

Annex A Proposed National Development Assessment Tables

The summary of the methodology outlined in Section 1 provides an explanation of the colours used in the detailed assessment tables, which are also included here for reference. The initial stage of assessment focuses on identifying if effects are positive or negative, and the significance of this on a negligible, minor or significant scale.

Table A.1: Key for project element scoring

Key
Significant negative (increases emissions)
Minor negative (increases emissions)
Negligible negative (increases emissions, several negligible effects could combine in the summary table)
Negligible positive (increases emissions, several negligible effects could combine in the summary table)
Mixed negligible (both increases and reduces emissions at a negligible scale)
Mixed (both increases and reduces emissions at a minor scale)
Minor positive (reduces emissions)
Significant positive (reduces emissions)

The initial assessment is followed by a summary table which uses the scales of effect related to the benchmarking process for direct effects. Indirect effects reflect the scales of effect in Table A.1.

Table A.2: Key for overall direct effects scoring

Overall effect colour codes (positive)	Overall effect colour codes (negative)
Minor	Minor
Moderate	Moderate
Major	Major
Super	Super

Table A.3: Aberdeen Harbour

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Aberdeen Harbour	Upgraded port facilities	Transport	Existing vessel emissions Most marine vessels and vehicles are fuelled by diesel	Negligible negative effects from transportation of machinery and materials required for the construction of manufacturing and support services and renewable energy development.	Mixed effects from the development. It will enable larger vessels, including cruise ships, to visit Aberdeen. These larger vessels may therefore travel more often to Aberdeen, however they will be more efficient. Enhancements to the harbour may reduce journey length for larger vessels by providing an additional harbour. It may also increase the number of larger vessels which have to make longer journeys to access ports which can berth vessels of this size. In addition, GHG emissions will arise from port workers commuting to/from work and maintenance activities.		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Unsure of the number of marine vessel journeys which will be made to/from the harbour.
		Electricity			Negligible negative effects from electricity requirements for the operational phase of the development.			
		Buildings/Heat	Heating is dependent on fossil fuels		Negligible negative effects from heating for buildings.			
		Industrial, manufacture and construction processes	Existing facilities/buildings at the harbour. Carbon embodied within existing infrastructure	Minor negative effects from embodied carbon in new infrastructure and materials to be used in the development. Energy required for construction.	Negligible negative effects from energy requirements for the operation of businesses for renewable energy research, manufacture and support services. Materials used during the operations of the development.		Negligible negative effects from decommissioning of development infrastructure. Energy required for decommissioning.	
		Waste		Negligible negative	Negligible negative effects		Negligible negative	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				effects from waste material generated during the construction phases.	from operational waste.		effects from waste material generated during the decommissioning phases.	
		LULUCF	Previously developed land	Negligible negative effects from disturbance to soil and vegetation during the construction.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	A cluster of port accessible renewable energy research, manufacture and support services, regeneration of existing employment land and reorganisation of land use around the harbour , with sustainable and active travel and green infrastructure	Transport	Existing vessel emissions Most marine vessels and vehicles are fuelled by diesel	Negligible negative effects from transportation of machinery and materials required for the construction of development associated with the south harbour.	Negligible negative effects from additional journeys generated from workers commuting to/from site, partly balanced by sustainable and active travel. Transport related to the operation of businesses based at the harbour. .		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Uncertain on the types of development that will be located here, and associated transport needed. Uncertain of the number of jobs to be provided.
		Electricity			Negligible negative effects from electricity requirements for land based operations (e.g., offices, security, lighting etc).	Minor positive effects from renewable energy generation enabled by research, manufacturing and support services		Uncertain if electricity will be from a low carbon source
		Buildings/ Heat			Negligible negative effects from buildings (e.g., offices) will require heating			
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in new infrastructure to be developed at South Harbour. Energy required for construction.	Negligible negative effects from energy requirements for harbour operations and buildings.		Negligible negative effects from energy required during the decommissioning phases.	
		Waste		Negligible negative effects from waste	Negligible negative effects from operational waste of the		Negligible negative effects from waste	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				material generated during construction phases	harbour.		material generated during the decommissioning phases	
		LULUCF		Negligible negative effects from Disturbance to soil and vegetation during the construction.	Negligible positive effects from potential for carbon sequestration through green infrastructure during the operational phase of the development.		Negligible negative effects from disturbance to soil and vegetation during the decommissioning.	Uncertain how much greenfield land will be developed Uncertain as to any restoration plans for the site.
	Renewable hydrogen production and hydrogen production related chemicals including ammonia	Transport		Negligible negative effects from transportation of staff, materials and equipment for the delivery of the development.	Negligible negative effects from transportation of hydrogen.	Minor positive effects as renewable hydrogen provides low carbon fuel for transport.	Negligible negative effects from transportation of staff, materials and equipment during decommissioning.	It is uncertain how much renewable hydrogen will be produced and how it will be transported.
		Electricity				Minor positive effects as renewable hydrogen will facilitate greater efficiency of renewable electricity via renewable energy storage.		Impact will depend on the scale; how much renewable hydrogen will be produced
		Buildings/ Heat				Minor positive effects from production and use of a renewable hydrogen as a low carbon heating source		Will depend on the scale of the activities.
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of renewable	Negligible negative effects from potential for hydrogen leakage. Fugitive emissions from transport of hydrogen.	Minor positive effects as renewable hydrogen provides a low carbon fuel for industrial purposes.	Negligible negative effects from energy required for decommissioning	Will depend on the scale of the activities.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				hydrogen facilities.				
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	
		LULUCF		Negligible negative effects from loss of and disturbance of soil and vegetation on brownfield and greenfield site			Negligible negative effects from the disturbance to soil and vegetation during the decommissioning.	

Table A.4: Aberdeen Harbour

Aberdeen Harbour						
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transportation of machinery and materials required for the construction of manufacturing and support services, hydrogen facilities and renewable energy development.	Negligible negative effects from commuting of workers to/from site, partly balanced by use of sustainable and active transport, transport related to the operation of businesses based at the harbour and maintenance related transport.		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Minor negative GHG balance from transport. Low confidence as it is uncertain how much additional marine and road traffic will be generated by this development, and how much hydrogen produced will be used for transport.	
Electricity	Negligible negative effects from energy required for the construction.	Negligible negative effects from electricity requirements for the operational phase of the development.	Minor positive effects from use of surplus renewable energy for hydrogen production and from renewable energy research, manufacturing and support services which will enable innovative and more efficient solutions and will	Negligible negative effects from energy required for decommissioning.	Minor negative GHG balance from electricity. Medium confidence as it is uncertain if energy demands will be met by renewable sources.	

Aberdeen Harbour					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
			support the transition to renewable energy and supporting renewable energy generation.		
Buildings (heat)		Negligible negative effects from heating for buildings and offices.	Minor positive effects from the production and use of a renewable hydrogen as a low carbon heating source		Minor negative GHG balance from buildings (heat), low confidence due to assumed small increase in heat demand.
Industrial, manufacture and construction processes	Minor negative effects from embodied carbon in new infrastructure and materials to be used in the development and energy required for construction.	Negligible negative effects from energy requirements for the operation of businesses and the materials used. Additionally, fugitive hydrogen emissions will have negative effects.	Minor positive effects as renewable hydrogen provides a low carbon fuel for industrial purposes.	Negligible negative effects from decommissioning of development infrastructure. Energy required for decommissioning.	Minor negative GHG balance from industrial processes. Medium confidence as it is assumed that carbon heavy materials will be required for construction and operation phases and that some hydrogen will be leaked during production, storage and transportation.
Waste	Negligible negative effects from waste material generated during the construction phases.	Negligible negative effects from operational waste from the mixed-use development. Operational waste of the harbour, including from cruise ships.		Negligible negative effects from waste materials generated during the decommissioning phases.	Minor negative GHG balance from waste, medium confidence due to uncertainty over quantity of waste produced by the operations.
LULUCF	Negligible negative effects from using some areas of currently vegetated land for development.	Negligible positive effects from the potential for carbon sequestration through green infrastructure during the operational phase of the development.		Negligible negative effects from the disturbance to soil and vegetation during the decommissioning.	Minor negative GHG balance from LULUCF. Medium confidence as it is assumed that the development would be partly delivered on both brownfield and greenfield land.
Summary of direct lifecycle GHG effects	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Low confidence in minor negative effects from transport as it is uncertain how much additional marine and road traffic this development is likely to generate, and how much of the hydrogen produced will be used for transport purposes. ▪ Medium confidence in minor negative effects from electricity as it is expected that this development will require electricity for operation, and it is uncertain if energy demands will be met from renewable sources. ▪ Low confidence in minor negative effects for buildings due to uncertainty if hydrogen will be used as a heat source. It is assumed there is a small increase in heat demand. ▪ Medium confidence in minor negative effects in relation to industrial processes as this development will require a significant amount of carbon heavy materials for construction and operational phases, and it is uncertain how much renewable hydrogen will be used for industrial purposes. ▪ Medium confidence in minor negative effects from waste due to uncertainty over the quantity of waste generated by the operations. ▪ Medium confidence in minor negative effects arising from LULUCF as it is assumed that the development would be delivered on both brownfield and greenfield land. 				
Summary of indirect direct lifecycle GHG effects	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>This development is likely to enable increased generation of renewable electricity through research and support services. This could displace higher carbon fuel sources across Scotland. The research elements are likely to have a multiplier effect for renewable energy development over the medium to long term. In addition, it</p>				

Aberdeen Harbour					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	<p>is likely to facilitate the more efficient use of renewable energy by using surplus electricity to produce renewable hydrogen. Renewable hydrogen may be used for transport, heat and industry. Low confidence in indirect positive effects due to uncertainty about the scale of the renewable energy production of the use of surplus electricity for hydrogen production, the scale of hydrogen production and deployment across different sectors.</p> <p>This development is likely to also enable renewable electricity energy development</p>				
Summary of overall lifecycle GHG effects	<p>When direct and indirect effects are combined, it is likely that this development will have net positive effects on lifecycle GHG emissions due to the facilitation and enabling of renewable energy development across Scotland, and the production of renewable hydrogen over long timescales.</p> <p>The scale of this effect could range from low to high. A low scale of effect would result from higher levels of increased transport emissions from the site operations using high carbon fuels, but with a lesser contribution by the development to enabling renewable energy and a lesser quantity of renewable hydrogen produced. Conversely, if the additional site transport emissions are lower overall and use low carbon fuels, and the proportion of renewable energy development enabled and renewable hydrogen produced is higher, this could result in a high positive effect.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the nature and scale of these effects means there is low confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Prioritise the use of renewable / low carbon energy to power the development.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused or recycled.</p> <p>Provide low carbon transport options for the site to reduce car dependency.</p>				

