targets.

11.8 Gateway reviews and decision points

The ten-year commitment does not create an unconditional ten-year entitlement to expenditure. UK-GMEP contains formal review points at Years 2, 5 and 8.

The Year 2 review tests whether programme design is functioning operationally: whether applications are reaching investment, whether the funding tiers are appropriate, whether projects can navigate planning and infrastructure requirements and whether the Strategic Project Pipeline is producing investable proposals. The Year 5 review is the principal strategic review. It determines whether the Programme is delivering additional investment, whether public intervention remains proportionate, whether the balance between grant and repayable finance should change and whether progress remains consistent with the ten-year objectives.

The Year 8 review determines the exit and successor strategy, including which interventions can be withdrawn, which should transition into mainstream government programmes and whether any continuing structural market failures justify further targeted intervention.

Failure to meet individual output targets does not automatically terminate the Programme. Reviews distinguish between weak programme design, external shocks and projects that require longer development periods. They nevertheless provide government with explicit points at which ineffective interventions can be modified or stopped.

11.9 Delivery principle

The roadmap deliberately overlaps policy development and physical delivery. UK-GMEP does not spend its first several years completing every legislative, planning and institutional reform before supporting investment.

Activities that can proceed under existing powers begin immediately. More complex planning, energy and regulatory reforms are developed alongside early investment, and the lessons from live projects inform subsequent changes.

This creates a delivery-led approach to policy development: begin with what government can do now, identify barriers through real projects, remove those barriers systematically, and scale the mechanisms that demonstrate measurable results.

By Year 10, the principal test of UK-GMEP is therefore not whether government has established a new programme architecture, but whether the UK has a larger, more modern, more investable and more resilient greenhouse production base, supported by an established cycle of infrastructure renewal that can continue beyond the programme itself.

12. PUBLIC PROCUREMENT AND DEMAND STABILISATION

12.1 Purpose

UK-GMEP addresses not only the cost of investing in greenhouse infrastructure, but also the revenue uncertainty against which those investments must be financed.

A modern greenhouse may operate for several decades, yet growers frequently make investment decisions against much shorter supply agreements and highly variable input and market conditions. This creates a structural mismatch between the duration of the asset and the visibility of future revenues. Even where an investment is technically sound and productive, limited certainty over future market access can reduce borrowing capacity and increase the cost of capital.

UK-GMEP therefore establishes a Demand Stabilisation Framework alongside its capital and finance mechanisms. Its purpose is not to guarantee prices or protect individual businesses from normal competition. It is to increase the proportion of domestic greenhouse production sold through credible, transparent and sufficiently durable commercial arrangements to support long-term investment.

Public procurement provides one mechanism within this framework. Retail, wholesale, food-service and other commercial markets remain the principal destination for UK greenhouse produce.

12.2 Public procurement as an anchor market

The UK public sector purchases food at substantial scale through the NHS, schools, local authorities, prisons, defence establishments and other public institutions [26]. UK-GMEP uses this purchasing power strategically by creating clearer and more accessible routes through which greenhouse-grown fresh produce can compete for public contracts.

The objective is not to establish a blanket requirement for public bodies to purchase UK-grown produce. Procurement remains subject to applicable procurement and trade obligations, competition, affordability and the operational requirements of individual contracting authorities.

Instead, UK-GMEP enables procurement specifications and contract structures to recognise legitimate outcomes associated with a resilient food system. These can include supply continuity, freshness, nutritional quality, environmental performance, resource efficiency, seasonal availability, transparency, delivery reliability and supply-chain resilience where these are relevant and proportionate to the contract.

This shifts procurement away from an unnecessarily narrow focus on short-term unit price towards whole-value procurement, while retaining competitive tendering and value-for-money requirements.

12.3 UK-GMEP Fresh Produce Procurement Framework

Government establishes a UK-GMEP Fresh Produce Procurement Framework for participating public-sector purchasers.

The framework provides standardised procurement specifications, contract models, quality requirements, reporting arrangements and routes to market that can be adopted by NHS bodies, local authorities and other eligible contracting authorities. Crown Commercial Service and relevant sector procurement organisations support development of the commercial framework.

The framework is structured around product categories rather than individual growers. Tomatoes, cucumbers, peppers and other qualifying protected crops can therefore be aggregated into purchasing lots appropriate to regional or national demand.

Participation does not guarantee suppliers a contract. Growers and producer organisations compete for framework access and subsequent supply opportunities against published commercial, quality and delivery requirements. The advantage for growers is a clearer and more predictable route to institutional demand. The advantage for public purchasers is access to a pre-qualified supplier base operating against consistent standards.

12.4 Contract duration

Where appropriate, UK-GMEP encourages multi-year supply arrangements rather than repeated short-duration purchasing.

For qualifying fresh-produce categories, contracting authorities should normally consider contract structures of approximately three to five years, subject to procurement law, market conditions and appropriate break and review provisions. Longer contracts do not mean fixed prices for five years. Such an arrangement would transfer excessive commodity and input-cost risk either to the grower or the purchaser.

Instead, contracts can contain transparent periodic price-review mechanisms. These may recognise agreed movements in relevant input costs, market reference prices or other objectively verifiable indices while preserving incentives for efficiency.

The purpose is to provide demand visibility rather than absolute price certainty. For lenders assessing a greenhouse investment, evidence that a proportion of future production has a credible multi-year route to market can materially improve the

quality of projected cash flows without requiring government to guarantee the profitability of the business.

12.5 Demand commitments and GMEP investment

For major Tier 3 and Tier 4 projects, market access forms part of investment appraisal.

Applicants are not required to demonstrate that 100% of future production has already been contracted. Requiring this could prevent investment in new capacity and give purchasers excessive bargaining power before construction begins. However, major projects are expected to provide credible evidence of demand through existing customer relationships, framework agreements, letters of intent, supply contracts, market analysis or equivalent evidence.

Where public procurement forms part of the commercial case, contracting decisions remain separate from GMEP investment decisions. Receipt of a GMEP grant does **not** create an entitlement to a public-sector supply contract, and winning a procurement contract does not automatically qualify a business for GMEP capital support.

This separation is important to maintain competition and prevent government from effectively financing a business and then guaranteeing the market for its output.

12.6 Regional procurement aggregation

A significant barrier to public-sector food procurement is fragmentation. Individual hospitals, schools or local authorities may not purchase sufficient volumes to justify dedicated grower supply arrangements, while smaller producers may lack the volume, logistics or administrative capacity to serve multiple institutions independently.

UK-GMEP therefore supports regional demand aggregation. Where appropriate, public-sector purchasers within a region combine forecast demand for relevant fresh-produce categories and procure through coordinated frameworks. This creates commercially meaningful volumes while reducing duplication of procurement activity.

Regional aggregation can align particularly well with Strategic Greenhouse Opportunity Areas and Regional GMEP Delivery Partnerships. A regional greenhouse cluster can therefore be developed with visibility of both commercial markets and aggregated institutional demand.

This does not mean that produce must be sourced from the nearest greenhouse. It creates a more coherent regional market opportunity within which qualifying suppliers can compete.

12.7 Access for smaller growers and cooperatives

The procurement framework is specifically designed to avoid excluding smaller growers.

Large contracts can unintentionally favour a small number of large suppliers because individual growers cannot meet year-round volume, logistics, insurance or administrative requirements. UK-GMEP therefore uses appropriately sized lots, producer organisations, cooperatives and aggregation mechanisms to enable smaller businesses to participate.

Several growers may, for example, supply through a producer organisation or cooperative that manages grading, packing, logistics, invoicing and continuity of supply.

This links the procurement framework directly to the Small Grower, Cooperative and Regional Inclusion Framework in the sections below. Public procurement should therefore contribute to market diversity rather than inadvertently accelerating concentration of production among the largest operators.

12.8 Commercial demand partnerships

Public procurement alone cannot provide sufficient demand to support the scale of investment envisaged under UK-GMEP. The Programme therefore establishes a parallel Commercial Demand Partnership involving retailers, wholesalers, food-service companies, processors and other major purchasers.

Participation is voluntary and does not involve government setting commercial prices or allocating customers to growers. The purpose is to develop contracting practices that better support long-term infrastructure investment. This includes greater use of multi-year relationships, transparent approaches to major input-cost changes, advance communication of expected crop demand and earlier involvement of growers where substantial new domestic capacity is being considered.

For major expansion projects, the Programme Office can convene potential producers, purchasers and investors during project development where this helps establish whether sufficient market demand exists.

Commercially sensitive negotiations remain between the businesses concerned.

12.9 Demand aggregation for strategic expansion

Where UK-GMEP identifies a significant opportunity to expand domestic production of a particular crop, government can undertake structured demand aggregation exercises before committing major public capital.

For example, if several growers are considering substantial expansion of UK pepper production, the Programme Office can establish aggregate market interest from retailers, food service, wholesalers and public-sector purchasers. This does not allocate contracts. It provides evidence of the scale, timing and characteristics of potential demand.

That information can then inform grower investment decisions, lender appraisal and government assessment of whether supporting additional productive capacity is likely to generate genuinely additional UK production or simply redistribute market share between existing domestic growers.

This is an important safeguard against publicly financing overcapacity.

12.10 Price and cost risk

UK-GMEP does not establish guaranteed minimum produce prices. Price guarantees could create significant fiscal exposure, weaken incentives to respond to markets and potentially encourage production that is not commercially competitive.

The preferred mechanism is risk sharing rather than price protection. Longer-term contracts can incorporate agreed price-review provisions where appropriate, allowing exceptional changes in major input costs to be considered rather than leaving one party to absorb the full impact of an external shock. Contracting authorities and commercial partners remain free to determine the precise mechanism appropriate to their market.

UK-GMEP monitors whether persistent disparities between production costs and market returns are preventing investment, but it does not routinely compensate growers for commodity-price movements.

12.11 Procurement and nutritional outcomes

Public procurement also creates an opportunity to connect greenhouse investment with wider government objectives around diet and health.

Where procurement budgets and operational requirements allow, participating institutions can increase the availability and quality of fresh fruit and vegetables within meals rather than simply substituting one supplier for another. This distinction matters. Replacing an imported tomato with a UK-grown tomato may strengthen domestic production, but increasing the amount of fresh produce consumed can generate an additional public benefit.

DHSC and participating public bodies therefore assess UK-GMEP procurement pilots against both supply-chain and nutritional outcomes.

UK-GMEP does not, however, transfer responsibility for public-health policy to growers. Horticultural procurement remains one component of a much wider approach to diet and preventative health.

12.12 Procurement pilots

The Demand Stabilisation Framework begins with a limited number of regional procurement pilots during Years 1–2.

Initial pilots should be selected in areas where there is existing greenhouse production or a credible pipeline of GMEP investment and sufficient institutional demand to test aggregation at meaningful scale.

Each pilot tests the complete procurement model: demand forecasting, aggregation, tender design, lot size, supplier participation, pricing mechanisms, logistics, contract performance and administrative burden. The pilots should run for sufficient time to capture seasonal variation rather than being evaluated after only a few months. The key question is not simply whether public institutions can purchase more domestically produced food. The evaluation must determine whether improved demand visibility changes grower investment behaviour or improves access to finance.

Mechanisms that merely displace existing commercial sales without generating additional investment or resilience should not be scaled nationally.

12.13 Relationship with food-service intermediaries

UK-GMEP recognises that many public institutions do not purchase fresh produce directly from growers. Procurement frequently operates through wholesalers, distributors, caterers and food-service companies.

The framework therefore applies relevant supply-chain requirements through intermediaries rather than assuming direct grower-to-hospital or grower-to-school contracts.

Where an intermediary supplies a public contract, appropriate reporting requirements enable the contracting authority to understand the origin, resilience and relevant performance characteristics of the produce supplied. This allows the Programme to work with the existing food-distribution system rather than attempting to construct a parallel public-sector supply chain.

12.14 Data and demand forecasting

The Programme Office develops an aggregated Protected Produce Demand Outlook using available market, procurement and production information. The Outlook identifies indicative demand by major crop group, expected domestic production,

relevant import exposure, seasonal supply gaps and significant planned changes in productive capacity.

Its purpose is not to forecast market prices or direct production decisions. It provides a common evidence base that reduces information asymmetry between government, growers and investors.

For major Tier 3 and Tier 4 projects, this evidence forms part of the assessment of market additionality and overcapacity risk. Commercially confidential customer and supplier information is not published.

12.15 Worked delivery example

A regional NHS procurement partnership identifies predictable annual demand for tomatoes, cucumbers and peppers across several hospitals. Demand is aggregated through a multi-year procurement framework using defined quality, delivery, resilience and sustainability requirements.

At the same time, a group of growers is developing a 25 ha UK-GMEP greenhouse cluster within the region. The growers do not receive an automatic NHS contract because they are receiving GMEP investment support. They compete through the procurement process alongside other qualifying suppliers.

Successful suppliers obtain a three- to five-year contractual route to part of the institutional market, with agreed price-review mechanisms and performance requirements. The growers continue to sell the majority of their output through retail, wholesale and food-service markets.

When lenders assess the greenhouse investment, the institutional contract contributes to evidence of future revenue without becoming a government guarantee for the entire project.

The result is a deliberate separation of capital support, competitive procurement and commercial market risk, while allowing the three to reinforce one another.

12.16 Governance and accountability

Defra is accountable for the overall Demand Stabilisation Framework. DHSC leads the health-policy interface, while relevant NHS organisations, Crown Commercial Service, local authorities and other contracting authorities retain responsibility for their own procurement decisions.

The UK-GMEP Programme Office coordinates the relationship between procurement activity and the investment pipeline but does not award supply contracts. Commercial demand partnerships remain voluntary and are governed by normal competition law and commercial arrangements.

Programme monitoring reports the value and duration of participating contracts, supplier composition, SME and cooperative participation, domestic production supported, procurement performance and evidence that demand mechanisms have influenced investment.

12.17 Success criteria

The purpose of this pillar is not to maximise the percentage of publicly purchased food carrying a particular national origin. Its success is determined by whether public and commercial demand mechanisms reduce investment uncertainty while maintaining competition and value for money.

By Year 5, UK-GMEP should have demonstrated whether regional aggregation and multi-year procurement materially improve grower investment confidence and access to finance. Successful mechanisms are then expanded during Years 6–10, while those that merely shift existing sales between customers are discontinued.

By the end of the Programme, longer-term contracting and improved demand visibility should form part of the normal investment environment for greenhouse horticulture rather than remaining dependent on bespoke government intervention. The central principle is therefore that government does not guarantee a market for UK-GMEP production; it creates the conditions in which credible future demand can be translated into investable revenue certainty.

13. PLANNING, LAND USE, AND INFRASTRUCTURE INTEGRATION

13.1 Purpose

UK-GMEP establishes a more predictable and strategically coordinated planning pathway for food-producing greenhouse infrastructure. The objective is not to weaken planning scrutiny or create an automatic presumption in favour of greenhouse development. It is to ensure that strategically important greenhouse proposals are assessed consistently, at the appropriate spatial scale, and with proper recognition of their contribution to food production, infrastructure efficiency, energy integration and regional economic development.