Table A.5: Central Scotland Green Network

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Central Scotland Green Network	Expansion of green infrastructure network.	Transport	Existing green network enables active travel including walking/cycling, but is not fully connected	Negligible negative effects from transport emissions from construction activities related to the development of new greenspace	Significant positive effects from expansion will enable more journeys to be made by sustainable modes (walking, cycling). The focus of expanding green infrastructure in relation to development will support sustainable transport in new developments.			Uncertain as to the scale of expansion. Uncertain extent to which new active travel opportunities will reduce vehicular journeys.
		Electricity			Negligible negative effects from limited electricity to be used to provide a safer environment (for example, providing lights in parks and along green corridors).			
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from energy use associated with growth of new trees, construction and development of new green space, access routes, lighting and other infrastructure	Mixed effects. Negligible negative effects from creation and installation of protective structures once trees are planted until they reach some level of maturity (e.g., fences, stakes, tree tubes). Minor positive effects from improvements to surface water management and drainage, and reduction in impacts of flood risk on infrastructure and property.			
		Waste		Negligible positive effects from removal and reuse of excess soil/vegetation for creation of paths	Negligible negative effects from removal of protective structures once trees reach maturity			
		LULUCF	Soil carbon stored in soil	Mixed effects from creating greenspace from previously developed land. Disturbance of soil and	Significant positive effects from enhancing carbon sequestration through woodland planting and peatland regeneration.			Uncertainty about level of expansion, habitat types, rate of carbon sequestration How much green

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				release of carbon.				space will be created as opposed to enhanced Uncertainty over type of tree/species and their sequestration value

Table A.6: Central Scotland Green Network

Central Scotland Green Network						
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transport emissions arising from construction activity (materials and machinery) and transport of trees for planting	Significant positive effects due to more journeys made by sustainable modes of transport			Super positive GHG balance from transport due to more active travel. Medium level of confidence depending on the scale of network expansion, uptake of sustainable travel and rate of expansion of active travel network.	
Electricity		Negligible negative effects on electricity used to power lighting etc.			Minor negative GHG balance from electricity use. High confidence due to assumed level of use for lighting only.	
Buildings (heat)					Neutral GHG balance from heat. High confidence as no heating requirements.	
Industrial, manufacture and construction processes	Negligible negative effects from energy use associated with construction and development of new green space/corridors, and associated infrastructure (lighting, seating etc), including carbon embodied in materials.	Minor positive effects from improvements to surface water management and drainage, and reduction in impacts of flood risk on infrastructure and property assumed to outweigh negligible negative effects from protection of new planting .			Minor positive GHG balance from positive effects of reduced flood risk assumed to outweigh negligible negative effects from infrastructure and protection of new planting . Medium confidence due to assumed low carbon content of infrastructure and construction work.	
Waste	Negligible negative effects from removal and reuse of soil materials during construction	Negligible negative effects relating to disposal of protective structures for young trees			Minor negative GHG balance from waste. High confidence - limited waste expected.	
LULUCF	Minor positive effects from creation/enhancement of new green space on previously developed land.	Significant positive effects from enhancing carbon sequestration through woodland planting and peatland regeneration.			Major positive GHG balance from LULUCF. Medium confidence depending on scale of the tree planting, peatland restoration and expansion of green space.	

Central Scotland Green Network					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in super positive effects for transport related to the assumed greater uptake of active modes of travel displacing emissions from transport over a long time period and at a national scale, however there is uncertainty over the uptake of active travel. ▪ Medium confidence in major positive effects for LULUCF from greater carbon sequestration from creation of new greenspace and large-scale planting of trees. However, there is uncertainty surrounding the scale of green network enhancements. ▪ Medium confidence in minor positive effects for industrial, manufacture and construction processes due to reduced flood risk and impacts on property and infrastructure. ▪ High confidence in minor negative effects for electricity, and waste due to assumed limited emissions associated with these sectors. 				
Summary of lifecycle GHG balance (indirect effects)	No indirect effects identified.				
Overall summary of effect	<p>This proposed national development is likely to have net positive effects on lifecycle GHG emissions due to reduced transport emissions from higher uptake of active travel, reduced flood risk and greater rates of carbon sequestration due to the creation of new greenspace and large-scale planting of trees.</p> <p>The scale of this effect is likely to be in the range of medium to high as it will encourage a change in behaviour around active travel in central Scotland over a long time period. A medium scale of effect would result from higher embodied carbon in construction infrastructure, lower levels of active travel and lower levels of flood risk reduction. Conversely, lower embodied carbon in construction infrastructure, higher levels of active travel and higher levels of flood risk reduction would result in a higher scale of effect.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. However there is considerable uncertainty and this could be within the range of medium to high positive impact. Uncertainty about the scale of these effects means there is medium confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Maximise the scale of expansion, number of trees and type of development, whilst protecting existing high carbon soils.</p> <p>Ensure low carbon materials are used for associated infrastructure (seating, lighting, tree protective equipment etc).</p> <p>Consider the use of the green network for providing renewable heating.</p> <p>Ensure that green network is well linked with other active travel routes and public transport modes to further reduce potential emissions from transport.</p>				

Table A.7: Chapelcross Power Station Redevelopment

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Chapelcross Power Station Redevelopment	Business development with a particular focus on energy and energy supply chain with sustainable and active travel connections	Transport		Negligible negative effects from transportation of machinery and materials required for the development.	Negligible negative effects from transport relating to the operation of businesses based at the development, including workers commuting to/from the site, partly mitigated by provision of sustainable and active travel opportunities.		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Scale of business and employment generation is uncertain.
		Electricity			Negligible negative effects from electricity requirements for businesses based at the development	Negligible positive effects from indirect support for renewable energy generation		Unsure as to whether businesses will utilise the low carbon energy generated elsewhere within the development.
		Buildings/ Heat	Heat provided by unsustainable sources		Negligible negative effects from heat requirements for businesses based at the development			
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in construction materials used to build the development, and energy requirements of land remediation of potentially contaminated land.	Negligible negative effects from energy requirements of businesses based at the development.		Negligible negative effects from decommissioning of development	
		Waste		Negligible negative effects from waste produced during construction	Negligible negative effects from waste produced by businesses based at the development.		Negligible negative effects from decommissioning of development	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		LULUCF	Carbon stored in soils	Negligible negative because of the potential disturbance to soil and vegetation during construction.	Negligible positive effects from landscaping elements of the development may provide some opportunities for carbon sequestration.	Negligible positive from the use of a brownfield site and avoiding the use of a greenfield site.	Negligible negative effects from disturbance to soil and vegetation during decommissioning.	Unsure of the inclusion and scale of any landscaping
	Energy generation from solar, electricity storage, generation of heat	Transport	Existing emissions from vehicles	Negligible negative effects from transport of materials for the development of green energy generating storage and distribution facilities.	Negligible negative effects from commuting of workers to/from site, partly mitigated by provision of sustainable and active travel opportunities. Maintenance required during the operation of solar, storage and heat generation facilities		Negligible negative effects from decommissioning related transport of resources and waste for processing.	
		Electricity	Need for more green energy		Minor positive effects from increased electricity production from renewable energy. This will have lower GHG emissions compared to electricity from fossil fuels.	Minor positive effects from the role of the site supporting or as a catalyst for energy generation, storage and distribution. Battery storage facility provides greater reliability and security of energy supply by utilising intermittent supply of electricity from offshore wind and supporting additional offshore wind energy development.		Scale of solar energy generated is uncertain.
		Buildings/ Heat			Low carbon heat generation and use.			
		Industrial, manufacture and construction processes	Carbon stored in materials for construction	Negligible negative effects from carbon embodied in materials for the development and any associated infrastructure.	Negligible negative effects from energy requirements for the successful operation of the battery storage		Negligible negative effects from decommissioning of development infrastructure.	Scale of battery storage unknown.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				Battery storage facility may have high carbon footprint.	facility.			
		Waste		Negligible negative effects from waste material generated during the construction phases			Negligible negative effects from waste material generated during the decommissioning phases	
		LULUCF	Carbon stored in soils; reuse of land prevents disturbance of soils elsewhere	Negligible negative because of the potential disturbance to soil and vegetation during construction.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	Renewable hydrogen production	Transport		Negligible negative effects from transportation of staff, materials and equipment for the delivery of the development.	Negligible negative effects from transportation of hydrogen, including leakage.	Minor positive effects from hydrogen which provides a low carbon fuel for transport.	Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	
		Electricity			Negligible positive effects from use of surplus renewable electricity to generate renewable hydrogen.	Minor positive effects from renewable hydrogen as it facilitates renewable energy storage.		It is uncertain how much renewable hydrogen will be produced.
		Buildings/ Heat				Negligible positive effects from production of low carbon heating source		Impact will depend on the scale; how much renewable hydrogen will be produced
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of renewable hydrogen facilities.	Negligible negative effects from potential for hydrogen leakage. Fugitive emissions from transport of hydrogen.	Minor positive effects from hydrogen which provides low carbon fuel for industrial purposes.	Negligible negative effects from energy required for decommissioning	Will depend on the scale of the activities.
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
							decommissioning	
		LULUCF		Negligible negative because of the potential disturbance to soil and vegetation during construction.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	Low carbon hydrogen production	Transport		Negligible negative effects from transportation of staff, materials and equipment for the delivery of the development.	Negligible negative effects from energy requirements for transportation of oil and gas, hydrogen and captured carbon.	Minor positive effects from hydrogen which provides low carbon fuel for transport.	Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	
		Electricity			Minor negative effects from electricity required for carbon capture and storage.			It is uncertain how much low carbon hydrogen will be produced.
		Buildings/ Heat				Negligible positive effects from production of lower carbon heating source		Impact will depend on the scale; how much hydrogen will be produced
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of hydrogen and ammonia production and storage facilities.	Minor negative effects from energy required for hydrogen production; energy required for carbon capture, storage and utilisation. Use of oil and gas only in combination with CCUS. Potential for fugitive emissions from hydrogen, ammonia, oil and gas and CCUS (from production, distribution and storage).	Minor positive effects from hydrogen which provides a low carbon fuel for industrial purposes.	Negligible negative effects from energy required for decommissioning	Will depend on the scale of the activities. Low carbon hydrogen production dependent on oil and gas production.
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		LULUCF		Negligible negative because of the potential disturbance to soil and vegetation during construction.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	storage of hydrogen and ammonia	Transport		Negligible negative effects from transportation of staff, materials and equipment for construction of transport and storage infrastructure.	Negligible negative effects from energy requirements for transportation of hydrogen and ammonia.	Minor positive effects from hydrogen and ammonia storage and distribution infrastructure will enable use of hydrogen as a low carbon fuel for transport.	Negligible negative effects from transportation of staff, materials and equipment after decommissioning	Type and method of hydrogen and ammonia storage
		Electricity			Negligible negative effects from electricity required for hydrogen and ammonia storage.			
		Buildings/ Heat				Negligible positive effects from production of lower carbon heating source		Impact will depend on the scale; how much hydrogen will be produced
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials and equipment used for construction of transport and storage infrastructure. Energy required for construction.	Negligible negative effects from potential for fugitive emissions from hydrogen and ammonia storage.	Minor positive effects from hydrogen storage will enable use of hydrogen as a low carbon fuel for industrial purposes.	Negligible negative effects from energy required for decommissioning	Level of hydrogen and ammonia storage.
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	
		LULUCF		Negligible negative because of the potential disturbance to soil and vegetation during construction.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	