Greenhouse planning is treated as an infrastructure coordination issue as well as a land-use issue. A modern commercial greenhouse depends on land, energy, water, transport, labour and logistics, and in some cases on direct physical connections to heat networks, industrial sites, wastewater infrastructure or electricity networks. These requirements need to be considered together rather than through a series of disconnected decisions.

For England, UK-GMEP is integrated with the Land Use Framework, the National Planning Policy Framework, Spatial Development Strategies and emerging strategic infrastructure planning. Equivalent arrangements are developed with Scotland, Wales and Northern Ireland within their respective planning systems.

13.2 Current planning problem

The current planning environment creates avoidable uncertainty for greenhouse investment. Commercial greenhouse developments can be treated differently between authorities because they combine characteristics of agriculture, built infrastructure, industrial energy use and logistics. The greenhouse itself may be agricultural in purpose, while associated packhouses, energy centres, heat networks, water reservoirs, electricity infrastructure and distribution facilities introduce additional planning considerations.

This can create classification ambiguity and variation in the evidence requested from applicants. Similar projects may therefore encounter different interpretations of landscape impact, traffic, energy infrastructure, employment, agricultural need or appropriate site location depending on the authority involved.

Planning timelines can also be poorly aligned with investment decisions. Major greenhouse projects frequently depend on several parallel processes, including land agreements, grid connections, heat-supply arrangements, water availability, environmental assessment and finance. Delay or uncertainty in one component can affect the viability of the entire project.

The problem is particularly significant for co-location. A greenhouse designed to use residual heat from a data centre, industrial facility or wastewater-treatment plant may depend on both developments progressing within compatible timescales. If the greenhouse is considered only after the adjoining infrastructure has been designed and consented, the opportunity for efficient integration may already have been lost.

Local authorities also operate within increasingly complex demands on land. Housing, renewable energy, nature recovery, water, transport, food production and economic development are often planned through different processes. This is precisely the type of fragmentation the Land Use Framework seeks to address.

UK-GMEP therefore does not simply seek to make greenhouse applications faster. It seeks to make *the location and appraisal of greenhouse infrastructure more strategic, predictable and integrated*.

13.3 National planning classification

In England, MHCLG and Defra establish a consistent national planning policy definition for Strategic Food Production Infrastructure, covering qualifying permanent commercial greenhouse developments and their directly enabling infrastructure.

Designation as Strategic Food Production Infrastructure does not remove a project from the normal planning system and does not automatically make it a Nationally Significant Infrastructure Project. Local planning authorities retain their statutory functions unless another existing planning regime applies.

The classification instead ensures that greenhouse proposals are consistently recognised as long-lived productive infrastructure and that their contribution to national and regional food resilience is explicitly considered within planning decisions.

National Planning Practice Guidance sets out the treatment of the principal components of a greenhouse development, including the production structure itself, packhouses, energy centres, reservoirs, thermal storage, heat-network connections, electricity infrastructure and directly associated logistics.

The guidance also distinguishes between routine commercial greenhouse development and *Strategic GMEP Projects*, where the scale, shared infrastructure or national/regional importance warrants enhanced coordination.

13.4 Strategic Greenhouse Opportunity Areas

UK-GMEP introduces Strategic Greenhouse Opportunity Areas (SGOAs) as the principal spatial mechanism for directing future large-scale development. SGOAs are not compulsory development zones and do not allocate land automatically for greenhouse use. They identify locations where national and regional evidence

indicates that greenhouse development may provide particularly strong combined value.

The national assessment considers greenhouse-growing suitability alongside existing greenhouse clusters, electricity infrastructure, current and future grid capacity, low-carbon and residual heat sources, water availability, wastewater infrastructure, transport networks, labour markets, distribution centres, environmental designations, flood risk, landscape constraints and proximity to major markets.

The assessment is integrated with the spatial evidence being developed through the Land Use Framework rather than creating an independent national land-use map. In England, the UK-GMEP spatial layer feeds into the Defra Land Use Unit's wider national spatial picture and into relevant Spatial Development Strategies. This allows greenhouse development to be considered alongside planned housing, energy, transport, water, nature recovery and other infrastructure.

The purpose is spatial prioritisation rather than spatial prescription. A project outside an SGOA remains capable of receiving planning permission or UK-GMEP support where it demonstrates a strong case. Conversely, location within an SGOA does not guarantee either planning permission or programme funding.

13.5 Integration with the Land Use Framework

The UK-GMEP approach directly applies the Land Use Framework principle of multifunctional and efficient land use.

Greenhouse horticulture is particularly suited to this approach because relatively small land areas can support high levels of food production while the infrastructure can, where appropriately located, interact positively with surrounding energy, water and industrial systems.

A well-designed greenhouse development can therefore deliver several functions simultaneously: food production, productive use of residual heat, efficient use of water, regional employment, demand for renewable electricity and potentially more efficient utilisation of existing infrastructure.

This does not mean that greenhouse development is inherently the best use of any particular site. Land-use decisions must continue to consider environmental sensitivity, landscape, flood risk, water availability, biodiversity, transport, agricultural land quality and competing strategic needs.

The relevant question is therefore not simply *“is this land suitable for a greenhouse?”*, but: *“Does locating protected food-production infrastructure here provide greater combined long-term value than realistic alternative locations and uses?”*

This is especially important when considering highly productive agricultural land. Greenhouse production should not automatically be directed to the highest-quality agricultural soils simply because those areas have historically supported horticulture.

Because many commercial greenhouse systems are largely decoupled from underlying soil, suitable development may be possible on lower-quality agricultural land, previously developed land or land associated with industrial infrastructure, where environmental and logistical conditions permit.

Equally, avoiding high-grade soils should not become an inflexible rule where an existing greenhouse cluster, energy network, water infrastructure or supply chain makes continued production on that site substantially more efficient than relocation. The Land Use Framework is therefore used as a decision-support framework for balancing outcomes, rather than as a mechanism for assigning one nationally prescribed land use to each location.

13.6 Required planning reforms

UK-GMEP introduces five changes to the planning treatment of greenhouse infrastructure in England.

- 1) First, national Planning Practice Guidance establishes a consistent definition and appraisal framework for commercial greenhouse and associated infrastructure development.
- 2) Second, qualifying Tier 3 and Tier 4 developments gain access to a Strategic GMEP Planning Route. This does not bypass statutory planning requirements. Instead, it provides enhanced pre-application coordination, a named planning lead, early involvement of infrastructure and environmental bodies, an agreed evidence schedule and a project-specific timetable.
- 3) Third, shared infrastructure is assessed as part of the overall production system rather than as a series of unrelated developments. Where a greenhouse cluster requires heat, electricity, water or logistics infrastructure, the planning authority should consider the functional relationship between those assets and the food-production development.
- 4) Fourth, national guidance establishes clear principles for co-location with industrial and infrastructure assets, including data centres, wastewater-treatment facilities, energy infrastructure and other sources of recoverable heat or resources.
- 5) Fifth, major greenhouse proposals use a standard national appraisal framework, reducing unnecessary differences in information requirements between authorities.

The Strategic GMEP Planning Route is intended to accelerate coordination and decision-making, not lower the threshold for approval.

13.7 Strategic GMEP Planning Route

Tier 3 and Tier 4 projects, and other developments designated strategically important by the Programme Office, enter a coordinated planning pathway. Each project

receives a named Planning Coordination Lead, normally within the relevant local or strategic planning authority. The UK-GMEP Programme Office supports coordination where the project crosses several administrative or infrastructure boundaries. At the start of the process, the applicant, planning authority and relevant statutory and infrastructure bodies agree a Planning Delivery Plan. This identifies the information required, responsible organisations, key dependencies, expected consultation activity and decision timetable.

For sufficiently complex proposals, this is supported through an appropriate Planning Performance Agreement or equivalent project-management mechanism.

The purpose is to move major projects away from a sequential model:
land → planning → energy → water → finance

towards a parallel model:

land + planning + energy + water + environment + finance assessed together.

This is particularly important for projects where the viability of one element depends upon another.

13.8 Standard greenhouse planning appraisal

National guidance establishes a common evidence framework for qualifying major greenhouse applications. The scale of evidence remains proportionate to the development, but assessments are structured around the same core issues.

Appraisal area	Principal question
Strategic need	What productive capacity is retained or created and what market or resilience need does it address?
Site selection	Why is the proposed site appropriate relative to credible alternatives?
Land use	How does the development interact with agricultural land, existing development and other strategic land-use priorities?
Energy	Is there a credible long-term heat and electricity strategy?
Water	Is water demand secure and compatible with catchment and regional water-resource constraints?
Infrastructure	Are grid, heat, water, transport and digital requirements deliverable?
Environment	What are the impacts on biodiversity, protected sites, water, carbon and environmental quality, and how are these avoided, mitigated or compensated where required?
Landscape and visual impact	Can scale, massing, lighting, screening and design impacts be appropriately managed?
Flood and drainage	Is flood risk acceptable and is surface-water management adequately designed?
Transport and logistics	Can workforce, freight and servicing requirements be accommodated safely?

Workforce	Is there a credible workforce and skills plan for major developments?
Resource integration	Does the proposal create opportunities for shared heat, water, energy or other infrastructure?
Economic impact	What employment, investment and supply-chain effects are expected?
Whole-life adaptability	Can the site accommodate future changes in technology and energy systems?

A project is assessed on the overall planning balance. No single claim of food-security benefit overrides material environmental or community impacts, but equally food production is not treated as a secondary consideration once other infrastructure requirements have been assessed.

13.9 Treatment of co-location and shared infrastructure

Co-location receives explicit consideration within UK-GMEP because its benefits can be missed when individual developments are assessed independently.

Where greenhouse production makes productive use of residual heat, shared energy infrastructure, water or another resource stream, the planning case should recognise the combined system benefit where it is evidenced and deliverable.

For example, a greenhouse development adjoining a data centre may allow recoverable heat to substitute for a proportion of conventional heating demand. The appraisal should therefore consider the greenhouse, heat-recovery infrastructure and associated development as functionally connected where that connection is material to the proposal.

This does not mean that one development automatically justifies another. The claimed integration must be technically credible and supported by appropriate contractual or infrastructure evidence. Planning authorities should give limited weight to speculative claims that a future heat source or infrastructure connection may become available where there is no credible route to delivery.

This distinction is important because UK-GMEP should encourage real industrial symbiosis rather than nominal co-location used principally to strengthen a planning case.

13.10 Local authority guidance

Local planning authorities remain responsible for balancing development benefits against environmental, community and infrastructure impacts within the applicable planning framework.

For qualifying greenhouse developments, councils explicitly consider food-production value alongside the conventional planning considerations relevant to the site. The

assessment should recognise that greenhouse infrastructure is long-lived and that decisions about location can affect productive capacity for 30–50 years. Energy, water and transport infrastructure should therefore be assessed on a comparable strategic horizon rather than solely against immediate conditions.

Authorities should also distinguish between the visual scale of a greenhouse and the intensity of its land use. Large greenhouse structures can have substantial landscape effects that require careful assessment and mitigation, but their physical scale can also correspond to high levels of productive output from a comparatively small area.

Objections concerning traffic, lighting, landscape, biodiversity, water, noise or other effects remain material where relevant and are not displaced by designation as Strategic Food Production Infrastructure. The appraisal instead asks whether impacts can first be avoided, then mitigated, and where appropriate addressed through other established mechanisms. Strategic benefits are considered only as part of the overall planning balance.

Where an application has significant infrastructure or environmental deficiencies that cannot reasonably be mitigated, GMEP status does not require approval.

13.11 Local plans and Spatial Development Strategies

Strategic greenhouse opportunity is incorporated progressively into plan-making rather than dealt with only through individual applications. In England, Strategic Planning Authorities consider relevant UK-GMEP spatial evidence when preparing or updating Spatial Development Strategies. Local planning authorities then use this strategic evidence when preparing local plans and identifying appropriate employment, agricultural or infrastructure locations.

Where a Strategic Greenhouse Opportunity Area has a sufficiently developed investment pipeline, planning authorities can identify appropriate locations or planning policies in advance rather than waiting for speculative applications. Local Development Orders or other existing plan-led mechanisms can be considered where they are legally appropriate and where environmental and infrastructure issues can be addressed adequately in advance. Their use is determined locally and does not replace project-specific assessment where significant impacts remain.

The long-term objective is for strategically appropriate greenhouse development to become increasingly *plan-led rather than application-led*.

13.12 Infrastructure reservation and future-proofing

Planning should also protect opportunities that may not be economically reproducible later. Where new industrial, energy, data-centre, wastewater or heat-network infrastructure creates a credible opportunity for future greenhouse co-location,

relevant authorities should consider whether reasonable provision can be made for future connection.

This may include safeguarding heat-network corridors, allowing space for heat exchangers, reserving appropriate utility capacity or avoiding development layouts that unnecessarily prevent later connection. The principle is not that every data centre or industrial development must have an adjoining greenhouse. It is that potentially valuable resource flows should not be inadvertently designed out before their productive use has been considered.

Similarly, new greenhouse developments should be designed with sufficient flexibility to transition between energy technologies over their expected operating life.

13.13 Planning workflow template

The standard UK-GMEP planning process for a major Tier 3 or Tier 4 project is:

Stage	Action	Lead	Output
1. Strategic identification	Site/project identified through SGOA, existing cluster or promoter proposal	Programme Office / regional body	Initial strategic fit assessment
2. GMEP triage	Project assessed for scale, strategic value and likely planning route	Programme Office	Tier and planning-route designation
3. Planning lead appointed	Named local/strategic authority planning coordinator assigned	Planning authority	Single planning contact
4. Multi-agency inception meeting	Planning, energy, water, environment, transport and infrastructure bodies convened	Planning lead	Agreed project dependencies
5. Planning Delivery Plan	Evidence requirements, consultation requirements and timetable agreed	Planning authority / applicant	Written delivery plan
6. Site and alternatives assessment	Proposed location tested against strategic spatial evidence and realistic alternatives	Applicant	Site-selection case
7. Infrastructure confirmation	Heat, electricity, water, transport and other requirements tested	Relevant infrastructure bodies	Infrastructure feasibility position
8. Pre-application design	Environmental, landscape, drainage, transport and	Applicant / authority	Mature application design

	community issues addressed before submission		
9. Community engagement	Appropriate early consultation undertaken for significant projects	Applicant / local authority	Consultation record and design response
10. Application validation	Complete application checked against agreed evidence schedule	Planning authority	Valid application
11. Coordinated assessment	Statutory and infrastructure consultation proceeds in parallel	Planning authority	Consolidated assessment
12. Resolution of issues	Material concerns addressed through redesign, mitigation, conditions or obligations where appropriate	Applicant / authority	Final planning package
13. Determination	Decision made by competent planning authority	Planning authority	Permission/refusal
14. Conditions and infrastructure close	Planning conditions, funding, land and infrastructure agreements finalised	Project partners	Project ready for financial close
15. Construction and compliance	Development delivered against approved plans and relevant conditions	Developer / authority	Operational infrastructure

The Programme Office remains involved throughout where unresolved dependencies threaten the strategic project. It does not direct the planning authority's statutory decision.