Table A.8: Chapelcross Power Station Redevelopment

Chapelcross Power Station Redevelopment					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transportation of machinery and materials required for the development.	Negligible negative effects from transport relating to the operation of businesses based at the development, and transportation of hydrogen and ammonia.	Minor positive effects from hydrogen which provides low or carbon fuel for transport. Hydrogen and ammonia storage and distribution infrastructure will enable use of hydrogen as a low carbon fuel for transport.	Negligible negative effects from decommissioning related transport of resources and waste for processing.	Minor negative GHG balance from transport. Medium confidence as this development is likely to lead to an increase in transport related emissions from the site, only partly mitigated by sustainable and active travel provision.
Electricity		Negligible positive effect from increased production of renewable electricity that will have lower GHG emissions compared to electricity from current fossil fuels, balanced against minor increases in electricity demand.	Minor positive effects from the role of the site supporting or as a catalyst for energy generation, storage and distribution. Energy storage facility provides greater reliability and security of energy supply by utilising the intermittent supply of electricity from offshore wind.		Minor positive GHG balance from electricity. Medium confidence, as although this development will generate renewable electricity it will also use electricity for operational activities.
Buildings (heat)		Neutral effects from heat requirements for businesses based at the development balanced by low carbon heat generation.	Minor positive effects from the production of hydrogen for low carbon heat		Neutral GHG balance from buildings (heat), medium confidence as it is assumed that heat generation is low/zero carbon and meets on site heat demands.
Industrial, manufacture and construction processes	Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of hydrogen production and storage facilities.	Minor negative effects from the potential for hydrogen leakage. Use of natural gas in combination with CCUS results in net emissions. Potential for fugitive emissions from hydrogen, natural gas and CCUS (from production, distribution and storage).	Minor positive effects from hydrogen as it will enable use of hydrogen as a low or zero carbon fuel (depending on whether renewable hydrogen or low carbon hydrogen is deployed) for industrial purposes.	Negligible negative effects from decommissioning of development.	Minor negative GHG balance from industrial processes. Medium confidence as it is due to embodied carbon in construction materials and potential for hydrogen and ammonia leakage during the operations.
Waste	Negligible negative effects from waste produced during construction.	Negligible negative effects from waste produced by businesses based at the development.		Negligible negative effects from decommissioning of development.	Minor negative GHG balance from waste, medium confidence as it is assumed the development will increase waste generation overall.
LULUCF	Negligible negative because of the potential disturbance to soil and vegetation during construction.	Negligible positive effects from landscaping elements of the development may provide some opportunities for carbon sequestration.	Negligible positive from the use of a brownfield site and avoiding the use of a greenfield site.	Negligible negative effects from disturbance to soil and vegetation during decommissioning.	Minor negative GHG balance from LULUCF, low confidence due to the small scale of landscaping potential.

Chapelcross Power Station Redevelopment					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Summary of GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Low confidence in minor positive effects arising from electricity because of the uncertainty around the amount of renewable electricity generated versus the amount of electricity required for site operations. ▪ Medium confidence in minor negative effects arising from transport as this development is assumed to generate additional transport. ▪ Medium confidence in minor negative emissions from industrial processes due to embodied carbon in materials for its construction and also it will lead to hydrogen and ammonia leakage during its operations. ▪ Low confidence in minor negative effects on LULUCF due to the small scale of landscaping potential at this site. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The development is likely to support and provide a catalyst for low carbon energy generation, storage and distribution which is likely to help displace emissions from current fossil fuel-based energy, including for transport, heat and industrial processes. The indirect positive effects could range from minor to moderate positive due to uncertainty over how much the development supports hydrogen for fuel or supports renewable energy development elsewhere.</p> <p>Negligible positive effects are identified in relation to LULUCF, as this development is likely to avoid using a greenfield site which could have led to more significant soil carbon and vegetation loss.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to the production of renewable and low carbon energy and support for energy related business development.</p> <p>The scale of effects could range from low negative to low positive. A low negative effect would result from a lower level of renewable / low carbon energy produced or stored, and lower levels of enabling support for renewable energy related development which could be insufficient to balance against the embodied energy of construction and on site energy demands and increase in transport emissions. Conversely, if the levels of renewable/low carbon energy production and storage are higher and the enabling effect of the development for renewable energy is greater a low positive effect could be achieved. An overall net positive effect is concluded based on the assumption of a higher level of renewable/low carbon energy production and storage.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the scale of these effects means there is low confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	<p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or at least recycled.</p> <p>Consideration of the type and scale of green energy generation and whether it can be used to provide electricity to the businesses forming the development.</p> <p>Consideration should be given to potential restoration of the development site (or individual components) upon decommissioning.</p> <p>Ensure public transport connections and links to active travel routes.</p>				

Table A.9: Circular Economy Materials Management Facilities

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Sites and facilities which will enable retaining value of waste materials (to maximise the use of materials in the economy and minimise the use of virgin materials)		Transport		Negligible negative effects from transportation of staff, materials and equipment for construction of the facilities.	Minor negative effects from transportation of materials to and from facilities. Increased travel to and from the site (supply of waste and distribution of reprocessed materials). Transportation of staff.		Negligible negative effects from transportation of staff, materials and equipment for decommissioning of the facilities.	Details on how many such facilities will be delivered.
		Electricity			Minor negative effects from electricity to process materials.			What percentage of the processes are going to be powered with renewable energy.
		Buildings/ Heat			Negligible negative effects from heat for processing of materials.	Minor positive effects where surplus by-products can be utilised, for example surplus heat.		
		Industrial, manufacture and construction processes	Existing waste processing facilities	Negligible negative effects from carbon embodied in the materials used for constructing of the facilities.	Negligible negative effects from potential emissions from processing of materials.	Minor positive effects from potential for new innovative businesses that would reuse new materials and displace carbon emissions from current processes.	Negligible negative effects from energy required for the decommissioning of the facilities.	
		Waste	Limited recycling for certain materials, recycling decreases value of materials, some materials are cheaper new than recycled.	Negligible negative effects from construction waste.	Significant positive effects from potential for reduced waste as materials will be reprocessed and recycled. Increased capacity for waste reprocessing, increased reuse of materials. Reduced amount of virgin materials used for manufacturing and production. Increased potential for plastics reprocessing, reduced amount of virgin plastic used in the supply chain.	Minor negative effects from greater potential for other innovative circular economy businesses to reuse new materials.		
		LULUCF		Negligible negative effects from loss of soil and vegetation/			Negligible negative effects from disturbance	Depending on the site chosen.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				through development at a brownfield site			to soil and vegetation.	

Table A.10: Circular Economy Materials Management Facilities

Circular Economy Materials Management Facilities						
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transportation of staff, materials and equipment for construction of the facilities.	Minor negative effects from transportation of materials to and from facilities (supply of waste and distribution of reprocessed materials) and staff commute.		Negligible negative effects from transportation of staff, materials and equipment for decommissioning of the facilities.	Minor negative GHG balance from transport. Medium confidence as this development is likely to significantly increase emissions from transport considering the timescale of the development, however in the longer-term it is uncertain how these vehicles will be fuelled.	
Electricity		Minor negative effects from electricity to process materials.			Minor negative GHG balance from electricity, with medium confidence as this development will require a significant amount of electricity, however it is uncertain what percentage of this will be renewable electricity.	
Buildings (heat)		Negligible negative effects from heat for processing of materials.	Minor positive effects where surplus by-products can be utilised, for example surplus heat.		Minor negative GHG balance from buildings (heat), medium confidence as it is not anticipated that this development will significantly increase the demand for heat.	
Industrial, manufacture and construction processes	Negligible negative effects from carbon embodied in the materials used for constructing of the facilities.	Negligible negative effects from the potential emissions from processing of materials.	Minor positive effects from the potential for new innovative businesses that would reuse new materials and displace carbon emissions from current processes.	Negligible negative effects from energy requirements for decommissioning.	Minor negative GHG balance from industrial processes with medium confidence as this development will lead to limited additional emissions compared to existing processing facilities.	
Waste	Negligible negative effects from construction waste.	Significant positive effects from the potential for reduced waste as materials will be reprocessed and recycled. Increased capacity for waste reprocessing, increased reuse of materials. Reduced amount of virgin materials used for manufacturing	Minor positive effects from greater potential for other innovative circular economy businesses to reuse new materials.		Major positive GHG balance for waste, high confidence as this development has the potential to reduce waste from a range of materials by repurposing and reusing them.	

Circular Economy Materials Management Facilities					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
		and production. Increased potential for plastics reprocessing, reduced amount of virgin plastic used in the supply chain.			
LULUCF	Negligible negative effects from the loss of soil and vegetation.			Negligible negative effects from disturbance to soil and vegetation.	Neutral GHG balance from LULUCF, low confidence as it is assumed that such facilities will be delivered on brownfield sites and having very little impact on soil and vegetation.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> Medium confidence in minor negative effects arising from transport as it is assumed that more complex supply chains may be developed which may increase the transport, but it is uncertain how such vehicles will be fuelled in the future. Medium confidence in minor negative effects from electricity and heat as materials processing will require additional electricity and heat, but there is uncertainty over the source of electricity or heat. Medium confidence in minor negative effects from industrial, manufacture and construction processes as it is assumed this development will lead to limited additional emissions compared to existing processing facilities. High confidence in significant positive effects in relation to waste as this development has the potential to reduce waste from a range of waste streams by keeping them in the loop, repurposing and reusing them. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>This development may potentially encourage more innovation and may enable some businesses to use new materials that will reduce the demand for virgin materials, with positive effects for industrial, manufacture and construction processes. Potential for positive effects where surplus by-products can be utilised, for example surplus heat.</p> <p>The indirect positive effects could range from minor to moderate due to uncertainty over the role of the development in reducing emissions from production and processing of raw materials.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to increased efficiency in waste management and use of raw materials</p> <p>The scale of the positive effects could range from low to high positive depending on the volume of waste reprocessed. If the amount of waste reprocessed is relatively minor, vehicle movements are higher, energy demands of reprocessing are higher from reprocessing the overall positive effects will be minor. However, if this development enables reprocessing at a significant scale, uses low carbon transport, from reprocessing , it will lead to high positive effects.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the scale of these effects mean that there is medium confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that where possible transport is decarbonised to reduce the overall emissions from this development and also from transport sector.</p> <p>Ensure use of waste heat where possible.</p> <p>Support on site low carbon energy generation.</p> <p>Support local processing and reuse where possible.</p> <p>Ensure development on brownfield land where possible.</p>				

Table A.11: Clyde Mission

Development	Sub-category	Source of emissions	Baseline	Stage of development			Decommissioning	Uncertainty
				Construction	Operations (direct)	Operations (indirect)		
Clyde Mission	Redevelopment of vacant and derelict land, upgrading buildings and facilities for residential, commercial, business and industrial uses; tackling contamination and climate adaptation	Transport		Negligible negative effects from transportation of staff, materials, and equipment for construction phase of the development.	Negligible negative effects from transport linked with resident's commute to work and education, or staff travel; maintenance of the development.		Negligible negative effects from transport of staff, materials, and equipment after decommissioning.	Uncertainty over scale of the development; number of housing units and employment units. Number of journeys generated. Extent of provision of other transport modes connections (bus, rail, active travel routes).
		Electricity			Negligible negative effects from electricity demand of residents and businesses from the development.			Impact depends on the scale and the energy sources
		Buildings/ Heat			Negligible negative effects from heat requirements for residents and businesses within the development.			Impacts depend on the type of heating provided for this development
		Industrial, manufacture and construction processes		Minor negative effects from embodied carbon in the materials used for construction. Energy required for construction and remediation of potentially contaminated land.	Negligible negative effects from potential emissions from business operations.		Negligible negative effects from energy required to decommission and recycle materials that can be reused.	Depends on the nature of businesses located within the development
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operational waste from households and businesses.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Depends on the scale of the development, number of households and the nature of the businesses; depends on the timeframes of this development

Development	Sub-category	Source of emissions	Baseline	Stage of development			Decommissioning	Uncertainty
				Construction	Operations (direct)	Operations (indirect)		
		LULUCF	Vacant and derelict land	Negligible negative effects from disturbance to soil and vegetation during the construction.	Negligible positive effects from potential for carbon sequestration through green and blue infrastructure as part of the development	Negligible positive effects from development on vacant and derelict land takes pressure off from greenfield land.	Negligible negative effects from disturbance to soil and vegetation during the decommissioning.	
	Upgrade of existing port and harbour assets for servicing marine functions including freight and cruise uses and associated landside commercial and/or industrial land for supporting services	Transport		Negligible negative effects from transportation of staff, materials, and equipment for construction phase of the development.	Negligible negative effects from additional land and water based transport.		Negligible negative effects from transport of staff, materials, and equipment when decommissioning.	Scale of the additional transport movements uncertain.
		Electricity			Negligible negative effects from electricity demand of port operations.			Impact depends on the scale and the energy sources
		Buildings/ Heat			Negligible negative effects from heat requirements for port buildings			Impacts depend on the type of heating provided for this development
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in the materials used for construction. Energy required for construction and remediation of potentially contaminated land.	Negligible negative effects from potential emissions from port and harbour operations.		Negligible negative effects from energy required to decommission and recycle materials that can be reused.	Depends on the nature of businesses located within the development
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operational waste from households and businesses.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Depends on the scale of waste generation from port and harbour operations

Development	Sub-category	Source of emissions	Baseline	Stage of development			Decommissioning	Uncertainty
				Construction	Operations (direct)	Operations (indirect)		
		LULUCF	Vacant and derelict land	Negligible negative effects from disturbance to soil and vegetation during the construction.		Negligible positive effects from development on vacant and derelict land takes pressure off from greenfield land.	Negligible negative effects from disturbance to soil and vegetation during the decommissioning.	

Table A.12: Clyde Mission

Clyde Mission					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transport activity for the construction of the development	Minor negative effects from transport for residents, business, employment, and marine transport.		Negligible negative effects from decommissioning transport.	Minor negative GHG balance from transport. Medium confidence based on the nature of development which will generate travel, and uncertainty over the extent of sustainable travel which will be used.
Electricity		Negligible negative effects from electricity demand for residents and businesses from the development			Minor negative GHG balance from increased energy demand. Medium confidence based on the fact that the development will provide residential and business units with unknown electricity demands, uncertainty over energy efficiency measures or renewable energy generation as part of the development.
Buildings (heat)		Negligible negative effects from heat requirements for residents and businesses within the development			Minor negative GHG balance for heat demand. Low confidence based on unknown energy demands of households or businesses and on an assumption that this development will exist for at least 25 years and will use sustainable heating sources.
Industrial, manufacture and construction processes	Minor negative effects from carbon embodied in the materials and energy required for construction.	Negligible negative effects from business operations			Minor negative GHG balance from carbon embodied in the materials. Medium confidence based on requirement for carbon heavy materials required for development, but uncertainty over use of low carbon construction materials.
Waste	Negligible negative effect of waste produced during the construction of the	Negligible negative effects from waste produced by residents and businesses		Negligible negative effect of waste materials after decommissioning.	Minor negative GHG carbon balance from additional waste produced. Medium confidence based on unknown levels of waste associated with businesses and number of residential units.

Clyde Mission					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	development.				
LULUCF	Negligible negative effects from disturbance to soil and vegetation during construction.	Negligible positive effect from potential for carbon sequestration from green and blue infrastructure	Negligible positive effects as development on vacant and derelict land takes pressure off from greenfield land.	Negligible negative effects from disturbance to soil and vegetation during construction.	Minor positive GHG balance from the potential for carbon sequestration through green and blue infrastructure over lifetime of development. Low confidence depending on the final details of the development.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in minor negative effects related to industrial, manufacture and construction processes based on an assumption that this development will require a significant amount of carbon heavy materials, although there is uncertainty over the use of low carbon construction materials. ▪ Medium confidence in minor negative effects related to transport, electricity and waste, based on assumptions that the development will encourage an increase in travel, electricity demand and waste production. ▪ Low confidence in relation to minor negative effects for buildings (heat) based uncertainty over the use of sustainable heating sources. ▪ Low confidence in minor positive effects from LULUCF based on an assumption that the impact of development and implementation of green and blue infrastructure are unknown. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The development is taking place on previously developed land, and it is assumed that the development reduces pressure on greenfield land and reduces potential transport emission generated from equivalent development on greenfield land with fewer sustainable transport connections and LULUCF associated emissions. The scale of this effect is likely to be minor, due to the regional effect of this development.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net negative effect on lifecycle GHG emissions due to increased emissions from transport, electricity, heat, industrial, manufacture and construction processes and waste. This development is likely to be delivered on vacant or derelict land which is assumed to protect greenfield sites from being developed.</p> <p>The scale of this effect is likely to be low depending on the uptake of sustainable transport modes and low carbon/energy efficiency solutions, and LULUCF benefits.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net negative impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the scale of these effects mean that there is medium confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that electricity and heat demand and supplied from renewable or low carbon sources to reduce potential emissions.</p> <p>Exploit the potential for green and blue infrastructure to ensure climate resilience and adaptation, and also potential for active travel.</p> <p>Ensure requirement for high energy efficiency of new and retrofitted buildings.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or at least recycled.</p>				

Table A.13: Digital Fibre Network

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Digital Fibre Network		Transport	Currently limited access to internet in more remote locations	Negligible negative effects from transport of new network towers, fibre cables, equipment for installation, some of the transportation will happen on the mainland, some at the sea (additional emissions from transport).	Negligible negative effects from maintenance related transport (may be more frequent accounting for climate change, towers and overground cables may be damaged by extreme weather conditions)	Negligible positive effects from potential for reductions in travel, especially work-related commuting. May also increase travel due to facilitation of decentralised economic development due to greater connectivity.	Decommissioning related transport of resources and waste for processing.	The exact areas where the work is going to be carried out is still to be defined
		Electricity			Negligible negative effects from energy requirements of towers and cables. Increased number of devices (however they have the potential to be more energy efficient), nevertheless they may lead to overall increased energy demand. This will also increase indirect energy demand from data centres, although for a relatively small number of users overall.		Negligible negative effects from energy requirements for processing waste materials after decommissioning of the infrastructure	It is uncertain how better connectivity across more remote locations will impact on energy use, it is likely that it will decrease the need to travel, however it may encourage usage of more devices, working from second homes may become more frequent.
		Buildings/ Heat				Negligible negative effects from increased heat demands from increased working from home.		
		Industrial, manufacture and construction processes		Negligible negative effects from embedded emissions from network equipment (may include cables, towers, routers and other devices)	Negligible negative effects from maintenance activities		Negligible negative effects from processing of waste materials	Lack of information on how many new towers this development will require, and what impact this may have on land take. .
		Waste					Negligible negative effects from potential for fibre cable and	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
							tower waste after decommissioning	
		LULUCF		Negligible negative effects from disturbance to soil and vegetation installation of cables, towers and green data centres during construction.	Neutral effects from maintenance of cables in the ground may lead to the loss of carbon if biomass needs to be removed over time to dig the cables for maintenance purposes, potential for carbon sequestration once cables are installed.		Neutral effects from decommissioning may include excavation to remove the cables or replacing them with new ones via conduits. Excavation will impact on the soil and land use emissions.	Lack of information on how many new towers this development will require, and what impact this may have on land take, where the cables are going to be laid, impact on high carbon soils and extent of new network and process of decommissioning?

Table A.14: Digital Fibre Network

Digital Fibre Network					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from construction transport.	Negligible negative effects from maintenance travel which may be more frequent considering climate change.	Minor positive effects from potential travel savings due to better digital connectivity		Minor negative GHG balance. Medium confidence based on assumed low levels of maintenance required.
Electricity		Negligible negative effects from the potentially increased number of devices used for internet.			Minor negative GHG balance from increase in electricity use. Medium confidence based on assumed increase in devices and internet use.
Buildings (heat)			Negligible negative effects from increased home working		
Industrial, manufacture and construction processes	Negligible negative effects from embodied emissions in construction materials	Negligible negative effects from maintenance activities		Negligible negative effects from processing of waste materials	Minor negative GHG balance, medium confidence due to uncertainty on scale of embodied carbon in new infrastructure.
Waste				Negligible negative effects from the cable and tower waste after decommissioning	Minor negative GHG balance, medium confidence reflecting uncertain energy requirements for processing waste or loss of embodied carbon in waste materials.

Digital Fibre Network					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
LULUCF	Negligible negative effects from disturbance of soil and vegetation during construction.			Negligible negative effects from decommissioning of the infrastructure (cables, cement, digging up soil)	Minor negative GHG balance, medium confidence due to uncertainty over extent of loss of sequestered carbon in soils and vegetation.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in minor negative effects arising from transport related to the assumed more frequent maintenance travel. ▪ Medium confidence in minor negative effects from electricity due to an assumed increase in the number of devices and internet use. ▪ Medium confidence in minor negative effects related to industrial, manufacture and construction processes from the embodied carbon in the materials. ▪ Medium confidence in minor negative effects for waste reflecting uncertain energy requirements for processing waste or loss of embodied carbon in waste materials. ▪ Medium of confidence in minor negative GHG balance for LULUCF, due to uncertainty over extent of loss of sequestered carbon in soils and vegetation. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The development is likely to support digital connectivity in less well-connected areas of the Highlands and Islands. There is low confidence over the scale of impact of indirect positive effects on transport. The indirect positive effects may only be minor due to uncertainty over reductions in travel for work, as increased connectivity may also encourage an increase in travel in the medium to long term. Increased home working may result in minor indirect negative effects on heat demand, however this is likely to be limited in scale.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a negligible effect on lifecycle GHG emissions as the potential increases in maintenance travel and electricity use, and industrial, manufacture and construction processes could be counterbalanced by reduced journeys from improved connectivity.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall negligible impact on achieving national greenhouse gas emissions reduction targets. Uncertainty over the balance between reductions in travel and increases in travel means there is low confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Avoid development of in areas with high carbon soil.</p> <p>Development of best practice guidance/regulation to ensure that fibre cables and tower construction do not impact on high carbon soils.</p> <p>Ensure cable laying utilises conduits or existing infrastructure for lower carbon future cable replacement.</p>				