13.14 Target planning timetable

UK-GMEP does not create alternative statutory determination periods. It establishes programme service expectations around the existing legal planning process. For qualifying strategic projects, the objective is to resolve the major foreseeable planning and infrastructure issues during pre-application so that formal determination is not used as the stage at which fundamental problems are first discovered.

The Planning Delivery Plan sets a project-specific timetable, with the default expectation that a complete major application proceeds to determination within the applicable statutory period or an agreed extension where the complexity of the project genuinely requires it. Performance monitoring focuses not only on the

duration between validation and decision, but on the total period from entry into the Strategic GMEP Planning Route to an investable planning outcome. This avoids creating an artificial improvement in reported planning speed simply by extending the pre-application period indefinitely.

13.15 Worked example: greenhouse–data centre co-location

A developer proposes a new data centre in a Strategic Greenhouse Opportunity Area. Spatial analysis identifies suitable adjoining land, strong transport access and the potential for residual heat recovery.

The regional GMEP partnership brings the data-centre developer, greenhouse investors, planning authority, DNO, heat-network developer and water company together before either development is fully designed.

The data centre proceeds as a commercially independent development, while provision is incorporated for technically and economically viable heat recovery. A 20 ha greenhouse cluster is then designed around the available heat profile, with thermal storage and supplementary heating incorporated where necessary.

The greenhouse planning application demonstrates the productive capacity created, the long-term heat arrangement, water strategy, traffic impacts, environmental effects and the infrastructure linking the two developments.

The planning authority assesses the greenhouse on its full merits. The residual-heat benefit receives positive weight because it is evidenced through technically credible infrastructure and commercial arrangements, rather than being a speculative future possibility.

The key benefit of UK-GMEP intervention occurs before the planning application: the Programme identifies the opportunity and coordinates infrastructure early enough for both developments to be designed around it.

13.16 Delivery responsibility

Defra owns the greenhouse spatial strategy and national food-production evidence. MHCLG owns national planning policy and Planning Practice Guidance in England. Strategic Planning Authorities and local planning authorities incorporate the evidence into plan-making and retain responsibility for statutory planning decisions.

The Defra Land Use Unit provides the wider spatial framework through which food-production priorities are considered alongside water, nature, climate, housing and infrastructure. NISTA and the relevant strategic infrastructure processes provide the connection to wider national infrastructure planning, while DESNZ and NESO provide the energy-system interface.

Regional GMEP Delivery Partnerships coordinate projects where multiple infrastructure systems are involved, and the UK-GMEP Programme Office provides escalation where dependencies cross organisational boundaries.

Equivalent governance arrangements are agreed with the devolved governments rather than applying England's planning architecture across the UK.

13.17 Success criteria

The purpose of the planning reform is not simply to reduce the number of weeks required to determine an application. Its success is measured by whether planning becomes more predictable, strategically informed and capable of coordinating infrastructure before investment decisions are locked in.

By Year 2, national greenhouse planning guidance, the standard appraisal framework and the first Strategic Greenhouse Opportunity Areas should be operational. By Year 5, major Tier 3 and Tier 4 projects should routinely use the coordinated planning route, with strategic greenhouse evidence incorporated into relevant regional spatial planning.

By Year 10, greenhouse development should increasingly be anticipated through spatial and infrastructure planning rather than treated as an isolated agricultural application arriving late in the development process.

The intended transition is therefore from:

site identified → application submitted → infrastructure problems discovered

to:

strategic opportunity identified → infrastructure coordinated → site tested → project designed → planning decision → financial close.

That change is central to making long-lived greenhouse investment both more deliverable and more resilient.

14. ENERGY TRANSITION AND SYSTEM INTEGRATION

14.1 Purpose

Energy is the largest source of short-term downside risk within UK greenhouse production and one of the principal determinants of long-term investment viability. UK-GMEP therefore treats energy transition as a core infrastructure workstream rather than as a standalone decarbonisation measure.

The objective is to move the sector from a predominantly gas-dependent and site-specific energy model towards a lower-risk, progressively lower-carbon and infrastructure-integrated energy system in which greenhouse businesses have greater certainty over long-term heat and power costs.

The Programme does not prescribe a single technology pathway. Energy solutions are selected according to the thermal characteristics of the greenhouse, crop requirements, site location, grid capacity, available heat sources, whole-life cost, emissions performance and operational resilience.

The central principle is: energy transition must improve commercial resilience as well as carbon performance.

A technically low-carbon solution that creates excessive energy-price volatility, inadequate heat availability or unmanageable grid exposure is not considered a successful greenhouse transition.

14.2 Energy problem definition

Commercial greenhouse production requires substantial and relatively inflexible energy inputs. Energy commonly represents approximately 15–30% of turnover, and during periods of severe price disruption it can exceed 30%, pushing otherwise viable businesses into operating loss.

Unlike many industrial energy users, growers cannot simply reduce production temporarily when energy prices rise. Greenhouse crops remain biologically active and require defined temperature, humidity, ventilation and, in some production systems, lighting conditions. A grower can lower setpoints or alter crop strategy within limits, but aggressive curtailment can cause irreversible losses in yield, quality or crop value.

This creates an unusually asymmetric exposure. Energy costs can rise rapidly, while the ability to reduce demand or pass those costs through to customers is limited. The historic greenhouse energy model has also created substantial gas and CHP lock-in.

Combined heat and power systems became attractive because they could simultaneously generate electricity, recover heat and provide CO₂ for crop enrichment. Under favourable gas and electricity price relationships, this created an efficient and commercially attractive operating model.

The same integration now creates a transition challenge. Heat, electricity and CO₂ provision can all be tied to the same gas-based asset. Replacing the CHP unit therefore does not necessarily mean replacing one technology with another; it can require redesign of the site's complete energy and crop-management system.

Older greenhouse structures add a further constraint. Poorer thermal performance and legacy high-temperature heating systems may make direct transition to lower-temperature heat sources technically or economically difficult without simultaneous improvement of the greenhouse envelope and internal heat-distribution system. Energy transition must therefore be considered as an asset-system transition rather than a fuel switch.

14.3 Strategic objective

By the end of the initial ten-year UK-GMEP period, supported greenhouse businesses will have materially reduced their exposure to volatile fossil-energy markets and increased the proportion of energy supplied through efficient, secure and lower-carbon sources.

The Programme aims to achieve this through four linked outcomes: lower delivered energy intensity, reduced fossil-derived heat intensity, greater diversification of energy supply, and increased integration with wider energy infrastructure.

For supported sites, the Programme targets an average 25% reduction in delivered energy intensity and at least a 50% reduction in fossil-derived heat intensity by Year 10, subject to crop and site-specific baselines. Qualifying low-carbon or recovered heat should supply at least 60% of heat demand across supported heated greenhouse area by the end of the Programme.

These are portfolio-level outcomes rather than universal technology requirements. Individual sites may progress faster or slower depending on technical feasibility and asset condition.

UK-GMEP does not require every supported greenhouse to become fully fossil-free within ten years. It does require every material investment to avoid unnecessary new fossil-fuel lock-in and to demonstrate a credible pathway towards further decarbonisation over the asset's remaining life.

14.4 Energy Transition Plan

Every Tier 2, Tier 3 and Tier 4 project involving a heated greenhouse produces a Greenhouse Energy Transition Plan as part of the investment case. The plan

considers the current and future energy system over a minimum 15-year planning horizon and includes annual heat and electricity demand, peak thermal load, seasonal load profile, required flow temperatures, greenhouse-envelope performance, lighting demand where applicable, existing energy assets, grid capacity, available local heat sources, storage opportunities and future expansion requirements.

It also considers crop requirements and operating strategy. A tomato facility using year-round lighting and CO₂ enrichment cannot be assessed using the same energy assumptions as a seasonally heated salad-crop facility.

The Energy Transition Plan compares credible technology combinations on the basis of:

- whole-life cost;
- delivered energy cost;
- capital cost;
- operating cost;
- carbon intensity;
- price volatility;
- supply reliability;
- infrastructure dependence;
- technology maturity;
- maintainability;
- expected asset life; and
- compatibility with future greenhouse operation.

The Programme therefore evaluates energy systems rather than individual technologies. This allows flexibility in case new technologies emerge.

14.5 Energy efficiency first

The first stage of the transition hierarchy is to reduce avoidable energy demand. Before substantial investment in new heat-generation capacity, projects assess whether cost-effective improvements can be made to the greenhouse envelope and environmental-control system. Relevant measures include improved glazing, thermal screens, air-leakage reduction, climate-control optimisation, improved pipe insulation, more efficient motors and pumps, heat recovery, thermal buffering and improved sensing and control.

This principle is particularly important for heat pumps and lower-temperature heat networks. Supplying a poorly insulated legacy greenhouse with low-carbon heat can require unnecessarily large generation and grid capacity.

However, the Programme does not require every conceivable energy-efficiency measure before supporting heat transition. Investments are assessed on marginal cost and whole-life value rather than through an inflexible “fabric first” rule. The objective is to avoid oversizing expensive energy infrastructure to compensate for economically remediable inefficiency.

14.6 Eligible energy pathways

UK-GMEP supports a technology-neutral portfolio of energy pathways.

14.6.1 Heat networks

Heat networks are prioritised where greenhouse sites or clusters can access a reliable long-term supply at an appropriate temperature and cost. Greenhouses are potentially valuable heat-network customers because they can provide relatively large and predictable seasonal demand. Unlike residential heat networks, greenhouse systems may also be capable of utilising lower-temperature heat, particularly where internal heat-distribution systems are designed appropriately. Projects are assessed against available heat capacity, temperature, connection cost, backup requirements, network reliability, contract duration and expected future heat price.

14.6.2 Industrial residual and waste heat

Residual heat from data centres, industrial processes, energy infrastructure and wastewater treatment is a priority opportunity where technical and spatial conditions align. UK-GMEP supports the infrastructure required to recover, upgrade, transport and store this heat where the whole system is economically and environmentally justified.

Waste heat is not treated as “free heat”. Investment appraisal includes the cost of heat exchangers, heat pumps where required, pipe networks, pumping, thermal storage, backup plant, maintenance and the commercial value placed on the heat by its provider.

A long-term heat-supply arrangement is required before residual heat is relied upon as the principal basis of a Tier 3 or Tier 4 investment.

14.6.3 Heat pumps

Heat pumps are eligible for both individual sites and shared infrastructure. Their suitability depends strongly on source temperature, greenhouse heat-distribution temperature, electricity cost, electrical connection capacity and seasonal performance.

Heat-pump appraisal therefore uses expected seasonal performance rather than headline equipment COP alone. Low-temperature heat sources such as rivers, groundwater, wastewater, industrial cooling systems or ambient air may all be considered where technically and environmentally appropriate.

Heat pumps are particularly attractive where they can be combined with thermal storage and flexible electricity purchasing, reducing exposure to peak electricity prices.

14.6.4 Geothermal heat

Shallow and deep geothermal systems are eligible where the geological resource, drilling risk and heat demand justify investment. Geothermal is particularly suited to cluster-scale development where substantial and predictable heat demand can support the high upfront cost of exploration and drilling.

Early-stage geological and feasibility risk can be supported through the Project Development and Technical Assistance Fund, while successful infrastructure can be financed through Tier 4 where it serves multiple producers.

It is worth noting that the only geothermal greenhouse in the UK, is currently being tested at the University of Lincoln.

14.6.5 Renewable electricity

On-site solar PV and other appropriate renewable-generation systems are eligible where they reduce electricity cost or support wider energy-system integration. However, on-site renewables are not treated as a complete greenhouse energy strategy unless generation profile and demand genuinely align.

Greenhouse electricity demand, particularly where lighting or heat pumps are used, can substantially exceed on-site generation during winter periods. Projects therefore model annual and hourly demand rather than relying on annual generation totals that obscure seasonal mismatch.

Off-site renewable electricity procured through long-term power-purchase arrangements can also form part of the energy strategy.

14.6.6 Bioenergy and anaerobic digestion

Appropriate bioenergy and anaerobic-digestion systems can form part of the transition where feedstock is sustainable, local and demonstrably available over the investment period. Projects must account for lifecycle emissions, feedstock competition, transport, air-quality impacts and the opportunity cost of alternative feedstock uses.

UK-GMEP does not assume that bioenergy can scale universally across the greenhouse sector. It is treated as a site-specific option rather than a default pathway.

14.6.7 Thermal storage

Thermal storage is treated as an enabling technology rather than merely an efficiency measure. Buffer tanks and larger thermal stores can separate the timing of heat generation from greenhouse heat demand, improving heat-pump utilisation, allowing waste heat to be captured when available and reducing exposure to peak electricity prices. For large integrated sites, storage capacity is considered during initial system design rather than added retrospectively.

14.6.8 Local energy systems

Tier 4 projects can combine greenhouse demand with local generation, storage, heat networks and other users through appropriately structured local energy systems. These configurations may include several greenhouse businesses and adjacent industrial or public-sector assets.

The central requirement is that the arrangement has a credible physical, contractual and financial structure. UK-GMEP does not fund nominal “energy communities” without demonstrable infrastructure integration.

14.7 Hybrid systems

Hybrid energy systems are expected to play a substantial role during the transition period. For many existing greenhouse sites, immediate removal of all combustion-based backup capacity would be technically or economically inappropriate. A combination of heat pumps, recovered heat, thermal storage and limited peak or emergency backup may produce better whole-system resilience than oversizing low-carbon infrastructure to meet a small number of extreme winter hours. UK-GMEP therefore distinguishes between routine fossil-energy dependence and resilience backup.

A hybrid project can retain limited fossil-based backup where it demonstrates that this reduces whole-system cost or improves security without materially undermining the site's decarbonisation pathway. The investment case must quantify expected annual fossil-energy use and show that backup capacity is not being used to avoid economically viable transition.

New CHP investment receives heightened scrutiny because of the risk of locking sites into gas dependence for another asset cycle. Support is provided only where there are a compelling transitional case and a credible pathway for conversion or retirement.

14.8 CHP transition

Existing CHP requires a specific transition pathway because it currently performs several functions simultaneously.

UK-GMEP requires CHP-dependent businesses to identify separately how they will meet future requirements for heat, electricity and CO₂ enrichment. Electricity may transition towards grid supply, renewables or long-term PPAs. Heat may transition towards recovered heat, heat pumps, geothermal or network supply. CO₂ may require alternative sources, recovery technologies or changes in crop-management strategy [24].

This unbundling is important because replacing only the heat function while leaving unresolved dependence on CHP-derived CO₂ can prevent genuine transition. Existing CHP assets are not required to be retired before the end of their technically useful life where early retirement would represent poor value for money. However, major publicly supported refurbishment of CHP systems must demonstrate why investment is preferable to an alternative transition pathway.

14.9 CO₂ supply

CO₂ enrichment is a material component of high-productivity greenhouse production for several major crops and must be incorporated into energy-transition planning. Historically, CHP and boiler exhaust have provided a convenient source of CO₂. As combustion-based systems decline, alternative supply pathways become increasingly important.

Eligible options include appropriate recovered biogenic or industrial CO₂, purified CO₂ supplied through commercial networks, and emerging capture and utilisation systems where quality requirements can be met.

CO₂ used in food production must satisfy relevant purity and safety requirements. UK-GMEP does not count the use of externally supplied CO₂ automatically as a carbon-removal measure. Carbon accounting distinguishes between temporary utilisation in crop production and permanent sequestration.

14.10 Grid and electricity requirements

Electrification can materially increase greenhouse electricity demand. A major heat-pump installation or expansion of LED lighting can require substantial connection capacity, and grid constraints can therefore make an otherwise viable decarbonisation project undeliverable.

Tier 3 and Tier 4 projects consequently obtain an early electricity-capacity assessment before financial approval. DESNZ, NESO and relevant network operators use the strategic project pipeline to identify areas where multiple prospective greenhouse investments create a material future load.

Where several projects are geographically concentrated, UK-GMEP evaluates whether coordinated network reinforcement or shared infrastructure represents better value than sequential individual connections.

The Programme also encourages technically appropriate flexibility. Thermal storage, batteries and controllable loads may allow some demand to shift away from constrained periods, but flexibility assumptions must reflect crop biology. A greenhouse cannot be treated as an indefinitely interruptible industrial load.

14.11 Recognition of greenhouse load characteristics

Greenhouse energy policy must recognise the distinction between *flexible and biologically essential demand*. Some greenhouse loads can be shifted. Thermal storage may allow heat generation to move between hours; batteries can alter grid-import profiles; lighting schedules can sometimes be adjusted within biological limits; and CO₂ enrichment can be optimised.

Other demand is much less flexible. Minimum crop temperatures, frost protection, humidity control and critical photoperiod requirements cannot be curtailed indefinitely without crop damage.

Energy-system planning and tariff design should therefore avoid assuming that greenhouse businesses can provide the same demand-response characteristics as conventional industrial processes. Where growers provide genuine flexibility services, those services should be measured and valued separately from their underlying essential demand.

14.12 Energy contracts

Capital investment is undermined if a greenhouse connects to a low-carbon energy system but has no credible visibility over future energy prices. Tier 3 and Tier 4 energy investments therefore require contracts appropriate to the expected financing period.

For heat networks and residual-heat systems, contracts normally define heat volume, availability, temperature, indexation, service standards, outage arrangements, backup responsibility and termination provisions.

Where infrastructure is financed over 15–30 years, contracts need sufficient duration or renewal certainty to support the underlying investment. UK-GMEP does not prescribe one pricing formula. However, energy contracts supported by the Programme must avoid transferring unmanageable one-sided risk to growers.

For example, a waste-heat contract indexed entirely to wholesale gas prices would provide limited protection from the volatility the project was intended to remove.

14.13 Power purchase arrangements

Long-term electricity procurement can form part of the energy-risk strategy for electricity-intensive greenhouse businesses. Corporate or aggregated PPAs may allow growers to procure a proportion of electricity at a more predictable price over multiple years.

Where individual businesses lack sufficient scale or credit quality, UK-GMEP can facilitate aggregation or explore appropriate guarantee mechanisms within the Finance Facility. The Programme does not guarantee electricity prices generally.

Support is targeted at overcoming specific credit or contracting barriers where long-term renewable procurement materially improves project investability.

14.14 Energy infrastructure finance

Energy-transition investment is financed according to asset ownership and public value. Energy equipment located within and serving a single greenhouse normally falls within Tier 1, 2 or 3 support.

Shared infrastructure such as heat networks, geothermal assets, major thermal storage, shared electricity connections or water-energy systems is financed through Tier 4, with public capital support of up to 40% of eligible shared-infrastructure cost where justified.

The remainder can be provided by infrastructure investors, energy-service companies, the National Wealth Fund, commercial lenders, growers or other project partners. Where possible, energy infrastructure is financed separately from the greenhouse operating business. This can reduce pressure on grower balance sheets and align the financing term more closely with the life of the infrastructure.

Energy-as-a-service, heat-as-a-service and special-purpose vehicle structures are eligible where they provide transparent costs and appropriate risk allocation.

14.15 Regulatory treatment

UK-GMEP does not create a separate energy-regulation regime for greenhouse horticulture. It works within existing electricity and heat-market structures while correcting barriers that prevent greenhouse projects from participating effectively. The regulatory workstream covers four areas:

1. First, government recognises qualifying commercial greenhouse production as strategically important, energy-intensive food-production infrastructure for the purposes of relevant future support and infrastructure-planning decisions. This does not automatically give growers access to every scheme available to conventional energy-intensive industry; eligibility remains subject to the rules of the relevant scheme.
2. Second, strategic greenhouse demand is incorporated into energy-network and spatial-infrastructure planning where the scale and maturity of the project pipeline justify it.
3. Third, heat-network rules and guidance should accommodate commercial horticultural users whose heat profiles and contractual requirements differ from domestic consumers.
4. Fourth, grid-connection and reinforcement decisions should consider coordinated cluster development rather than treating each greenhouse connection in isolation where a shared solution is demonstrably more efficient.

Any regulatory change is developed jointly by Defra, DESNZ and the appropriate regulator or system body rather than through unilateral sector exemption.

14.16 Emissions accounting

UK-GMEP establishes a standard greenhouse-energy and carbon accounting methodology for supported projects. At minimum, projects report annual delivered electricity, gaseous and liquid fuels, imported heat, exported energy where relevant, and the associated greenhouse-gas emissions.

Performance is reported both in absolute terms and normalised against productive area and appropriate crop-specific measures of saleable output. The methodology should allow output to be expressed using the most relevant physical and economic measures for the crop concerned, rather than relying on a single cross-sector measure such as kilograms per hectare. This is necessary because a modern greenhouse may increase total energy consumption while also producing substantially more food or extending domestic production into additional months.

For recovered heat, the accounting methodology clearly defines how emissions are attributed between the heat source and the greenhouse user to avoid double counting. For grid electricity, an agreed government emissions factor is used consistently. For PPAs or other contractual renewable-electricity arrangements, reporting distinguishes between physical energy consumption and contractual renewable attributes where appropriate.

Projects are evaluated primarily on real reductions in energy exposure and emissions intensity, not solely on accounting classifications.

14.17 Site typology

The transition pathway differs substantially according to the condition and location of the existing asset. UK-GMEP therefore applies four energy-site typologies.

Site type	Primary energy strategy	Typical UK-GMEP approach
A. Legacy / constrained site	Reduce demand, avoid stranded investment, determine whether replacement is preferable	Limited retrofit, efficiency, transitional hybrid systems; replacement assessment
B. Modern retrofit-capable site	Deep energy transition while retaining core greenhouse structure	Heat pumps, recovered heat, storage, grid reinforcement, envelope upgrades
C. New-build site	Design low-carbon and resilient energy system from outset	Low-temperature heating, efficient envelope, storage, renewable/recovered heat, future-ready grid

D. Strategic cluster site	Integrate food production with shared regional infrastructure	Heat network, waste heat, geothermal, shared storage, grid/water infrastructure, SPV ownership
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Type A: Legacy and constrained sites

These sites include older greenhouses with poor thermal performance, limited structural capability, high-temperature heat distribution or difficult grid access. The Programme avoids investing heavily in energy systems that extend the life of fundamentally obsolete infrastructure without a credible long-term case. Shorter-payback efficiency measures and transitional hybrid systems may be supported while the business develops a replacement or relocation pathway.

Type B: Modern retrofit-capable sites

These sites have structures with sufficient remaining life to justify substantial energy investment. Typical projects can combine envelope improvements, heat pumps, thermal storage, residual-heat connections, grid upgrades and improved climate control. Investment is designed around the expected remaining life of the greenhouse structure.

Type C: New-build sites

New greenhouse developments are designed around future energy requirements from the outset. They should minimise avoidable heat loss, support lower-temperature heat distribution, provide adequate space for energy equipment and thermal storage, and avoid unnecessary reliance on a single volatile fuel source. Energy, water and electrical infrastructure are considered before the greenhouse design is finalised.

Type D: Strategic cluster sites

Cluster sites provide the greatest opportunity for infrastructure integration. Multiple growers or greenhouse units can share heat sources, energy centres, thermal storage, water systems and network connections. The energy infrastructure can be separately financed and owned, allowing long-term infrastructure investors to participate without taking direct crop-production risk.

14.18 Energy decision framework

Every major project follows a common energy hierarchy:

- 1) Reduce economically avoidable demand.
- 2) Identify locally available heat and energy resources.
- 3) Assess opportunities for shared infrastructure.
- 4) Determine technically credible electrification and low-carbon heat options.
- 5) Incorporate storage and flexibility where economically justified.
- 6) Define backup and resilience requirements.
- 7) Secure credible long-term energy contracts.
- 8) Test the system against energy-price and outage scenarios.
- 9) Assess whole-life cost and emissions.

- 10) Confirm that the proposed system does not create unnecessary long-term lock-in.

A Tier 3 or Tier 4 project cannot reach final investment approval until this assessment is complete.

14.19 Stress testing

Major projects are stress-tested against plausible adverse energy conditions before public finance is committed. The financial model examines sensitivity to electricity and fuel prices, changes in heat-source availability, lower-than-expected heat-pump performance, network-charge changes and temporary loss of the primary heat source.

The objective is not to predict future energy prices accurately. It is to determine whether a project remains operationally and financially resilient under credible adverse scenarios.

Where failure of one third-party heat supplier would threaten an entire crop, the project must demonstrate adequate redundancy, storage or backup. This introduces the same level of energy-risk discipline expected in other major infrastructure investments.

14.20 Worked example: existing 10 ha gas/CHP site

A 10 ha tomato greenhouse currently uses CHP and gas boilers for heat, on-site electricity and CO₂ enrichment. The greenhouse structure has sufficient remaining life for a 20-year energy investment, but its heating system requires relatively high flow temperatures.

The UK-GMEP Energy Transition Plan first identifies envelope and screen improvements capable of reducing peak heat demand. The project then assesses a nearby wastewater-treatment plant as a source of low-grade heat.

Heat pumps upgrade the recovered heat to the required temperature, while a large thermal store allows the system to operate more consistently and reduce electricity use during peak-price periods.

Existing boilers are retained initially as peak and emergency backup rather than being used for routine baseload heating. CHP operating hours are progressively reduced. Electricity is supplied through a combination of grid power and a multi-year renewable procurement arrangement.

The greenhouse also develops an alternative CO₂ supply strategy so that reduction in CHP operation does not unintentionally reduce crop productivity. The project is financed as a Tier 3 greenhouse retrofit, while any shared heat infrastructure

between the wastewater site and additional users can be assessed separately through Tier 4.

The investment case is approved only after the heat agreement, electrical connection, backup strategy and long-term CO₂ pathway are sufficiently developed.

14.21 Worked example: new regional cluster

A Regional GMEP Delivery Partnership identifies a location suitable for approximately 30 ha of new greenhouse development adjacent to an industrial heat source. Instead of each grower installing an independent heating plant, the Partnership develops a shared energy centre and heat network. An infrastructure SPV owns the heat-recovery equipment, network, thermal storage and backup system. Growers purchase heat under long-term contracts and finance their greenhouse structures separately.

The shared infrastructure receives Tier 4 support because its benefits extend across multiple businesses, while individual greenhouse assets are assessed under Tier 3. NESO and the relevant network operator assess future electricity demand at cluster level, avoiding repeated individual connection applications where coordinated reinforcement is more efficient.

The result is a separation between food-production risk and infrastructure risk: growers remain responsible for crop and commercial performance, while professional infrastructure operators own and manage the long-lived energy system.

14.22 Delivery responsibilities

DESNZ is accountable for the UK-GMEP energy-system workstream, working jointly with Defra on sector requirements. NESO provides strategic energy-system input, while relevant network operators deliver electricity connections and reinforcement within their regulated functions.

The UK-GMEP Programme Office maintains the national greenhouse-energy project pipeline and identifies concentrations of future demand that require coordinated infrastructure planning. The National Wealth Fund and other infrastructure investors participate in major shared infrastructure where the project meets their investment criteria. The British Business Bank and commercial lenders support qualifying business-level energy investments.

The Environment Agency, water companies, local authorities and other bodies participate where energy systems depend upon wastewater, water bodies, geothermal resources or other regulated environmental assets.

The precise regulatory role of independent bodies remains separate from programme delivery. UK-GMEP coordination does not override statutory energy, planning or environmental decisions.

14.23 Programme targets

Energy performance is measured against the verified Year 1 baseline. By Year 3, all Tier 2–4 supported heated projects should operate under the common energy-accounting methodology, and the first strategic heat and energy-integration projects should be operational or under construction.

By Year 5, supported sites should demonstrate an average reduction of at least 20% in delivered energy intensity, with at least 35% of heat demand across supported heated area supplied from qualifying low-carbon or recovered sources.

By Year 10, the programme target is an average reduction of at least 25% in delivered energy intensity, at least 50% reduction in fossil-derived heat intensity, and at least 60% of heat supplied from qualifying low-carbon or recovered sources across supported heated greenhouse area.

These portfolio targets are accompanied by a reduction in the number of supported businesses whose commercial viability remains critically dependent on a single volatile energy source.

The final measure of success is therefore broader than carbon reduction. UK-GMEP succeeds when energy moves from being one of the sector's principal sources of systemic vulnerability to becoming a planned, financeable and increasingly integrated component of greenhouse infrastructure.

15. WORKFORCE, MIGRATION, AND SKILLS

15.1 Purpose

UK-GMEP treats workforce capacity as a core infrastructure requirement rather than as a separate labour-market issue. Greenhouse production is labour intensive, and even highly automated businesses continue to depend on large numbers of people for harvesting, crop handling, packing, crop management, supervision, maintenance and technical operation. At the same time, modernisation is changing the composition of labour demand by increasing the need for engineers, technicians, automation specialists, data-literate growers and energy-system expertise.

The Programme therefore addresses two linked challenges: *ensuring sufficient access to operational labour and building the higher-level technical skills required by a modern controlled-environment horticulture sector.*

The objective is not simply to increase labour supply. It is to create a workforce system that is more stable, more skilled, less exposed to recurrent shortages and better aligned with the long-term investment cycle of greenhouse infrastructure.