Table A.15: Dundee Waterfront

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Dundee Waterfront	Mixed use development with new and or upgraded green and blue infrastructure and new and/or upgraded active and sustainable travel routes	Transport	Site centrally located with good links to public transport and with proximity to essential services. Areas of undeveloped brownfield land.	Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Negligible negative effects from increased travel resulting from the development, balanced by increased transport using sustainable and active travel modes.		Negligible negative effects from transportation of staff, materials and equipment for decommissioning.	Number of additional journeys generated.
		Electricity			Negligible negative effects from increased electricity demand from the operations of the development (household and business demand), lighting along the paths and at bus stops and public transport stations.	Minor positive effects due to supporting off-shore renewables production.		
		Buildings/ Heat			Negligible negative effects from increased demand for heat from residential and business premises			
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials and equipment used for construction, and energy required for construction.	Negligible negative effects from potential for emissions from business operations.		Negligible negative effects from energy required for decommissioning	Energy demands of business
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from construction waste and increased waste production from households, and business operations.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from disturbance to soil and vegetation during	Negligible positive effects from potential for carbon sequestration through green and blue		Negligible negative effects from disturbance to soil and vegetation during decommissioning.	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				construction.	infrastructure.			
	Land reclamation for port expansion and new or upgraded port facilities for vessel berthing and related landside activities including for lay-down, freight handling and marine sector services	Transport	Existing vessel emissions Most marine vessels and vehicles are fuelled by diesel	Negligible negative effects from transportation of machinery and materials required for the construction of manufacturing and support services and renewable energy development.	Mixed effects from the development. It will enable larger vessels to visit Dundee. These larger vessels may therefore travel more often to the harbour, however they will be more efficient. New or upgraded port facilities for vessel berthing and related activities may reduce journey length for vessels. It may also increase the number of vessels accessing the port. In addition, GHG emissions will arise from port workers commuting to/from work and maintenance activities.		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Unsure of the number of marine vessel journeys which will be made to/from the harbour.
		Electricity			Negligible negative effects from electricity requirements for the operational phase of the development.	Minor positive effects from renewable energy generation enabled by the port enhancements.		It is uncertain how much renewable electricity will be generated at this site or supported by it.
		Buildings/ Heat	Heating is dependent on fossil fuels		Negligible negative effects from heating for buildings.			
		Industrial, manufacture and construction processes	Existing facilities/buildings at the harbour. Carbon embodied within existing infrastructure	Minor negative effects from embodied carbon in new infrastructure and materials to be used in the development. Energy required for	Negligible negative effects from energy requirements for the operation of marine sector.		Negligible negative effects from decommissioning of development infrastructure. Energy required for decommissioning.	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				construction.				
		Waste		Negligible negative effects from waste material generated during the construction phases.	Negligible negative effects from operational waste.		Negligible negative effects from waste material generated during the decommissioning phases.	
		LULUCF	Previously developed land	Negligible Negative effects from disturbance to soil and vegetation during construction.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	

Table A.16: Dundee Waterfront

Dundee Waterfront						
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Minor negative effects from increased travel overall resulting from the development, including port related travel, partly balanced by high levels of use of sustainable and active travel modes.		Negligible negative effects from transportation of staff, materials and equipment for decommissioning.	Minor negative GHG balance from transport. Medium confidence as even though this development is likely to increase transport it is also assumed that sustainable and active provisions will be delivered and that over time it will become the most convenient transport mode.	
Electricity		Negligible negative effects from increased electricity demand from the operations of the development (household and business demand).	Minor positive effect from supporting off-shore renewable energy production.		Minor negative effects from electricity, medium confidence as it is uncertain to what extent renewable energy will be incorporated on site.	
Buildings (heat)		Negligible negative effects from increased demand for heat from residential and business premises			Minor negative effects from buildings (heat), due to increased heat demand, medium confidence as it is uncertain to what extent low carbon heat will be incorporated on site.	
Industrial, manufacture and construction processes	Minor negative effects from carbon embodied in the materials and equipment used for construction, and energy required for construction.	Negligible negative effects from the potential for emissions from business operations.		Negligible negative effects from the energy required for decommissioning	Minor negative GHG balance from industrial processes. Medium confidence as it is assumed that this development will require carbon heavy construction materials.	

Dundee Waterfront					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Waste	Negligible negative effects from construction waste.	Negligible negative effects from an increased waste production from households, and business operations.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Minor negative GHG balance from waste, high confidence as it is assumed that the development will increase overall levels of waste generated.
LULUCF	Negligible negative effects from the disturbance to soil and vegetation during the construction.	Negligible positive effects from the potential for carbon sequestration through green and blue infrastructure.		Negligible negative effects from the potential loss of soil and vegetation.	Neutral GHG balance from LULUCF, medium confidence as it is assumed that the development uses previously developed land and will incorporate green and blue infrastructure.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> Medium confidence in minor negative effects in relation to transport based on an assumption that this development will increase overall journeys but will also enable sustainable and active transport. Medium confidence in minor negative effects arising from electricity and heat due to increased demand and uncertainty over extent of renewable or low carbon electricity or heat incorporated into the development. Medium confidence in minor negative effects arising from industrial processes as it is assumed that carbon heavy materials will be required for the construction phase of the development. High confidence in minor negative effects from waste, as the development will increase overall levels of waste generated. Medium confidence in negligible GHG balance from LULUCF due to assumed use of previously developed land and incorporation of green and blue infrastructure. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions. The development is likely to support the decommissioning of the oil and gas industry and increase capacity of off-shore renewables. The scale of indirect effects is likely to be minor, however there is low confidence over the scale of indirect positive effects on electricity due to uncertainty over the quantity of renewables that will be supported by this development.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to the transport emissions being partly balanced by indirect support for renewable energy development.</p> <p>The scale of this effect is likely to be low positive to negligible, depending on the level of renewable energy supported by the development and the level of travel generated by the development. If a relatively small amount of renewable energy generation supported by this development negligible effects are expected, whereas if this development supports a significant amount of renewable energy generation then minor positive effects are expected. However, it is assumed that a significant amount of renewable energy capacity will be supported considering the location of the harbour in relation to off-shore renewables and the relatively large-scale expansion of the harbour.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty over the scale of effects means there is low confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that public transport connections are frequent and convenient to offer an effective alternative to private vehicles.</p> <p>Ensure that the site is connected with active travel network.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused or recycled.</p> <p>Implement district heating.</p> <p>Ensure renewable energy generation is incorporated into the development.</p>				

Table A.17: Edinburgh Waterfront

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Edinburgh Waterfront	Mixed use development with new or upgraded green and blue infrastructure and upgraded active and sustainable travel routes	Transport		Negligible negative effects from transportation of staff, materials and equipment for construction.	Minor negative effects from increased transportation to and from the development once operational (housing and employment sites).		Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	
		Electricity			Mixed effects from increased electricity demand from the development.			
		Buildings/ Heat			Minor negative effects from increased demand for heat from residential and business premises.			Whether any renewable or low carbon heating will be installed.
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials and equipment used for construction. Energy required for development.	Negligible negative effects from energy requirements of operational elements of the development.		Negligible negative effects from energy required for decommissioning.	
		Waste		Negligible negative effects from construction waste.	Minor negative effects from household and business waste.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from loss of soil and vegetation during construction.	Negligible positive effects from potential for carbon sequestration if green infrastructure is part of the development.		Negligible negative effects from disturbance to soil and vegetation during decommissioning.	Split of development on brownfield or greenfield land.
	New and/or upgraded port facilities for vessel berthing and related landside	Transport	Existing vessel emissions Most marine vessels and vehicles are	Negligible negative effects from transportation of machinery and materials required for the construction of	Minor negative effects from the development. It will enable larger vessels to visit Edinburgh. These larger vessels may therefore travel more often to the harbour,		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Unsure of the number of marine vessel journeys which will be made to/from the

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
	activities including for lay-down, and marine sector services.		fuelled by diesel	manufacturing and support services and renewable energy development.	however they will be more efficient. In addition, GHG emissions will arise from port workers commuting to/from work and maintenance activities.			harbour.
		Electricity			Negligible negative effects from electricity requirements for the operational phase of the development.	Minor positive effects from renewable energy generation enabled by the port enhancements.		It is uncertain how much renewable electricity will be generated at this site or supported by it.
		Buildings/ Heat	Heating is dependent on fossil fuels		Negligible negative effects from heating for buildings.			
		Industrial, manufacture and construction processes	Existing facilities/buildings at the harbour. Carbon embodied within existing infrastructure	Minor negative effects from embodied carbon in new infrastructure and materials to be used in the development. Energy required for construction.	Negligible negative effects from energy requirements for the operation of marine sector.		Negligible negative effects from decommissioning of development infrastructure. Energy required for decommissioning.	
		Waste		Negligible negative effects from waste material generated during the construction phases.	Negligible negative effects from operational waste.		Negligible negative effects from waste material generated during the decommissioning phases.	
		LULUCF	Previously developed land	Negligible negative effects from the disturbance to soil and vegetation during construction.			Negligible negative effects from disturbance to soil and vegetation.	

Table A.18: Edinburgh Waterfront

Edinburgh Waterfront					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transportation of staff, materials and equipment for the construction.	Minor negative effects from increased travel to and from the development once operational (harbour and port, housing and employment site).		Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	Minor negative GHG balance from transport, as it is expected that this development will lead to an increase in overall transport emissions from a high number of residents and marine transport. Medium confidence due to anticipated travel patterns with a high reliance on sustainable and low carbon transport.
Electricity	Negligible negative effects from electricity required for development.	Minor negative effects from an increased electricity demand from the development, partly balanced by support for offshore energy, which is assumed to be renewable.	Minor positive effects from renewable energy generation enabled by the port enhancements.	Negligible negative effects from electricity required for decommissioning.	Minor negative GHG balance from electricity, as it is expected that this development will lead to an increase in the overall electricity demand from a significant number of housing units. Medium confidence, as unknown if development may stipulate certain levels of renewable /low carbon energy generation or heating or the energy demands of the commercial and industrial uses.
Buildings (heat)		Minor negative effects from an increased demand for heat from residential and business premises.			Minor negative GHG balance from buildings (heat) as it is expected that this development will result in an increase in the overall heat demand. Medium confidence, as unknown if development may stipulate certain levels of renewable heat generation.
Industrial, manufacture and construction processes	Minor negative effects from carbon embodied in the materials and equipment used for construction.	Negligible negative effects of energy requirements of employment elements of the development.		Negligible negative effects from energy required for decommissioning.	Minor negative GHG balance from industrial processes. Low confidence due to unknown nature of operational energy demands.
Waste	Negligible negative effects from construction waste.	Minor negative effects from household and business waste.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Minor negative GHG balance from waste as this development is likely to increase the overall waste production. High confidence due to the assumed number of households.
LULUCF	Negligible negative effects from the loss of soil and vegetation.	Negligible positive effects from the potential for carbon sequestration if green infrastructure is part of the development.		Negligible negative effects from the disturbance to soil and vegetation.	Negligible GHG balance from LULUCF, as this development is likely to result in the loss of soil and vegetation however it has the potential to increase sequestration over the lifetime of the development. Low confidence due to lack of information on existing soil and vegetation carbon stores and extent of new green infrastructure.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in minor negative effects related to the assumed increased transport, due to uncertainty over the potential for the greater uptake of sustainable travel. ▪ Medium confidence related to the assumed increase in the overall electricity and heat demand. 				