15.2 Workforce problem definition

Labour is the largest recurring cost for many greenhouse businesses, typically accounting for around 25–45% of turnover depending on scale, crop and level of automation. Vacancy rates of approximately 10–20% have been reported across the sector, and severe labour shortages can contribute to crop losses of up to 15% through delayed harvesting, reduced planting, quality loss or inability to complete labour-intensive crop operations [20].

The sector also remains heavily dependent on migrant labour. In many larger businesses, non-UK nationals make up a substantial proportion of the operational workforce. This reflects the seasonal and repetitive nature of many roles, the geographic location of production sites and the difficulty of recruiting sufficient domestic labour at the required scale and timing.

However, the greenhouse labour requirement is not purely seasonal. Many protected crops are produced over long cycles, and some businesses require labour for nine to twelve months of the year. This creates a mismatch between year-round production systems and migration arrangements designed principally around shorter seasonal peaks.

At the same time, modernisation is creating a second workforce constraint. Advanced greenhouse systems require specialist skills in electrical and mechanical engineering, environmental control, irrigation, energy systems, automation, robotics, sensors, data analysis and digital crop management. Vacancy rates in some technical and engineering roles are estimated at around 15–25%.

Automation will reduce some manual labour requirements, but it will not eliminate workforce dependency. It frequently shifts labour demand from repetitive tasks towards higher-skilled technical, maintenance and supervisory roles.

The workforce challenge is therefore both quantitative and qualitative: the sector needs enough people, but it also needs a different skills mix.

15.3 Strategic objective

By Year 10, UK-GMEP will establish a workforce and skills system capable of supporting a larger, more automated and more technically sophisticated greenhouse sector.

The Programme aims to reduce persistent general vacancies among participating businesses by approximately 50% relative to the Year 1 baseline, with technical and engineering vacancies reduced by around 40%.

At the same time, the share of workforce demand met through structured domestic training, apprenticeships, progression pathways and improved retention should increase, while migration routes remain available where domestic supply cannot meet genuine sector need.

The long-term objective is not zero reliance on migrant labour. It is a more balanced workforce model in which immigration policy, domestic recruitment, training, automation and career development operate as complementary rather than competing mechanisms.

15.4 National workforce baseline

During Year 1, Defra and DWP establish a *Protected Horticulture Workforce Baseline* covering greenhouse food production. This records workforce size, employment type, seasonality, nationality, vacancy rates, turnover, recruitment lead times, pay ranges, accommodation requirements where relevant, use of the Seasonal Worker route, technical vacancies and known skills shortages.

The baseline also distinguishes between operational roles and specialist technical roles so that policy responses are targeted appropriately. The data are aggregated to protect commercially sensitive information, but they provide government with a consistent evidence base for migration, skills and investment decisions.

15.5 Migration policy

The Home Office retains responsibility for immigration policy, but UK-GMEP provides the sector evidence required to align migration routes with actual production needs. The Seasonal Worker route remains an important component of workforce supply for labour-intensive crop operations [31]. However, UK-GMEP recognises that protected horticulture often requires longer and more continuous employment than open-field seasonal production.

Defra therefore provides the Home Office with an annual evidence-based assessment of protected-horticulture labour demand, including the timing, duration and regional distribution of unmet need. Where evidence demonstrates that current visa duration or eligibility rules materially constrain otherwise viable year-round greenhouse production, the Programme provides a formal route for policy review [31]. This does not create an automatic entitlement to additional migration. It creates a standing evidence mechanism rather than relying on ad hoc representations after shortages have already affected production.

15.6 Domestic recruitment and retention

UK-GMEP does not assume that migration alone can solve greenhouse labour shortages. Participating businesses are expected to demonstrate active domestic recruitment and retention strategies proportionate to project size.

These can include improved job design, clearer progression, predictable working patterns, transport solutions, childcare-compatible shift design where feasible, better workforce accommodation where provided, and stronger links with local employment services.

Regional GMEP Delivery Partnerships work with DWP, local authorities and employment providers to identify labour pools within practical commuting distance of major greenhouse clusters. Where transport is a barrier, regional delivery plans can include coordinated workforce transport or links with existing public transport rather than assuming that every worker has private access to a car.

Retention is measured alongside recruitment because repeatedly filling the same vacancies does not represent a sustainable workforce solution.

15.7 Skills England and technical skills pathways

Skills England leads development of a Protected Horticulture Skills Framework for England [32]. The framework defines current and future occupational requirements across:

- crop production and greenhouse management;
- climate and environmental control;
- irrigation and fertigation;
- electrical and mechanical engineering;

- heating and energy systems;
- heat pumps and heat networks;
- automation and robotics;
- sensors and digital systems;
- data analysis and AI-supported production;
- maintenance and technical troubleshooting;
- packhouse and cold-chain systems; and
- supervisory and management roles.

These requirements are translated into apprenticeship standards, FE provision, technical qualifications and employer-led short courses. The framework is reviewed regularly as technology changes, rather than locking the sector into a static list of occupations.

15.8 Regional skills delivery

Skills provision is delivered regionally around existing and planned greenhouse clusters. Where a Tier 3 or Tier 4 project creates significant new employment demand, the investment case includes a workforce and skills plan developed with the relevant regional authority, Skills England, FE providers, universities/colleges and major employers.

This ensures that training capacity develops before or alongside infrastructure construction rather than after new facilities become operational. Regional provision should be practical and employer-linked. Courses should include direct exposure to commercial greenhouse systems, energy centres, automation, sensors and environmental-control equipment rather than relying solely on classroom delivery. Where several growers share similar skills requirements, UK-GMEP supports pooled training provision and shared technical apprenticeships.

Good examples of this approach are Thanet Earth and Hadlow College in Kent.

15.9 Apprenticeships and career pathways

The Programme establishes clearer progression routes into protected horticulture. A typical pathway can progress from entry-level crop and packhouse roles into skilled crop technician, irrigation technician, automation technician, engineering, supervisory and production-management roles.

Apprenticeships are particularly important for engineering and technical occupations because greenhouse businesses often require hybrid skillsets spanning horticulture, mechanical systems, electrical systems and digital control.

UK-GMEP therefore works with employers and training providers to develop qualifications that reflect the integrated nature of modern greenhouse operations rather than treating each skill as an isolated discipline. The Programme also

supports conversion and upskilling pathways for workers already employed in the sector who need to operate new technology introduced through GMEP investment.

15.10 Higher education and specialist capability

Universities and specialist training organisations including colleges contribute where skills requirements exceed standard vocational provision. Relevant areas include advanced crop physiology, controlled-environment management, energy-system optimisation, data science, robotics, AI, engineering and management of complex integrated production systems.

Major regional clusters can establish formal partnerships with nearby universities and colleges to provide higher-level training, placements, applied research and professional development.

The objective is not to require degrees for roles that do not need them, but to ensure that the sector has access to the specialist scientific and technical capability required by increasingly sophisticated infrastructure.

15.11 Automation and labour productivity

UK-GMEP treats automation as part of workforce planning, but not as a substitute for workforce policy. Automation can reduce labour demand in repetitive activities such as grading, handling, transport and selected harvesting operations. It can also improve productivity, consistency and worker safety.

However, current automation does not remove the biological complexity of crop production, and many tasks remain difficult to automate reliably across crops and production systems. Major automation investments therefore include a workforce impact assessment covering expected labour savings, technical roles created, training requirements and operational dependencies.

Projects should not justify automation solely on headline reductions in labour numbers. The investment case should demonstrate how technology changes labour productivity and skills demand over the full operating system.

15.12 Workforce requirements for GMEP investment

All major Tier 3 and Tier 4 projects include a formal workforce assessment before financial close. The assessment sets out expected employment during construction and operation, seasonal peaks, technical requirements, recruitment assumptions, migration dependency, training needs and the likely effect of automation. Projects that rely on labour assumptions that are demonstrably unrealistic are not considered fully investable.

This is important because a greenhouse can be technically complete but commercially unusable if sufficient labour cannot be recruited at the required time.

Workforce planning is therefore treated in the same way as energy, water and grid capacity: as an enabling infrastructure requirement.

15.13 Small-grower access

Smaller growers frequently lack the scale to run dedicated training teams or apprenticeships independently. UK-GMEP therefore supports shared workforce mechanisms through cooperatives, producer organisations and regional clusters. These can include pooled apprenticeship programmes, shared technical specialists, mobile engineering support, joint training days and regional recruitment partnerships. This allows smaller businesses to access specialist capability without each having to employ a full internal technical team.

15.14 Workforce quality and productivity

The Programme does not define success simply as filling vacancies. Participating businesses are encouraged to improve job quality, progression and retention because a high-turnover workforce imposes training and productivity costs on the business itself.

The monitoring framework therefore tracks vacancy rates, retention, employee turnover, recruitment lead times, progression into skilled roles and crop losses attributable to labour shortages.

Where possible, productivity is measured alongside workforce numbers so that a reduction in labour demand caused by improved technology is distinguished from reduced employment caused by contraction in production.

15.15 Worked example: major new greenhouse development

A 20 ha Tier 3 greenhouse development is expected to require 300 operational staff at peak production alongside 25 specialist technical and supervisory roles. Before financial approval, the developer prepares a workforce plan showing existing labour availability within the travel-to-work area, expected domestic recruitment, migration requirements, transport arrangements and the training pathway for engineering and automation roles.

The Regional GMEP Delivery Partnership works with DWP and local employment services to recruit locally, while Skills England commissions relevant technical provision through nearby FE institutions.

The business also establishes apprenticeships in greenhouse engineering and environmental control, with specialist training supported by a local university. Seasonal Worker demand is then quantified against the residual labour gap rather than assumed at the outset.

By the time construction is complete, the workforce pipeline is already operating. This avoids the common sequence in which a facility is built first and its labour requirements addressed only immediately before production begins.

15.16 Worked example: existing grower automating harvest and handling

A 4 ha Tier 2 grower invests in automated crop transport, grading and digital production control. The investment is expected to reduce routine labour demand but creates new requirements for maintenance, sensors and data interpretation.

The GMEP investment case therefore includes both the capital technology assessment and a workforce transition plan. Existing staff receive training to move into higher-skilled operational roles, while the grower accesses a regional shared engineering apprenticeship programme.

The outcome is measured not only through reduced labour cost but through improved productivity, lower vacancy exposure, staff retention and successful operation of the new technology.

15.17 Governance and delivery

Defra owns the greenhouse workforce evidence base and sector requirements. DWP leads domestic workforce and adult-skills policy in England, with Skills England responsible for translating sector needs into occupational standards and training provision.

The Home Office retains responsibility for immigration policy and receives annual evidence from Defra and DWP on protected-horticulture labour requirements. Regional authorities, FE colleges, universities, independent training providers and employers deliver skills provision locally.

The UK-GMEP Programme Office coordinates workforce planning with the investment pipeline so that regions can anticipate labour and skills demand from planned Tier 3 and Tier 4 projects. Equivalent arrangements are led by the devolved governments within Scotland, Wales and Northern Ireland.

15.18 Programme targets

By the end of Year 2, the Protected Horticulture Workforce Baseline and Skills Framework will be operational, with regional workforce plans in place for the first strategic greenhouse clusters.

By Year 5, persistent general vacancies among participating businesses should have reduced by around 30% relative to baseline, while technical vacancy rates should

show a material downward trend. Major supported projects should routinely include workforce and skills plans before construction begins.

By Year 10, the Programme aims to achieve approximately a 50% reduction in persistent general vacancies and around a 40% reduction in technical and engineering vacancies among participating businesses. Crop losses attributable primarily to labour shortages should also decline materially from the Year 1 baseline.

These targets are assessed alongside output and productivity so that apparent vacancy reductions caused by business contraction do not count as success. The ultimate measure of success is whether workforce availability ceases to be a recurring constraint on otherwise viable greenhouse investment. UK-GMEP should leave the sector with a more stable operational workforce, clearer domestic career pathways, more effective use of migration where required, and the technical capability to operate the next generation of greenhouse infrastructure.

16. INNOVATION, DIGITALISATION, AND TECHNOLOGY DEPLOYMENT

16.1 Purpose

UK-GMEP treats innovation as a deployment challenge rather than primarily a research challenge.

The UK greenhouse sector already has access to a wide range of advanced technologies, including high-performance glazing, LED lighting, environmental-control systems, sensors, robotics, automation, digital crop-management platforms, AI-supported decision tools, heat pumps, thermal storage and advanced irrigation systems. The principal constraint is that commercial adoption remains uneven because deployment is capital intensive, technically complex and often difficult to justify within ageing infrastructure and narrow operating margins.

UK-GMEP therefore focuses on accelerating the movement of technologies through the later stages of the innovation pathway:

demonstration → validation → commercial deployment → sector-wide diffusion.

The objective is not to create a permanently grant-supported technology market. It is to reduce the technical, financial and information risks associated with early commercial adoption so that proven technologies can transition into routine private investment.

16.2 Innovation problem definition

Technology availability and technology adoption are not equivalent [21-23]. Many greenhouse technologies already demonstrate strong technical potential, but growers face several barriers when deciding whether to invest. These include high upfront capital cost, uncertainty over payback, limited independent performance evidence, incompatibility with legacy structures, integration difficulties between equipment from different manufacturers, technical-skills shortages and concern that rapidly evolving technology may become obsolete before the investment has been recovered [21-23].

These barriers are amplified by the financial structure of the sector. Businesses operating on narrow margins and carrying significant existing debt have limited capacity to absorb the consequences of a technology that underperforms commercially, even where the potential long-term benefits are substantial.

Older greenhouse infrastructure creates an additional constraint. Robotics, advanced lighting, low-temperature heating, automated crop movement and sophisticated

environmental-control systems may require structural height, electrical capacity, digital connectivity or internal layouts that legacy sites cannot provide efficiently.

Innovation policy therefore needs to address not simply whether a technology works, but whether it can be deployed reliably, integrated with the wider production system and financed at commercial scale.

16.3 Strategic objective

By Year 10, UK-GMEP will establish a greenhouse sector in which commercially proven technologies move rapidly from successful demonstration into routine deployment.

The Programme will increase digital monitoring across supported greenhouse area, accelerate adoption of technologies that demonstrably improve productivity or resilience, and reduce the gap between the most technologically advanced businesses and the wider commercial sector.

UK-GMEP will also establish a stronger evidence base around real-world technology performance so that growers, lenders and government can distinguish between:

- technical feasibility;
- commercial readiness;
- bankability; and
- mature, replicable deployment.

These stages are treated separately because a technology can function technically without yet representing a sound commercial investment.

16.4 Technology readiness and support pathway

UK-GMEP uses a staged technology-deployment pathway.

Stage 1: Research and technical development

Fundamental and early applied research remains primarily within existing research and innovation mechanisms, including UKRI and relevant Research Councils. UK-GMEP does not duplicate this activity.

Stage 2: Commercial-scale demonstration

Technologies with sufficient technical evidence but limited commercial track record can receive support for deployment within operational greenhouse environments. Demonstration projects test performance under real crop, labour, energy and commercial conditions rather than solely within experimental facilities.