Edinburgh Waterfront					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	<ul style="list-style-type: none"> Medium confidence in minor negative emissions from industrial processes as it is assumed that this development will require carbon heavy construction materials. High confidence in minor negative effects related to the assumed increased amount of waste produced. 				
Summary of lifecycle GHG balance (indirect effects)	This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions. The development is likely to support the increasing capacity of off-shore renewables. The scale of indirect effects is likely to be minor, however there is low confidence over the scale of indirect positive effects on electricity due to uncertainty over the quantity of renewable energy that will be supported by this development.				
Overall summary of effect	<p>It is likely that this development will have a net positive effect on lifecycle GHG emissions due to the indirect positive effect from the support for the renewables industry which is judged to outweigh the negative direct effects of the development from the provision of housing, employment and industry leading to increased GHG emissions from transport, electricity and heat demand.</p> <p>The scale of this effect could range from low positive to negligible positive depending on the uptake of sustainable travel, energy efficiency measures, potential blue and green infrastructure, the nature of industries based within the development and their potential emissions, and the scale of support for the renewable sector. There is considerable uncertainty over the scale of renewable energy enabled by this development. If the scale is significant then this development could have low positive effects, whereas if the amount of renewable energy enabled is relatively minor it would lead to negligible positive effects.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty over the scale of these effects means there is low confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that active travel routes are provided to the site and across the site.</p> <p>Ensure that good public transport connections are secured and delivered pre-completion of the development.</p> <p>Ensure that high levels of renewable energy and heat are installed.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or at least recycled.</p> <p>Ensure that green infrastructure opportunities are implemented across the development.</p> <p>Ensure that low carbon heating is installed for residential heating and ensure requirement for high energy efficiency buildings.</p>				

Table A.19: High Speed Rail

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
High Speed Rail	high speed rail services between Glasgow and Edinburgh and onward to cities in England and mainland Europe including upgrades to track and electrification, new stations and new depot facilities.	Transport	Currently, trains within the UK and Scotland do not offer connections that are time or cost competitive to flying.	Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Significant positive effects from significant potential to reduce emissions from transportation if more people use trains for travel between Scottish cities, other UK areas and to Europe, supporting a modal shift from air to rail.	Minor positive effects from reduction in domestic air travel from Scotland to the UK and Europe.	Negligible negative effects from transportation of staff, materials and equipment for the decommissioning stage of the development.	Number of stations in total that will need to be constructed in Scotland
		Electricity			Negligible negative effects from increased electricity demand to power trains and provide electricity to new stations.			
		Buildings/ Heat			Negligible negative effects from increased demand for heat for new train stations.			
		Industrial, manufacture and construction processes		Minor negative effects from carbon embodied in the materials and equipment used for construction of multi-modal stations, depot facilities and infrastructure, and energy for construction			Negligible negative effects from energy required for decommissioning.	
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from waste from operations.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Minor negative effects from loss of soil and vegetation through a construction of new stations, railway and depot facilities.	Negligible negative effects from maintenance of vegetation along the railway during the operational phase to provide clearance for tracks and power lines.		Negligible negative effects from disturbance to soil and vegetation.	Where will the railway be built?

Table A.20: High Speed Rail

High Speed Rail					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Significant positive effects from the potential to reduce emissions from transportation if more people will use trains for travel between Scottish cities, other UK areas and to Europe.	Minor positive effect from reduction in domestic air travel from Scotland to the UK and Europe.	Negligible negative effects from transportation of staff, materials and equipment for the decommissioning stage of the development.	Major positive GHG balance from transport, medium confidence as this development can divert emissions from private cars and aircraft to trains which can significantly reduce the overall transport emissions, although there is uncertainty over the level of modal shift.
Electricity		Negligible negative effects from an increased electricity demand to power trains and provide electricity to new stations.			Negligible GHG balance from electricity, medium confidence as even though this development will increase the demand for electricity it is assumed that renewable energy will be used.
Buildings (heat)		Negligible negative effects from an increased demand for heat for new train stations.			Minor negative GHG balance from buildings, medium confidence as it should lead to a small increase in heat demand.
Industrial, manufacture and construction processes	Minor negative effects from carbon embodied in the materials and equipment used for construction (steel, concrete, glass, etc.) and energy for construction.			Negligible negative effects from energy required for decommissioning.	Minor negative GHG balance from industrial processes, high confidence as due to the nature of this development significant requirement for carbon heavy materials.
Waste	Negligible negative effects from construction waste.	Negligible negative effects from waste from operations.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Minor negative GHG balance from waste, medium confidence as overall it should not lead to any significant increase in waste production. Majority of the materials use for rail infrastructure can be fully recycled.
LULUCF	Minor negative effects from the loss of soil and vegetation through a construction of new stations and railway.	Negligible negative effects from the maintenance of vegetation along the railway during the operational phase to provide clearance for tracks and power lines.		Negligible negative effects from the disturbance to soil and vegetation.	Minor negative GHG balance from LULUCF, medium confidence as this development will require land take for infrastructure, although impacts on high carbon soils are unknown.
Summary of lifecycle GHG balance (direct effects)	This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on: <ul style="list-style-type: none"> ▪ Medium confidence for major positive effects in relation to transport as this development could divert emissions from private cars and aircraft to trains reducing the overall emissions, although there is uncertainty over the level of this modal shift, it is likely to occur over a long timeframe. ▪ High confidence in minor negative effects in relation to industrial, manufacture and construction processes as due to the nature of this development a lot of carbon heavy materials will be required. ▪ Medium confidence in minor negative effects from buildings and waste as electricity is assumed to be from renewable sources and limited waste will be generated. ▪ Medium confidence in minor negative effects in relation to LULUCF as this development will require land take and vegetation maintenance. 				
Summary of lifecycle GHG balance	This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.				

High Speed Rail					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
(indirect effects)	This development will provide high speed rail which has the potential to reduce domestic air travel to the UK and Europe and the associated transport GHG emissions. The indirect positive effects are likely influence travel across the UK and occur over the long term. There is low confidence in indirect positive effects as there is uncertainty to how much air travel will be reduced.				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to displacement of emissions from private cars and air travel over a long time period</p> <p>The scale of this effect could range from negligible to high positive depending on the level of uptake of train travel. If this development enables a significant amount of modal shift from private car and aeroplane to train, then a high positive effect is expected. Whereas, if this development enables to only a relatively small modal shift, negligible effects are expected.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the scale of these effects means there is low confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that renewable energy is provided for running of the train services.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or at least recycled.</p> <p>Ensure that the development avoids high carbon soils or areas important for carbon sequestration.</p> <p>Ensure limitations on comparable air routes and competitive pricing to support use of rail.</p>				

Table A.21: Hunterston Strategic Asset

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Hunterston Strategic Asset	Electricity generation (of or exceeding 50 megawatts) and related infrastructure	Transport	Emissions from vehicles	Negligible negative effects from transport of materials for the construction phase of the development.	Negligible negative effects from transport emissions relating to the occasional maintenance required during the operation electricity generation facilities.		Negligible negative effects from decommissioning related transport of resources and waste for processing.	
		Electricity	Need for more green energy		Minor positive effects from increased electricity production, including from renewable energy. This will have lower GHG emissions compared to electricity from current fossil fuels.			Uncertainty surrounding the scale of renewable energy generation. Uncertainty whether the port supports the renewable energy industry more widely through construction and maintenance.
		Buildings/ Heat						
		Industrial, manufacture and construction processes	Carbon stored in materials for construction	Negligible negative effects from carbon embodied in materials for the construction phase of the development and any associated infrastructure. Energy required for construction.	Negligible negative effects from carbon embodied in the materials used for maintenance.	Minor positive effects from greater production of renewable energy will enable industrial production to displace emissions from current fossil fuels	Negligible negative effects from decommissioning of development infrastructure. Energy required for decommissioning.	Uncertainty surrounding the scale and type of renewable energy generation.
		Waste		Negligible negative effects from waste material generated during the construction phases			Negligible negative effects from waste material generated during the decommissioning	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		LULUCF	Carbon stored in soils; reuse of land prevents disturbance of soils elsewhere	Negligible negative effects from the disturbance to soil and vegetation during construction.			Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	
	Low carbon hydrogen production and infrastructure and hydrogen related chemical production (ammonia)	Transport		Negligible negative effects from transportation of materials for required infrastructure	Minor negative effects from staff commuting to work and maintenance. Increased transport movement linked to the supply of natural gas and hydrogen.	Minor positive effects as hydrogen provides low carbon fuel for transport. Greater deployment of hydrogen in shipping and heavy transport (HGVs/buses) will reduce or displace GHG emissions from current fossil fuels.	Negligible negative effects from transport of waste materials to disposal or recycling location	Emissions from transport at the operations stage may have a greater impact depending on the scale of the development. If a significant amount of hydrogen is produced, there will be a larger amount of natural gas required (more emissions from production and transport)
		Electricity	Currently, insufficient low carbon electricity to meet the demand (and achieve net-zero)		Minor negative effects from electricity required for carbon capture and storage.			Amount of low carbon hydrogen produced is unknown. Uncertain whether desalinisation is required.
		Buildings/ Heat	Emissions from existing fossil fuel-based power plants and difficult to decarbonise industries.			Negligible positive effects from production of a lower carbon heating source for commercial and industrial uses.		Impact will depend on the scale; how much hydrogen will be produced
		Industrial, manufacture and construction processes	carbon locked in natural gas	Negligible negative effects from carbon embodied in the construction materials. Energy requirements	Minor negative effects from increased use of natural gas in combination with CCUS. Potential for fugitive emissions	Minor positive effects as hydrogen provides low carbon fuel for industrial purposes and will displace GHG emissions	Negligible negative effects from energy requirements of decommissioning.	Uncertain how much hydrogen will be produced.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				during construction of hydrogen production facilities, and CCUS/ SMR facilities.	from hydrogen, ammonia, natural gas and CCUS. Leakage of hydrogen, ammonia, or fossil fuels during transportation.	from fossil fuels without carbon capture. Provision of lower carbon fuel for carbon intensive industries.		
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from disposal waste materials from production plant that cannot be reused or recycled	
		LULUCF		Negligible negative effects from the disturbance to soil and vegetation from construction.		Negligible positive effects from reusing brownfield land and avoiding development on greenfield land.	Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	
	Renewable hydrogen generation and infrastructure	Transport		Negligible negative effects from transportation of materials and equipment for the delivery of the development.	Negligible negative effects from transportation of hydrogen, and staff commuting to work and for maintenance purposes.	Minor positive effects from hydrogen as it provides low carbon fuel for transport.	Negligible negative effects from transportation waste materials and equipment after decommissioning.	
		Electricity				Minor positive effects from renewable hydrogen as it facilitates use of surplus renewable electricity to generate renewable hydrogen.		It is uncertain how much renewable hydrogen will be produced.
		Buildings/ Heat				Negligible positive effects from production of low carbon heating source		Impact will depend on the scale; how much renewable hydrogen will be produced

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of hydrogen production facilities.	Negligible negative effects from potential for hydrogen leakage. Fugitive emissions from transport of hydrogen.	Minor positive effects as hydrogen provides low carbon fuel for industrial purposes.	Negligible negative effects from energy required for decommissioning	Will depend on the scale of the activities.
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	
		LULUCF	Carbon stored in soils; reuse of land prevents disturbance of soils elsewhere	Negligible negative effects from loss of and disturbance of soil and vegetation.		Negligible positive effects from reusing brownfield land and avoiding development on greenfield land.	Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	energy storage	Transport		Negligible negative effects from minor negative effects for transportation of materials and machinery to deliver the construction phase of the project	Negligible negative effects from transport emissions relating to the ongoing maintenance of the low carbon and renewable hydrogen storage facility.		Negligible negative effects from minor negative effects for transportation of waste materials and machinery during decommissioning	
		Electricity	Increasing offshore wind energy			Minor positive effects as hydrogen storage facility provides greater reliability and security of energy supply by utilising intermittent supply		Uncertain as to the scale of battery storage and how much electricity this can supply.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
						of energy from offshore wind and supporting additional offshore wind energy development.		
		Buildings/Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in materials used for the construction of the hydrogen storage facility.	Negligible negative effects from energy requirements for the successful operation of the hydrogen storage facility.	Negligible positive effects from hydrogen storage facility provides greater reliability and security of energy supply.	Negligible negative effects from decommissioning of the hydrogen storage facility.	Scale of hydrogen storage facilities uncertain.
		Waste		Negligible negative effects from waste material generated during the construction phases			Negligible negative effects from waste material generated during the decommissioning phases	
		LULUCF	Carbon stored in soils; reuse of land prevents disturbance of soils elsewhere	Negligible negative effects from loss of soil and vegetation on brownfield site.		Negligible positive effects from reusing brownfield land and avoiding development on greenfield land.	Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	Infrastructure to support a multi-modal deep water harbour including buildings for industrial, commercial, research and training, facilities for marine energy generation fabrication, decommissioning, and servicing.	Transport		Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Minor negative effects from increased transportation due to an improved harbour infrastructure		Negligible negative effects from transportation of staff, materials and equipment for decommissioning.	
		Electricity			Negligible negative effects from electricity demand for the port's operations.			

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		Buildings/ Heat			Negligible negative effects from heat required for the operations of the development.			
		Industrial, manufacture and construction processes		Minor negative effects from carbon embodied in the materials used for construction of harbour upgrades and infrastructure.	Negligible negative effects from potential emissions from port operations.		Negligible negative effects from energy required for decommissioning.	Depending on the nature and scale of operations carried out at the port.
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operational waste.		Negligible negative effects from waste from materials which cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from loss of soil and vegetation on brownfield site.			Negligible negative effects from the disturbance to soil and vegetation during the decommissioning.	
	transport network, including active travel links	Transport		Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Mixed effects from increased transportation due to a new road network and active travel paths.		Negligible negative effects from transportation of staff, materials and equipment for decommissioning.	Depending on the scale of uptake of active travel transport mode.
		Electricity			Negligible negative effects from electricity demand for lighting for the roads and active travel paths and other infrastructure electricity demand.			
		Buildings/ Heat						

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials used for construction of this infrastructure. Energy required for construction.			Negligible negative effects from energy required for decommissioning.	
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials which cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from disturbance to soil and vegetation.	Negligible positive effects from potential for regeneration of soil and vegetation along the roads.		Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	broader range of commercial activity	Transport		Negligible negative effects from transportation of staff, materials and equipment for the construction phase of the development.	Negligible negative effects from increased transport movement to and from facilities as employment sites		Negligible negative effects from transportation of staff, materials and equipment for decommissioning.	
		Electricity			Negligible negative effects from electricity demand for the commercial operations.			Uncertainty about the source of electricity for this development.
		Buildings/ Heat			Negligible negative effects from heat demand for operations.			
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials used for construction of	Negligible negative effects from potential emissions from industrial operations including potentially contaminated land		Negligible negative effects from energy required for decommissioning.	Uncertainty of the nature of businesses and their scale.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				this infrastructure. Energy required for construction.	remediation works.			
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operational waste.		Negligible negative effects from waste from materials which cannot be recycled after decommissioning.	Uncertainty of the scale of waste produced by the commercial activity.
		LULUCF		Negligible negative effects from loss of soil and vegetation on brownfield site.			Negligible negative effects from the disturbance to soil and vegetation.	
	Sustainable flood risk management solutions	Transport		Negligible negative effects from transport emissions from construction activities related to the development of flood management solutions	Negligible negative effects from transport activities relating to ongoing maintenance of flood management solutions		Negligible negative effects from transport of materials and waste after decommissioning	
		Electricity						
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon within construction materials, and energy use required during construction of hard and soft flood defences.		Negligible positive effects from flood risk management avoids the GHG emissions associated with clean up and replacement property from flood events.	Negligible negative effects from energy requirements of decommissioning of flood defences.	
		Waste		Negligible negative effects from waste material generated during the construction			Negligible negative effects from waste material generated during the construction phases	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				phases				
		LULUCF		Mixed negligible effects from loss of carbon in soils on land from construction of flood defences Creation and/or enhancement of existing green space to be used as natural flood defences (e.g., maximising flood plains, enhancing riverbanks, SuDS and landscaping)	Minor positive effects from enhanced carbon sequestration through sustainable flood management with biodiversity enhancement.			Scale is uncertain.

Table A.22: Hunterston Strategic Asset

Hunterston Strategic Asset						
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transport of materials for the construction of the elements of the development.	Minor negative effects from staff commuting to work and maintenance. Increased transport movement linked to the supply of natural gas and hydrogen, and upgrades to infrastructure of multi-modal deep water harbour that will enable more activity. Leakage of hydrogen or fossil fuels during transportation.	Minor positive effects from renewable and low carbon hydrogen as it provides low carbon fuel for transport. Greater deployment of hydrogen in shipping and heavy transport (HGVs/buses) will displace GHG emissions from current fossil fuels.	Negligible negative effects from decommissioning related transport of resources and waste for processing.	Minor negative GHG balance from transport as this development is likely to increase the overall transport emissions from the site due to increased journeys and the transport of natural gas and hydrogen will result in GHG emissions. Medium confidence as the level of additional journeys is uncertain, and the extent of low carbon and renewable hydrogen production is unknown.	
Electricity		Minor positive effects from an increased electricity production from renewable energy. This will have lower GHG emissions compared to electricity from	Minor positive effects from increased use of surplus renewable energy which will displace emissions from current fossil fuels and		Minor positive GHG balance from electricity, as the development supports increased electricity production from renewable sources. Low confidence as it is uncertain how much renewable electricity will be produced. It is	

Hunterston Strategic Asset					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
		fossil fuels, partly balanced by increased energy demand from some processes.	increase efficiency of renewable energy produced.		uncertain whether there will be demand for desalinisation for hydrogen production and whether this will be powered by electricity, and if so, whether the electricity would be renewable.
Buildings (heat)		Negligible negative effect from heat demand for commercial operations.	Minor positive effects from the production of hydrogen as a lower carbon heating source.		Minor negative GHG balance from buildings (heat). High confidence as it is assumed limited heat requirement from the development.
Industrial, manufacture and construction processes	Negligible negative effects from carbon embodied in materials for the construction of renewable energy schemes and any associated infrastructure, hydrogen production facilities and upgrades to oil and gas infrastructure to facilitate low carbon hydrogen production and CCS. Energy required for construction and land remediation.	Minor negative effects from the use of natural gas in combination with CCUS for hydrogen production. Potential for fugitive emissions of hydrogen, ammonia, natural gas and carbon dioxide from CCUS. Increased demand for natural gas for the operations process.	Minor positive effects from hydrogen as it provides low carbon fuel for industrial purposes and will displace GHG emissions from current fossil fuels. Provision of lower carbon fuel for carbon intensive industries.	Negligible negative effects from decommissioning of development infrastructure. Energy required for decommissioning.	Minor negative GHG balance from industrial processes as this development will continue reliance on fossil fuels such as natural gas. Low confidence as it is uncertain how much low carbon and renewable hydrogen will be produced.
Waste	Negligible negative effects from waste material generated during the construction phases of renewable energy schemes	Negligible negative effects from the operational waste.		Negligible negative effects from waste material generated during the decommissioning phases of renewable energy schemes	Minor negative GHG balance from waste, medium confidence as it is assumed the development will increase overall waste production but at a limited scale.
LULUCF	Negligible negative effects from disturbance to soil and vegetation during the construction.	Minor positive effects from enhanced carbon sequestration through sustainable flood management.		Negligible negative effects from the disturbance to soil and vegetation during decommissioning. .	Minor positive GHG balance from LULUCF as this development will enable greater carbon sequestration also sustainable flood management. Low confidence as the scale of this element of the development is uncertain.
Summary of lifecycle GHG balance (direct effects)	This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on: <ul style="list-style-type: none"> ▪ Medium confidence in minor negative effects arising from transport as it is assumed that there will be an increase in transport movements and vehicles will be fossil fuel powered. ▪ High confidence in minor positive effects in relation to electricity as it is assumed that more electricity will be produced than consumed by other processes at the site, although there is uncertainty over the scale of production of renewable energy in excess of 50 megawatts. ▪ High confidence in minor negative effects from heat due to assumed increase in heat demand. 				

Hunterston Strategic Asset					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	<ul style="list-style-type: none"> Low confidence in minor negative effects in relation to industrial processes as it is uncertain how much low carbon and renewable hydrogen respectively will be produced and uncertainty generally regarding the deployment of new and emerging technologies. Low confidence in minor positive effects from LULUCF as the development will enable carbon sequestration through sustainable flood management as it is assumed it will include green infrastructure, although the scale is uncertain. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The development is likely to support renewable energy and renewable and low carbon hydrogen production which is likely to enable displacement of GHG emissions from fossil fuel-based energy sources with and without carbon capture for electricity, transport and heat.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to support for renewable and low carbon hydrogen production, and electricity generation from renewable energy, increasing the renewable energy supply and security of supply over a long time period.</p> <p>The scale of these effects could range from low to high positive depending on the scale of electricity generation and storage, and the scale of use of fossil fuels. This development can deliver high positive effects if it will generate and store a significant amount of renewable and lower carbon energy displacing emissions from current fossil fuels. However, if this development delivers only a small amount of renewable or lower carbon energy then low positive effects are expected.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets.</p> <p>Uncertainty about the scale of these effects means there is medium confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or recycled.</p> <p>Ensure that heat is renewable or low carbon.</p>				

Table A.23: Industrial Green Transition Zone

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Hydrogen production	Low carbon hydrogen production,	Transport		Negligible negative effects from transportation of materials for required infrastructure	Negligible negative effects from staff commuting to work and maintenance. Increased transport movement linked to the supply of natural gas and hydrogen.	Minor positive effects from hydrogen provides low carbon fuel for transport. Greater deployment of hydrogen in shipping and heavy transport (HGVs/buses) will displace GHG emissions from current fossil fuels.	Negligible negative effects from transport of waste materials to disposal or recycling location	
		Electricity	Currently, insufficient low carbon electricity to meet the demand (and achieve net-zero)					Amount of low carbon hydrogen produced is unknown. Uncertain whether desalinisation is required if insufficient freshwater availability. Uncertain if desalinisation is powered by electricity or fossil fuel.
		Buildings/ Heat	Emissions from existing fossil fuel-based power plants and difficult to decarbonise industries.			Minor positive effects from production of lower carbon heating source.		Impact will depend on the scale; how much hydrogen will be produced
		Industrial, manufacture and construction processes	Carbon locked in natural gas	Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of	Minor negative effects from use of natural gas in combination with CCUS. Potential for fugitive emissions from hydrogen, and	Minor positive effects from hydrogen provides low carbon fuel for industrial purposes and will displace GHG emissions	Negligible negative effects from transport of waste materials to disposal or recycling location	Amount of low carbon hydrogen produced is unknown. Uncertain whether desalinisation is required if

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				hydrogen production facilities, and CCUS/ SMR facilities.	natural gas . Increased demand for natural gas for the hydrogen production process.	from current fossil fuels. Provision of lower carbon fuel for carbon intensive industries.		insufficient freshwater availability. Uncertain if desalinisation is powered by electricity or fossil fuel. If a significant amount of hydrogen is produced there will be a larger amount of natural gas required (greater fugitive emissions)
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from disposal waste materials from production plant that cannot be reused or recycled	
		LULUCF		Negligible negative effects from loss of soil and vegetation on brownfield and greenfield sites.			Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	
Hydrogen processing for storage	Pumping and compression equipment, and storage areas	Transport		Negligible negative effects from transport of staff, materials and equipment for construction.	Negligible negative effects from maintenance travel.		Negligible negative effects from transport of staff, materials and equipment for decommissioning.	
		Electricity			Negligible negative effects from electricity required for the compressor to operate.			
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in pumping and compression equipment. Energy requirements for the	Negligible negative effects from potential for leakage of hydrogen and ammonia during the storage phase.			