Stage 3: Independent validation

Technologies progressing through UK-GMEP are assessed against agreed performance measures. Depending on the technology, these can include crop yield,

product quality, labour productivity, energy use, water consumption, reliability, maintenance requirement and operating cost.

Stage 4: Early commercial deployment

Once a technology has demonstrated credible commercial performance, UK-GMEP can support deployment across a limited number of additional businesses to establish replicability across different sites and operating conditions. These sites will need to be located across the UK, to ensure latitudinal validation.

Stage 5: Mainstream diffusion

Once technical and commercial risk is sufficiently understood, the technology moves into normal Tier 1–3 infrastructure investment. At this stage, dedicated innovation subsidy declines or ends.

This progression prevents UK-GMEP from repeatedly funding the same mature technology under the label of innovation.

16.5 Eligible technology areas

UK-GMEP supports technologies that make a measurable contribution to productivity, resilience, resource efficiency, workforce productivity or environmental performance.

Priority areas include advanced greenhouse structures and materials, glazing and coatings, thermal screens, LED and hybrid lighting, environmental-control systems, irrigation and fertigation, water recycling, sensors, machine vision, robotics, automated crop handling, digital twins, AI-supported crop management, predictive maintenance, energy optimisation and integrated control of heat, power, lighting and crop environment.

Technologies associated with energy transition are coordinated with Section 14 rather than assessed independently. Similarly, automation projects with substantial workforce implications must include the workforce transition requirements set out in Section 15.

Technology eligibility remains outcome-based rather than supplier-led. UK-GMEP does not maintain a permanent list of preferred manufacturers or proprietary systems.

16.6 Commercial demonstration programme

Innovate UK, working with the UK-GMEP Programme Office, operates a Commercial Greenhouse Demonstration Programme. This programme is specifically designed for technologies that have progressed beyond laboratory or small pilot testing but lack sufficient commercial evidence for widespread grower or lender confidence.

Demonstration projects take place wherever possible within operating commercial greenhouse businesses. Projects must have a defined technical hypothesis, commercial use case, measurement protocol, independent evaluation route and credible pathway to wider deployment.

A demonstration is not considered successful simply because the technology operates. It must demonstrate whether the technology produces sufficient measurable value under commercial conditions to justify further adoption.

Demonstration support is time limited, and repeated funding for substantially unchanged technology is avoided unless new evidence or application conditions justify additional testing.

16.7 Independent technology validation

A central weakness in technology adoption is the difficulty growers face in comparing performance claims made using different experimental designs, crops, production systems and commercial assumptions.

UK-GMEP therefore establishes a *Greenhouse Technology Validation Framework*.

The framework provides standard principles for measuring technology performance while allowing crop- and technology-specific metrics.

Evaluation can include:

- yield per square metre;
- saleable yield;
- product quality;
- energy use per square metre;
- energy use per appropriate unit of saleable crop output;
- water use;
- labour hours per unit output;
- capital cost;
- operating cost;
- maintenance requirement;
- technology availability and downtime;
- expected payback;
- interaction with other systems; and
- whole-life performance.

Independent validation is undertaken by appropriately qualified organisations without a direct financial interest in the technology being evaluated. Technology suppliers can provide technical data and support but do not control final performance assessment.

16.8 Commercial performance database

Validated results from publicly supported projects feed into a *UK-GMEP Technology Evidence Base*. Commercially confidential information is protected, but sufficiently aggregated performance information is made available to growers, investors and programme decision-makers.

The purpose is to reduce repeated duplication of due diligence. If a particular technology has already been independently demonstrated across several commercial sites, each subsequent grower should not have to treat it as an entirely unknown investment.

The evidence base therefore helps move technologies progressively from high-risk innovation finance towards standard commercial finance. It also allows government to identify technologies that repeatedly fail to deliver their stated commercial benefits and prevent continued public subsidy of underperforming approaches.

16.9 Digital greenhouse standard

Digitalisation is treated as enabling infrastructure across UK-GMEP. All significant Tier 2–4 projects are expected to incorporate sufficient digital monitoring to measure the performance outcomes relevant to the investment.

A *UK-GMEP Digital Greenhouse Standard* establishes a minimum common data architecture covering, where relevant:

- internal and external climate;
- temperature and humidity;
- energy consumption;
- heat source;
- electricity demand;
- water use;
- irrigation and fertigation;
- crop production;
- lighting;
- equipment performance; and
- agreed workforce or productivity metrics.

The standard does not require every grower to use the same software platform. It defines common data fields, measurement principles and interoperability requirements, allowing different commercial systems to operate while producing comparable core information. This reduces technology lock-in and supports benchmarking across the Programme.

16.10 Interoperability and open standards

Technology integration is increasingly important as greenhouse businesses adopt equipment from multiple manufacturers. UK-GMEP therefore favours systems

capable of exchanging relevant data through documented interfaces and industry-standard protocols where technically practical.

Public support should not unnecessarily lock a grower into a single proprietary technology ecosystem for the entire lifetime of the greenhouse. For major supported investments, applicants demonstrate how core systems such as climate control, lighting, irrigation, energy management, sensors and automation can exchange the information required for effective operation.

This does not require manufacturers to disclose commercially sensitive intellectual property. It requires sufficient interoperability to allow the greenhouse asset to remain adaptable over a 20–40-year operating period despite much shorter technology replacement cycles.

16.11 Data ownership and commercial confidentiality

Data generated within a commercial greenhouse remains principally the commercial asset of the business that generates it, subject to contractual arrangements with technology providers. Receipt of UK-GMEP support does not transfer unrestricted commercial data ownership to government.

However, recipients agree to provide the specific information required for programme monitoring, verification and evaluation. The Programme distinguishes clearly between:

- **operational business data**, which remains confidential;
- **programme monitoring data**, which government receives under defined conditions; and
- **aggregated sector evidence**, which can be published without revealing commercially sensitive business information.

Technology contracts supported through UK-GMEP must also make clear who owns raw data, derived data and algorithmic outputs and what happens to business data if a supplier relationship ends. This is particularly important for cloud-based control systems, robotics and AI platforms.

16.12 Cybersecurity and operational resilience

As greenhouse production becomes more digital, dependence on connected control systems creates new operational risks. Climate control, irrigation, heating and other automated systems can become operationally critical. Failure, cyberattack or loss of remote connectivity could therefore create biological and financial consequences significantly greater than conventional IT disruption.

Tier 3 and Tier 4 projects involving substantial digital control systems include a proportionate digital resilience and cybersecurity assessment. Critical functions must have appropriate backup arrangements, access controls, data recovery mechanisms and manual or degraded operating modes where practical.

The Programme avoids creating a sector in which increased digital sophistication produces new single points of failure.

16.13 Artificial intelligence

AI-supported technologies are eligible where they address a defined production or infrastructure problem and can demonstrate measurable value. Potential applications include yield forecasting, environmental optimisation, pest and disease detection, irrigation management, energy optimisation, crop scheduling, predictive maintenance and automated quality assessment.

UK-GMEP does not treat the use of AI as an outcome in itself. An AI system receives support because it improves an identified metric such as productivity, resource use, reliability or labour efficiency, not simply because the technology is novel. Where AI informs material operational decisions, growers must retain appropriate oversight and understand the limitations of the system.

Training data quality, system performance and the consequences of erroneous recommendations form part of commercial validation.

16.14 Robotics and automation

Automation is a major opportunity for improving labour productivity and reducing exposure to persistent workforce shortages. UK-GMEP supports robotics and automation where commercial evidence demonstrates that the technology can operate reliably within the crop and greenhouse system in which it will be deployed. Priority applications can include crop transport, grading, packing, plant handling, scouting, spraying, harvesting and repetitive monitoring tasks.

However, automation projects must account for maintenance, downtime, technical support and the skilled workforce required to operate them. A technology that nominally removes ten manual positions but requires scarce specialist support, causes frequent production disruption or cannot operate reliably at commercial crop density may not represent a net resilience improvement.

Investment appraisal therefore considers *whole-system labour productivity rather than simple headcount reduction*.

16.15 Technology and legacy infrastructure

Not every technology is appropriate for every greenhouse. The Programme explicitly considers compatibility with existing structures.

For legacy sites, technology investment is prioritised where the greenhouse has sufficient remaining life to justify the asset or where the technology can subsequently be transferred to replacement infrastructure.

UK-GMEP avoids major investment in systems that become stranded when a structurally obsolete greenhouse is replaced shortly afterwards. Where the economic case for technology adoption depends on simultaneous structural modernisation, both investments are assessed together under the relevant Tier 2 or Tier 3 pathway.

16.16 Technology procurement and vendor neutrality

UK-GMEP maintains strict vendor neutrality. Funding decisions are based on project outcomes, technical credibility and value for money rather than manufacturer endorsement.

Technology suppliers can participate in demonstrations and supported investments, but participation in an early UK-GMEP trial does not confer preferred-supplier status in subsequent competitions.

For major investments, recipients demonstrate proportionate competitive procurement or market testing. Where highly specialised technology has limited suppliers, the business case must explain the basis on which value for money has been assessed.

This protects growers and government from premature dependence on individual technology providers.

16.17 Innovation vouchers and smaller growers

Smaller growers frequently face barriers to adopting technology because the cost of technical assessment, integration and specialist advice is disproportionately high relative to project size. UK-GMEP therefore operates *Innovation and Digitalisation Vouchers* within Tier 1.

These can support independent technical assessment, digital integration, small-scale automation, sensing, environmental monitoring and specialist consultancy. The voucher mechanism is deliberately simple and capped at a level proportionate to Tier 1 investment.

Its purpose is to help smaller businesses make informed technology decisions and participate in digitalisation, rather than fund large experimental projects. Cooperative applications are encouraged where several growers face the same technology or digital-infrastructure need.

16.18 Demonstration infrastructure and shared test facilities

The Programme also supports shared commercial demonstration capability where this reduces duplication and improves independent validation. This can include greenhouse test bays, commercial-scale demonstration sites, controlled comparison facilities and shared technology-validation infrastructure.

Such facilities must have a clear role in reducing deployment risk for the wider sector and should not duplicate research facilities already available elsewhere. Access arrangements should be transparent and open to multiple technology providers and growers. The objective is to provide a route through which technologies can be tested under commercially realistic conditions before growers are expected to take full investment risk.

16.19 Technology deployment finance

Innovation support declines as technology maturity increases. Early commercial demonstration may receive relatively high public intervention where technical and commercial uncertainty remains substantial.

Once a technology is validated, further deployment should increasingly be financed through the normal Tier 1–3 capital architecture. Mature technologies with well-established payback should receive no additional innovation premium simply because they are technologically sophisticated.

This creates a degressive support model:

high uncertainty → demonstration support
validated but early market → deployment support
mature commercial technology → normal infrastructure finance

The transition point is reviewed using evidence from commercial deployment rather than technology age alone.

16.20 Worked example: automation technology

A robotic crop-handling system has performed successfully in a research environment but has limited evidence from full commercial production. Innovate UK supports installation within two operational greenhouse businesses under the Commercial Greenhouse Demonstration Programme.

The project measures labour hours, throughput, downtime, crop damage, maintenance cost and operating reliability across a complete production cycle. Independent evaluation demonstrates that the technology reduces relevant labour requirements by 25% while maintaining product quality and operating reliably.

The technology then progresses into early commercial deployment across several Tier 2 sites with reduced innovation support. Once replicated successfully, it becomes eligible as a standard automation investment through the normal capital programme and receives no dedicated innovation subsidy.

The public intervention has therefore reduced the risk of first commercial adoption without permanently subsidising the technology.

16.21 Worked example: digital climate and energy optimisation

A 6 ha grower operates separate climate, lighting and energy-control systems that do not communicate effectively. A Tier 3 modernisation project installs an integrated digital management system capable of combining crop climate requirements with real-time energy performance and thermal-storage availability.

The system uses forecasting and optimisation software to determine how heat generation, storage and lighting can be scheduled without compromising crop requirements.

Performance is measured against the site's pre-investment baseline. If the system reduces energy intensity while maintaining or increasing saleable yield, the evidence contributes to the UK-GMEP Technology Evidence Base and informs subsequent deployment.

The outcome measured is therefore production and energy performance, not the presence of an AI or digital platform.

16.22 Governance and delivery

The Department for Business, Innovation, Science and Trade leads the innovation and commercial-technology component of UK-GMEP, working through Innovate UK for commercial demonstration and deployment.

Defra defines greenhouse-sector requirements and ensures that innovation investment remains aligned with food-production and infrastructure objectives. UKRI, including BBSRC and other relevant research councils, supports underpinning research and earlier-stage scientific development through existing programmes. Universities, research organisations, commercial growers and technology businesses deliver collaborative projects, while independent organisations undertake validation where appropriate.

The UK-GMEP Programme Office maintains visibility of the technology pipeline and prevents unnecessary duplication between research, innovation and mainstream capital programmes.

16.23 Programme targets

By the end of Year 2, the Digital Greenhouse Standard, Technology Validation Framework and initial Commercial Greenhouse Demonstration Programme will be operational.

By Year 5, at least 70% of major supported modernisation projects should incorporate independently evidenced technology that materially improves productivity, resource efficiency or resilience, and at least 85% of supported operational area should provide standardised digital monitoring of agreed energy, water and production indicators.

By Year 10, at least 80% of supported modernisation projects should incorporate independently verified productivity or resilience technologies, while at least 95% of supported operational area should operate with the minimum digital monitoring required by the Programme.

The Programme will also track the proportion of technologies that progress from demonstration into unsupported or mainstream commercial deployment. This is an important measure because a large number of successful pilot projects with little subsequent adoption would represent poor innovation performance.

The ultimate objective is to create a sector in which technology deployment becomes faster, better evidenced and less concentrated among a small number of leading businesses.

UK-GMEP succeeds when growers can adopt technology on the basis of credible commercial evidence, lenders can assess the resulting investment with greater confidence, and technologies that demonstrably work move rapidly into normal commercial use rather than remaining indefinitely within the innovation system.

17. SMALL GROWER, COOPERATIVE, AND REGIONAL INCLUSION FRAMEWORK

UK-GMEP is designed to modernise the greenhouse sector without accelerating unnecessary concentration of productive capacity or restricting public investment to businesses with the greatest existing financial and administrative capacity.

The Programme therefore applies an *inclusion principle across all funding and delivery mechanisms*, rather than establishing a separate small-grower programme.

Smaller businesses face different investment barriers from larger commercial operators. Individual projects are smaller, but fixed costs associated with feasibility studies, professional advice, finance applications, planning and technology assessment can represent a much greater proportion of total investment. Smaller growers may also be unable individually to finance or utilise infrastructure such as heat networks, water systems, specialist technical staff, automation or major procurement contracts.

UK-GMEP addresses these structural disadvantages through four mechanisms:

1. **First, proportionate access to capital.** Tier 1 provides higher potential intervention rates, simplified applications and access to technical assistance for qualifying smaller businesses. Application and monitoring requirements are proportionate to project scale while maintaining appropriate controls over public expenditure.
2. **Second, aggregation and cooperation.** Growers can participate collectively through producer organisations, cooperatives, joint ventures and other appropriate structures. This enables businesses to aggregate investment, purchasing, production, logistics or market demand without requiring ownership consolidation. Shared infrastructure can be supported through Tier 4 where it provides demonstrable benefits to multiple businesses.
3. **Third, access to regional infrastructure.** Strategic greenhouse clusters should not be designed exclusively around large anchor businesses. Where technically and commercially feasible, heat, water, energy, logistics, training and other shared infrastructure should be capable of accommodating smaller producers within the surrounding region.
4. **Fourth, access to markets, skills and technology.** Procurement frameworks use appropriate lot sizes and aggregation mechanisms to avoid unnecessarily excluding smaller suppliers. Regional skills provision, shared technical expertise and innovation support similarly allow smaller businesses to access capabilities that would be uneconomic to maintain individually.

Regional inclusion is considered alongside business-size inclusion. UK-GMEP investment is determined principally by strategic need, project quality and value for money rather than by predetermined geographic quotas. However, the Programme

monitors the regional distribution of investment to ensure that its design does not inadvertently concentrate support simply because some regions have greater existing administrative or investment capacity.

The Programme Office reports annually on the distribution of support by business size, region, project type and funding tier, including the proportion of investment reaching independent growers and cooperative or shared-infrastructure projects.

Where monitoring demonstrates persistent under-representation that cannot be explained by project quality or strategic need, the Programme Board can adjust technical assistance, application processes, funding windows or project-development support. It should not lower investment standards simply to achieve geographic or business-size quotas.

The objective is therefore equality of investable opportunity rather than equality of funding allocation.

UK-GMEP should enable a commercially viable 0.5 ha grower to modernise, several medium-sized businesses to jointly access a heat network, and a major commercial operator to construct a +20 ha modern greenhouse where each represents good strategic investment.

The test is whether the Programme supports the most productive and resilient future structure of the UK greenhouse sector, rather than inadvertently determining that structure through unequal access to public investment.

18. RISK REGISTER AND FAILURE PREVENTION FRAMEWORK

18.1 Purpose

UK-GMEP is a long-term intervention in a commercially exposed, capital-intensive sector. It will operate across changing energy markets, food prices, labour availability, technology, government spending cycles and infrastructure constraints. Some individual projects will underperform and some businesses receiving support may fail. The Programme is therefore designed around active risk management rather than an assumption that all supported investments will succeed.

Risk management operates at three levels: individual projects, programme-wide exposure and systemic risks affecting the greenhouse sector as a whole. The purpose is to identify problems early enough for government to change funding conditions, project design or programme policy before substantial public value is lost.

The framework is based on four principles:

prevent avoidable failure → detect emerging risk early → intervene proportionately → protect productive assets and public value where failure occurs.

Risk is not eliminated entirely. Attempting to remove all commercial risk would either prevent investment or transfer excessive risk to government. UK-GMEP instead determines which risks should remain with businesses, which can be shared with government or infrastructure partners, and which should not be accepted at all.

18.2 Risk allocation

The Programme begins from the principle that risk should sit with the party best able to manage it.

Growers remain responsible for normal commercial risks including crop performance, operational management, routine market competition and business efficiency. Technology providers remain responsible for contractual technology performance. Lenders retain meaningful credit risk. Energy and infrastructure providers remain responsible for delivery and performance under their contracts.

Government principally accepts risks associated with identifiable market failure, strategic infrastructure coordination and policy intervention.

UK-GMEP does not protect businesses from normal commercial competition or guarantee investment returns. This distinction is fundamental. The Programme exists

to make strategically desirable investment possible, not to socialise normal commercial losses.

18.3 Principal programme risks

The principal risks requiring active management are summarised below.

Risk	Potential consequence	Principal prevention / mitigation
Over-subsidisation / deadweight	Public money funds investment that would have occurred anyway	Funding-gap assessment; declining intervention rates; additionality test
Poor project selection	Capital committed to commercially or technically weak projects	Independent technical, commercial and financial appraisal; gateway approvals
Overcapacity	Publicly supported expansion depresses prices or displaces existing UK production	Demand assessment; phased expansion; market additionality test
Energy-price or supply shock	Supported businesses become financially unviable	Energy Transition Plans; diversification; storage; stress testing; appropriate contracting
Infrastructure dependency	Project completed without sufficient grid, heat, water or transport capacity	Infrastructure confirmation before financial close
Planning delay	Costs increase and investment is abandoned	Strategic planning route; early multi-agency coordination
Capital-cost inflation	Projects exceed approved budgets	Contingency; staged procurement; cost benchmarking; reappraisal above thresholds
Technology underperformance	Productivity benefits fail to materialise	Independent validation; staged deployment; supplier performance requirements
Labour shortage	Productive capacity cannot be fully utilised	Workforce assessment; regional skills planning; migration evidence mechanism; automation
Business failure	Publicly supported assets become stranded	Financial appraisal; monitoring; restructuring and asset-transfer provisions
Market concentration	Support disproportionately benefits large incumbents	Tier 1; aggregation; monitoring by business

		size; proportionate application routes
Regional concentration	Investment reflects administrative capacity rather than strategic opportunity	National spatial assessment; technical assistance; regional pipeline monitoring
Private capital withdrawal	Government becomes principal funder rather than catalyst	Minimum private contribution; financial-close requirements; leverage monitoring
Fraud / misuse of funds	Direct loss of public money	Verification, audit, milestone payments, clawback
Policy instability	Businesses delay investment because government support is unpredictable	Ten-year framework; multi-year funding settlements; published programme rules
Environmental constraint	Expansion creates unacceptable pressure on water, land, biodiversity or emissions	Planning and environmental appraisal; water and energy assessments
Climate risk	Assets are designed around historic rather than future conditions	Climate-resilience assessment for major projects
Systemic external shock	Energy, trade, disease or economic disruption affects multiple projects simultaneously	Portfolio stress testing; diversification; strategic reserve and government review

18.4 Preventing over-subsidisation

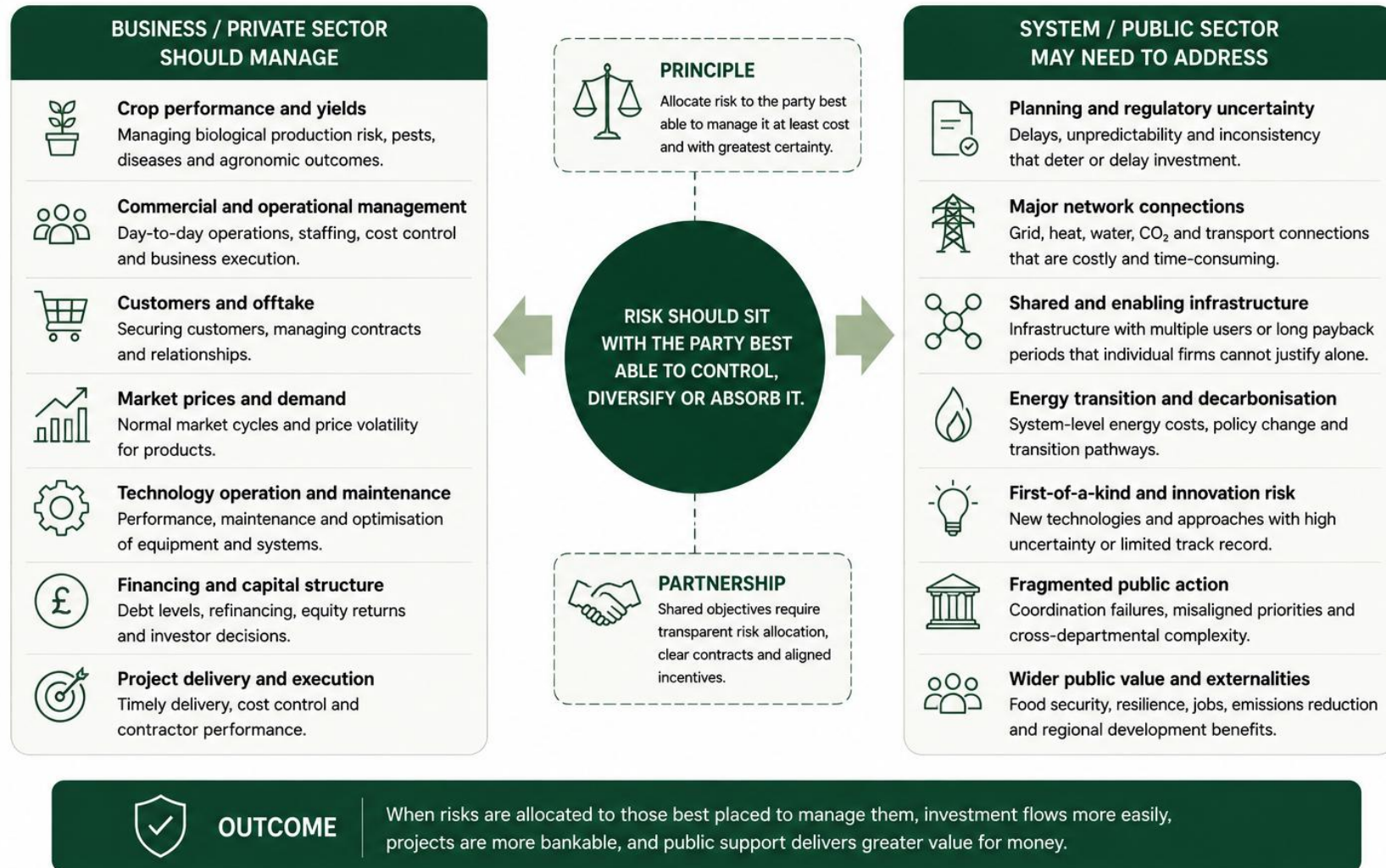
The most significant fiscal risk is that UK-GMEP pays businesses to undertake investment that would have occurred without public support. Every material award therefore includes an additionality and funding-gap assessment.

Applicants demonstrate why the proposed investment cannot reasonably proceed at the same scale, speed or specification without intervention. The assessment considers available cash, debt capacity, commercial financing, expected project returns and alternative investment options.

The relevant funding tier establishes the maximum intervention rate, not the default award. Where appraisal shows that a project can proceed with a smaller public contribution, the award is reduced. Where a project is already fully financed and committed before application, it will normally be ineligible.

Programme evaluation also compares supported investment against wider sector investment to identify whether apparent programme outputs principally represent substitution of public money for private capital.

Risk should sit with the party best able to control, diversify or absorb it.



18.5 Preventing overcapacity and market displacement

A programme designed to increase domestic production carries an important risk: government could finance new greenhouse capacity without creating additional demand. The result could be lower grower prices, displacement of existing UK production and business failure rather than improved food security.

Major Tier 3 and Tier 4 expansion projects therefore undergo a market additionality assessment. This considers existing domestic production, import penetration, seasonal supply gaps, expected demand, planned competing investment and evidence of credible routes to market.

Projects are not required to demonstrate that every kilogram of future production will replace an import. However, government should have reasonable confidence that substantial publicly supported expansion represents additional productive opportunity rather than publicly financed redistribution of existing UK market share.

Where evidence indicates that several proposed projects could collectively create excessive capacity in the same crop, investment can be phased rather than approving all projects simultaneously. This is one reason UK-GMEP maintains a national strategic project pipeline.

18.6 Preventing stranded assets

Greenhouse infrastructure can remain operational for several decades. Poor decisions made during UK-GMEP could therefore lock businesses into inappropriate sites, technologies or energy systems long after the Programme ends.

Tier 2–4 investments are consequently assessed against expected asset life and future infrastructure requirements. Particular scrutiny is applied to major investments in legacy greenhouse structures, new fossil-dependent heating systems, sites with unresolved water constraints, projects reliant on speculative waste-heat sources and developments without credible electricity-network capacity.

Government should not spend substantial public capital making an obsolete asset less obsolete for a few additional years where replacement provides better whole-life value.

For major projects, appraisal therefore explicitly considers the counterfactual options of retrofit, replacement, relocation and no intervention.

18.7 Energy and infrastructure failure

No major Tier 3 or Tier 4 greenhouse project reaches final investment approval without sufficiently developed arrangements for its critical infrastructure. This includes electricity, heat, water, drainage, transport and digital connectivity where material.

Projects dependent on third-party heat or energy infrastructure demonstrate credible contractual arrangements, backup provision and contingency plans. Energy systems are stress-tested against adverse price and availability scenarios as established in Section 14.

Particular attention is given to single points of failure. A 30 ha greenhouse cluster should not become dependent upon one industrial heat source without understanding what happens if that facility closes, reduces production or experiences an extended outage. Redundancy, alternative supply, thermal storage and contractual protections are therefore assessed as part of infrastructure design.

18.8 Business failure

Some supported businesses will fail during a ten-year programme. A zero-failure target would encourage excessively conservative investment and would not represent sensible programme design. The objective is instead to minimise preventable failures and protect productive assets where failure occurs.

Businesses undergo proportionate financial appraisal before support is committed. Larger projects are stress-tested against changes in energy costs, crop prices, interest rates, yields and operating costs.

Where a supported business subsequently experiences financial distress, government does not automatically provide additional subsidy. The first response is commercial restructuring where viable. Where the original operator cannot continue but the productive asset remains viable, funding agreements permit transfer to another qualifying operator where legally and commercially appropriate.

The preferred hierarchy is:

remediation → restructuring → transfer of productive asset → recovery of public funds where appropriate → closure as last resort.

The objective is to avoid a situation in which commercially useful greenhouse infrastructure is dismantled simply because the original recipient business fails.

18.9 Technology failure

Innovation necessarily involves greater technical uncertainty than conventional infrastructure investment. UK-GMEP controls this through staged exposure.

Unproven technologies are first supported at demonstration scale. Public exposure increases only as independent evidence of reliability and commercial performance accumulates. Major projects should not depend critically upon immature technology without appropriate redundancy or contingency.

Where a publicly supported technology repeatedly fails to meet agreed performance thresholds, dedicated deployment support is suspended pending review. This creates an explicit stop mechanism within the innovation programme rather than allowing unsuccessful technologies to continue receiving public support because previous funding has already been committed.

18.10 Cost escalation

Construction inflation, equipment prices, grid costs and project delay can materially increase greenhouse investment requirements between application and delivery. Funding agreements therefore specify an approved project cost and maximum public contribution.

Cost increases are not automatically shared proportionately with government. Applicants normally retain responsibility for overruns within an agreed tolerance. Where costs increase materially beyond that threshold, the project returns to appraisal.

Government can increase support where there is a compelling value-for-money case, reduce project scope, restructure finance or withdraw support. This prevents the original grant percentage becoming an open-ended commitment to absorb project inflation.

Conversely, where eligible project expenditure falls, the public contribution falls proportionately as established in the funding architecture.

18.11 Portfolio concentration risk

UK-GMEP manages risk at programme level as well as project level.

The Programme Office monitors exposure by:

- business and corporate group;
- crop;
- geographical region;
- technology;
- energy source;
- lender;
- infrastructure provider; and
- funding mechanism.

This is important because a portfolio of individually credible projects can still create systemic risk if they depend on the same market or infrastructure assumption. For example, excessive investment in one crop could create market risk, while widespread dependence on one technology provider or energy pathway could create technical risk.

The Programme Board can slow or modify further commitments where portfolio concentration exceeds agreed thresholds.

18.12 Climate resilience

Infrastructure financed today is likely to remain operational under climatic conditions different from those experienced historically.

Major projects therefore undertake proportionate climate-resilience assessment covering relevant risks such as extreme heat, drought, water availability, flooding, storms and changing pest and disease pressures. New greenhouse infrastructure should be designed against credible future climate conditions rather than solely against historic averages.

This requirement is particularly important for water infrastructure and cooling. A greenhouse capable of maintaining winter temperatures efficiently but unable to manage increasingly frequent summer heat extremes does not constitute resilient infrastructure. Climate resilience is therefore incorporated into technical appraisal rather than treated solely as an environmental reporting exercise.

18.13 Fraud, error and misuse of public funds

The payment architecture substantially reduces financial-control risk by linking public funding to verified expenditure and physical delivery. Recipients maintain appropriate financial records and provide evidence of expenditure. Larger projects are subject to independent certification and risk-based audit.

UK-GMEP uses data matching where legally permissible to identify duplicate public funding. False declarations, deliberate misrepresentation, diversion of funds or material breach of funding conditions can result in suspension, clawback and exclusion from subsequent programme support, alongside other action available under applicable law.

Controls remain proportionate to project size so that anti-fraud requirements do not create excessive administrative costs for small Tier 1 investments.

18.14 Moral hazard and repeated rescue

A government programme of this scale could create an expectation that strategically important greenhouse businesses will be rescued whenever commercial conditions deteriorate. UK-GMEP explicitly rejects this principle.

Receipt of public investment does not create an entitlement to future financial assistance. Additional intervention following business distress requires a separate assessment of public interest, asset viability and value for money. Government support should focus where appropriate on protecting strategically valuable productive infrastructure, rather than preserving the ownership or equity value of a particular company. This distinction substantially reduces moral hazard.

18.15 Policy and programme risk

Government itself represents a source of investment risk where programmes change frequently, funding windows are unpredictable or eligibility rules are altered after businesses have begun developing projects.

UK-GMEP mitigates this through its ten-year statutory and financial framework, published eligibility rules and multi-year project pipeline. This does not prevent government from changing ineffective policy.

Material changes are introduced through scheduled programme reviews wherever possible, with appropriate transitional arrangements for projects already formally admitted to the pipeline. The Programme therefore combines policy durability with the ability to adapt.

18.16 Gateway assurance

Major projects pass through formal gateways before increasing amounts of public exposure are committed.

Gateway	Decision
Gateway 0 – Strategic fit	Does the proposal contribute materially to UK-GMEP objectives?
Gateway 1 – Feasibility	Is there a credible technical, commercial and spatial proposition?
Gateway 2 – Development	Are planning, energy, water, workforce and market requirements realistically deliverable?
Gateway 3 – Investment	Is the financing package affordable, additional and value for money?
Gateway 4 – Financial close	Are private finance, contracts, permissions and critical infrastructure sufficiently secured?
Gateway 5 – Commissioning	Has the project been delivered to the required specification?
Gateway 6 – Operational performance	Is the project delivering the outcomes against which public support was approved?

Projects can be stopped, redesigned or returned to an earlier gateway. Progress through the pipeline therefore does not create an automatic entitlement to proceed to funding.

For major Tier 3 and Tier 4 projects, Gateway 4 is particularly important: substantial public capital should not be released simply because planning permission has been obtained if the remaining finance or critical infrastructure remains unresolved.

18.17 Early-warning system

Once operational, Tier 2–4 projects are monitored against a limited set of indicators capable of identifying emerging problems. These include material cost overruns, construction delay, withdrawal of private finance, changes in energy arrangements, loss of major customers, significant workforce shortages, repeated technology failure and substantial deviation from expected productive output.

Projects are classified through a simple *green–amber–red* system. Green projects remain within routine monitoring. Amber projects require corrective action and enhanced oversight. Red projects trigger formal review and potential intervention by the Programme Office or relevant financing body.

The purpose is not to micromanage normal commercial variation. It is to identify deterioration before a problem becomes an irreversible financial loss.

18.18 Programme-level triggers

In addition to project monitoring, UK-GMEP establishes explicit programme-level warning thresholds. These include persistently low private-capital mobilisation, excessive demand for maximum grant rates, repeated project failure within one technology or crop, significant regional or corporate concentration, sustained undersubscription of funding, major increases in government guarantee losses and evidence that supported expansion is displacing existing UK production.

Crossing a threshold triggers review; it does not automatically terminate the relevant intervention. This provides an important distinction between monitoring performance and mechanically managing to targets.

18.19 Strategic reserve

The funding architecture includes a programme contingency and strategic reserve. This reserve is not a general emergency fund for individual growers. It is retained for programme-level circumstances such as exceptional construction inflation, critical shared infrastructure requirements or major external shocks that threaten delivery of strategically important projects.

Use of the reserve requires explicit approval and a documented value-for-money case. Unused reserve funding remains uncommitted rather than being spent at the end of the Programme simply to maximise budget utilisation.

18.20 Independent review

The Independent Investment and Assurance Panel reviews major Tier 3 and Tier 4 investment decisions and programme-level risk. Its role is particularly important where a project combines substantial grant support, guarantees and publicly

supported infrastructure, because the headline grant alone may understate government's total financial exposure.

The Panel reports material concerns to the Programme Board and Senior Responsible Owner and has a defined escalation route for projects where it considers that risks are not adequately controlled. HM Treasury retains oversight of material fiscal and contingent liabilities.

18.21 Risk ownership

Each major programme risk has a named government owner.

Risk category	Principal owner
Programme delivery and sector outcomes	Defra / UK-GMEP SRO
Fiscal exposure and value for money	HM Treasury
Business finance and guarantees	Relevant finance institution
Energy-system risk	DESNZ
Planning-system risk	MHCLG
Water/environmental risk	Defra / Environment Agency
Workforce and skills	DWP / Skills England
Migration policy	Home Office
Innovation and technology deployment	Relevant business/innovation department / Innovate UK
Project commercial performance	Recipient business

Risk ownership does not transfer statutory responsibilities between departments. It identifies who is responsible for ensuring that the relevant risk is actively monitored and escalated within UK-GMEP.

18.22 Failure-prevention framework

The overall UK-GMEP failure-prevention model can therefore be summarised as:

Select carefully → develop properly → finance proportionately → verify dependencies → release funding progressively → monitor performance → intervene early → preserve productive value where possible → stop ineffective intervention.

This approach deliberately avoids two extremes. The first is excessive risk aversion, under which government supports only projects that are already sufficiently safe and profitable to proceed without intervention. Such a programme would produce high apparent success rates but little additional investment. The second is excessive risk transfer, under which government absorbs commercial, energy, technology and market risks that should properly remain with businesses and investors.

UK-GMEP instead accepts managed additionality risk: public intervention should enable projects that would not otherwise proceed, while maintaining clear boundaries around the risks government is prepared to carry.

18.23 Definition of programme failure

UK-GMEP should not be judged solely by the number of projects funded or the proportion of its budget spent. The Programme would represent a strategic failure if, after ten years, public expenditure had increased greenhouse investment temporarily but the underlying conditions preventing routine renewal remained substantially unchanged.

Specific failure conditions include persistent dependence on high capital grants; weak private-capital mobilisation; substantial publicly financed displacement of existing domestic production; concentration of support without productivity justification; construction of assets without secure energy, water or workforce provision; widespread technology or infrastructure underperformance; or an inability of the sector to continue investing once UK-GMEP support declines.

Conversely, the failure of an individual business or technology does not necessarily constitute programme failure where risk was appropriately assessed and wider learning or productive assets are preserved.

The ultimate risk test is therefore whether UK-GMEP leaves behind *a stronger investment system rather than merely a newer collection of greenhouse structures*. The Programme should be considered successful when the need for exceptional government intervention progressively declines because greenhouse renewal, strategic infrastructure investment and technology adoption have become sufficiently predictable and investable to continue through normal commercial and public-infrastructure mechanisms.

19. MONITORING, EVALUATION, AND REPORTING

19.1 Purpose

UK-GMEP will operate under a single monitoring and evaluation framework covering the full ten-year Programme. Its purpose is to establish whether public intervention is delivering additional investment, improving the productive capacity and resilience of UK greenhouse horticulture, and providing value for money.

Monitoring will distinguish between *inputs, outputs and outcomes*. Programme expenditure, projects approved and hectares supported are important measures of delivery, but are not in themselves evidence of success. Evaluation must determine whether UK-GMEP has resulted in investment that would not otherwise have occurred, or has materially accelerated or improved that investment.

Reporting requirements will be proportionate to the scale of public support and, wherever possible, existing administrative and operational data will be reused rather than collected repeatedly from growers.

19.2 Baseline and core measures

During Year 1, Defra will establish a verified *UK Greenhouse Sector Baseline*, building on the existing sector evidence developed for UK-GMEP. This will provide the reference point for subsequent evaluation and will be maintained as a UK Greenhouse Asset Register.

The baseline will cover commercial food-producing area, infrastructure age and condition, principal crops, energy systems, investment rates, workforce constraints, digitalisation and the regional distribution of production. Performance will then be assessed through a limited set of core indicators:

Area	Principal measure
Infrastructure	Area modernised, replaced and newly constructed
Production	Operational area and saleable output
Investment	Public and private capital invested
Additionality	Investment caused, accelerated or materially improved by UK-GMEP
Energy	Energy intensity, fossil-heat exposure and low-carbon/recovered heat
Productivity	Saleable output per m ² and relevant resource-efficiency measures
Workforce	Vacancy, retention and technical-skills indicators
Innovation	Technologies progressing from demonstration to commercial deployment

Digitalisation	Area meeting the UK-GMEP Digital Greenhouse Standard
Planning	Time from programme entry to an investable planning outcome
Inclusion	Distribution of support by region, business size and funding tier
Delivery	Cost, timetable and operational performance of supported projects

Modernisation, replacement and expansion will be reported separately. UK-GMEP will therefore not describe a hectare of existing greenhouse receiving new equipment as a hectare of new productive capacity.

19.3 Responsibilities

Defra will be the lead department for overall programme monitoring and will maintain the UK Greenhouse Asset Register. The UK-GMEP Programme Office will collect project-level information, maintain the programme dashboard, monitor delivery against milestones and produce quarterly reports for the Programme Board.

Individual departments will remain responsible for monitoring outcomes within their policy areas. DESNZ will oversee energy-transition indicators; MHCLG will monitor planning performance; DWP and Skills England will monitor workforce and skills outcomes; and Innovate UK and the relevant business and innovation department will monitor technology demonstration and commercial deployment.

HM Treasury will oversee value for money, fiscal exposure and the overall performance of the Programme's financial instruments. Public finance institutions involved in loans, guarantees or other financial products will report their respective commitments, repayments, defaults and contingent liabilities.

Regional GMEP Delivery Partnerships will provide regional pipeline and delivery information, including infrastructure constraints and major project dependencies. Recipients of UK-GMEP funding will provide the project-level information required under their funding agreements. Requirements will be proportionate: Tier 1 projects will have simplified reporting, while Tier 3 and Tier 4 projects will provide more detailed financial, operational and infrastructure performance information.

19.4 Additionality and value for money

A central evaluation question will be whether UK-GMEP has generated additional investment, rather than replacing expenditure that businesses would have undertaken anyway.

For material projects, the counterfactual established during appraisal will therefore be retained: whether, without UK-GMEP, the investment would have proceeded at the same time, scale and specification. Independent programme evaluation will compare these assumptions with actual outcomes and wider sector investment trends. This will allow government to distinguish between investment merely receiving UK-GMEP support and investment genuinely caused or materially accelerated by the Programme.

Value-for-money assessment will consider public expenditure alongside private capital mobilised, productive capacity created or retained, productivity and resilience improvements, and the continuing need for intervention.

19.5 Reporting and review cycle

The Programme will use a simple reporting cycle:

- **Quarterly:** the UK-GMEP Programme Office reports delivery, expenditure, pipeline and major risks to the Programme Board.
- **Annually:** Defra publishes a UK-GMEP Annual Report covering expenditure, investment mobilised, infrastructure delivered, energy and workforce outcomes, regional distribution and progress against the Programme's success criteria.
- **Year 2:** an independent process evaluation assesses whether application, appraisal, governance and delivery mechanisms are functioning effectively.
- **Year 5:** a full independent mid-term evaluation assesses additionality, value for money, market impact and progress against the strategic objectives.
- **Year 8:** government undertakes an impact and exit review to determine which interventions should end, continue or transition into mainstream policy.
- **Year 10:** a final independent evaluation assesses overall programme impact and the case for any successor arrangements.

The Year 5 review will have explicit authority to recommend changes to funding rates, eligibility criteria, financial instruments, delivery mechanisms and programme targets.

19.6 Public accountability

Defra will maintain a public *UK-GMEP Performance Dashboard* showing the principal non-commercial programme indicators, including investment, hectares supported, private capital mobilisation, regional distribution and progress against energy and infrastructure targets. Commercially sensitive business information will not be published.

The Secretary of State for Environment, Food and Rural Affairs will be accountable for the overall performance of UK-GMEP. An annual programme report will be published, while the major independent evaluations at Years 5 and 10 will be published and laid before Parliament.

The UK-GMEP Programme Board will be responsible for responding to identified underperformance. Where an intervention is consistently failing to deliver additionality or value for money, the Board will be able to reduce, redesign or discontinue it rather than maintaining expenditure simply to meet previously announced programme commitments.

19.7 Definition of success

The final assessment of UK-GMEP will not be based primarily on the amount of public money spent or the number of projects funded. Success will require evidence that the Programme has:

- materially modernised and expanded productive greenhouse capacity;
- mobilised substantial additional private investment;
- reduced energy and infrastructure risk;
- improved productivity and workforce resilience;
- accelerated commercially valuable technology deployment; and
- established conditions in which future greenhouse renewal can increasingly proceed with less direct government support.

The critical long-term test is therefore whether UK-GMEP has changed the investment environment, rather than simply financed one generation of greenhouse infrastructure.

By Year 10, government should be able to demonstrate not only what UK-GMEP built, but what changed because UK-GMEP existed and whether those changes are capable of continuing after the Programme ends.

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