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				construction of storage facilities.				
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from disposal of waste materials that cannot be reused or recycled	
		LULUCF		Negligible negative effects from loss of soil and vegetation on brownfield and greenfield sites.			Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	
Carbon Capture Utilisation and Storage (CCUS)	CCUS (including upgrades to/ new pipelines for transport of carbon; structures for carbon capture, storage plant and facilities)	Transport		Negligible negative effects from transportation of staff, materials and machinery required for construction	Negligible negative effects from energy requirements for transportation of oil and gas and captured carbon. Maintenance travel and travel associated with workers commuting to/from the development.	Minor positive effects from development of CCUS infrastructure supports the production of low carbon hydrogen which can be used as a lower carbon fuel for transport, displacing fossil fuels without carbon capture.	Negligible negative effects from transportation of staff, materials and machinery after decommissioning	
		Electricity			Minor negative effects from electricity required for CCUS operations, such as pumping and compression			
		Buildings/Heat				Negligible positive effects from development of CCUS infrastructure supports the production of low carbon hydrogen which can be used as a lower carbon heating source, displacing fossil fuels without		

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
						carbon capture.		
		Industrial, manufacture and construction processes		Negligible negative effects from energy required for the construction of infrastructure to enable CCUS.	Minor negative effects from use of oil and gas only in combination with CCUS. Potential for fugitive emissions from oil and gas, and CCUS (from production, distribution and storage).	Minor positive effects from development of CCUS infrastructure supports the production of low carbon hydrogen which can be used as a low carbon fuel for industrial purposes.	Negligible negative effects from energy required for the decommissioning of the development.	Will depend on the scale of the activities. Low carbon hydrogen production dependent on oil and gas production. Timescales of CCUS untested.
		Waste		Mixed negligible effects from waste from construction and reuse of existing oil and gas infrastructure (such as pipelines)			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	
		LULUCF		Negligible negative effects from loss of soil and vegetation on brownfield and greenfield sites.			Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	Uncertain if site is brownfield or greenfield.
	Bioenergy	Transport		Negligible negative effects from transport of staff, materials and equipment for construction.	Minor negative effects from transportation of materials for production of bioenergy.		Negligible negative effects from transport of staff, materials and equipment for decommissioning.	Uncertain if the bioenergy is used for electricity or heat or only carbon capture.
		Electricity			Minor positive effects from the lower carbon energy produced.			
		Buildings/Heat			Minor positive effects from lower carbon heat produced.			
		Industrial, manufacture and construction		Negligible negative effects from embodied carbon	Negligible negative effects from the potential of carbon leakage during the			

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		processes		bioenergy facility.	bioenergy production process.			
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from disposal of waste materials that cannot be reused or recycled	
		LULUCF		Negligible negative effects from the construction of biofuel facility.	Negligible negative effects from harvesting biofuels.		Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	Net negative emissions technologies with CCUS	Transport		Negligible negative effects from transport related to construction activities.	Minor negative effects related with transportation of biomass for burning over the lifetime of the development.		Negligible negative effects from decommissioning.	
		Electricity			Minor positive effects from the lower carbon energy produced and carbon captured.			
		Buildings/Heat			Minor positive effects from lower carbon heat produced.			
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon bioenergy facility and/or facilities for direct air carbon capture.	Negligible negative effects from the potential of carbon leakage during the bioenergy production process.			
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from disposal of waste materials that cannot be reused or recycled	
		LULUCF		Negligible negative effects from the disturbance to soil and vegetation during construction.	Minor negative effects from land use disturbance from harvesting biofuels.		Negligible negative effects from the disturbance to soil and vegetation decommissioning.	
		Negative Emissions			Minor positive effects from net			

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		Technologies			carbon removal			
	CCS on existing or replacement thermal power plant	Transport		Negligible negative effects from transportation of materials for required infrastructure	Negligible negative effects from staff commuting to work and maintenance. Increased transport movement linked to the supply of natural gas.		Negligible negative effects from transport of waste materials to disposal or recycling location	Emissions from transport at the operations stage may have a greater impact depending on the scale of the development.
		Electricity	Currently, insufficient low carbon electricity to meet the demand (and achieve net-zero)		Minor positive effects from producing a lower carbon energy source.			
		Buildings/ Heat	Emissions from existing fossil fuel-based power plants and difficult to decarbonise industries.			Negligible positive effects from production of a lower carbon heating source for commercial and industrial uses.		
		Industrial, manufacture and construction processes	Carbon locked in natural gas	Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of hydrogen production facilities, and CCUS/ SMR facilities.	Minor negative effects from increased use of natural gas in combination with CCUS. Potential for fugitive emissions from natural gas and CCUS. Leakage of fossil fuels during transportation.	Minor positive effects from provision of lower carbon fuel for carbon intensive industries.	Negligible negative effects from energy requirements of decommissioning.	
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from disposal waste materials from production plant that cannot be reused or recycled	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		LULUCF		Negligible negative effects from disturbance to soil and vegetation.			Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	
Grangemouth	Delivery of flood protection scheme to support continued and enhanced port operations and new or upgraded blue and green infrastructure	Transport		Negligible negative effects from transport emissions from construction activities related to the development of flood defences	Negligible negative effects from transport activities relating to ongoing maintenance	Negligible positive effects from the additional provision of green infrastructure and active travel.	Negligible negative effects from transport of materials and waste after decommissioning	Uncertain scale/connectivity of footpath network and to what extent this could facilitate active travel.
		Electricity						
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Minor negative effects from embodied carbon within construction materials, and energy use required during construction of hard and soft flood defences.		Minor positive effects from flood risk management avoids the GHG emissions associated with clean up and replacement property from flood events.	Negligible negative effects from energy requirements of decommissioning of flood defences.	
		Waste		Negligible negative effects from waste material generated during the construction phases		Minor positive effects from avoidance of waste generated during flood events	Negligible negative effects from waste material generated during the construction phases	
		LULUCF		Mixed negligible effects from loss of carbon in soils on land from construction of flood defences Creation and/or enhancement of existing green space to be used as natural flood defences (e.g., maximising flood	Negligible positive effects from ongoing enhancements to natural flood defences such as SuDS and landscaping techniques will increase rates of carbon sequestration.			

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				plains, enhancing riverbanks, SuDS and landscaping)				
	Town centre regeneration,	Transport		Negligible negative effects from transport emissions from construction activities related to the regeneration of Grangemouth	Negligible negative effects from increased journeys to and from Grangemouth	Mixed negligible effects from transport via private vehicle and sustainable modes linked with residents' commute to work and education, or staff travel. Transport related to the running of businesses within the town centre (deliveries etc.)	Negligible negative effects from transport of materials after decommissioning	Uncertain as to type and extent of regeneration and how many additional journeys this may generate.
		Electricity			Negligible negative effects from electricity requirements for residents and businesses within the town.			
		Buildings/ Heat			Negligible negative effects from heat requirements for residents and businesses within Grangemouth			Uncertain as to scale of district heating networks in Grangemouth
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in building materials. Energy requirements of construction.	Negligible negative effects from emissions from businesses operating within the town centre.		Negligible negative effects from decommissioning of buildings in the town centre.	Uncertain on the scale/type of restoration proposed and the energy use associated with it
		Waste		Negligible negative effects from waste produced during the development of new buildings/ redevelopment of	Negligible negative effects from waste produced by residents and commercial/retail industries within the		Negligible negative effects from waste materials after decommissioning	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				existing buildings	town centre			
		LULUCF		Negligible negative effects from reuse of vacant and derelict land/ buildings - potential for a minor carbon loss on land areas where there is green open space.	Negligible positive effects from developing and enhancing green space - greater rates of carbon sequestration		Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	
	Industrial and port development including new or upgraded utilities and or local energy network, new and or upgraded facilities at the port for inter-modal freight handling and passenger facilities at Grangemouth.	Transport		Negligible negative effects from transport emissions from construction activities related to the regeneration of Grangemouth port	Negligible negative effects from increased journeys to and from Grangemouth port	Mixed negligible effects from transport via private vehicle and sustainable modes linked with commute to work	Negligible negative effects from transport of materials after decommissioning	Uncertain number of additional journeys this development may generate.
		Electricity			Negligible negative effects from electricity requirements from port operations			
		Buildings/ Heat			Mixed effects from negligible negative effects from heat requirements of port operations, and negligible positive effects from local energy networks.			Uncertain as to scale of district heating networks in Grangemouth
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in building materials. Energy requirements of construction.	Negligible negative effects from emissions from port development.		Negligible negative effects from decommissioning of buildings	
		Waste		Negligible negative effects from waste produced during the	Negligible negative effects from waste produced by port		Negligible negative effects from waste materials after decommissioning	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				development of new buildings/ redevelopment of existing buildings	activities			
		LULUCF		Negligible negative effects from reuse of vacant and derelict land/ buildings - potential for a minor carbon loss on land areas where there is green open space.	Negligible positive effects from landscaping and green infrastructure that will enable carbon sequestration.		Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	

Table A.24: Industrial Green Transition Zone

Industrial Green Transition Zone					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transportation of materials for required infrastructure	Minor negative effects from staff commuting to work and maintenance, increased transport movement linked to the supply of natural gas and hydrogen, transportation of hydrogen and biomass throughout the lifetime of the development.	Minor positive effects from hydrogen as it provides low carbon fuel for transport. Greater deployment of hydrogen in shipping and heavy transport (HGVs/buses) will displace GHG emissions from current fossil fuels. Development of CCUS infrastructure supports the production of low carbon hydrogen which can be used as a low carbon fuel for transport.	Negligible negative effects from transport of waste materials to disposal or recycling location	Moderate negative GHG balance from transport as this development is likely to lead to significant increase in port traffic, transportation of staff, hydrogen and captured carbon, which increase energy use and potential for leakage during transport. Low confidence as it is unclear what scale of low carbon hydrogen production is anticipated, which affects the scale of overall losses during transport and increase in GHG emissions overall.
Electricity	Negligible negative effects from electricity required for the construction of this development	Negligible positive effects from low carbon electricity generation balanced by increased energy requirements for some processes such as hydrogen compression and carbon storage.		Negligible negative effects from electricity required for decommissioning	Minor positive GHG balance from electricity, as this development supports low carbon energy generation, but may increase electricity demand for hydrogen storage and carbon capture. Low confidence due to the efficiency of carbon capture, scale of hydrogen production, quantity of carbon captured and source of power for these processes.

Industrial Green Transition Zone					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Buildings (heat)		Minor positive effects from lower carbon heat produced from biomass and heat networks.	Minor positive effects from the displaced emissions from current fossil fuels used for heat generation.		Minor positive balance from building (heat). Medium confidence as the scale of heat networks in Grangemouth is uncertain.
Industrial, manufacture and construction processes	Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of hydrogen production facilities, bioenergy and CCUS facilities, flood protection scheme, town centre regeneration and port development.	Minor negative effects from the use of natural gas for low carbon hydrogen production, and the potential for fugitive emissions from hydrogen, natural gas, ammonia, and CCUS, including from production, storage and distribution. Emissions from business and port operations.	Minor positive effects as hydrogen provides low carbon fuel for industrial purposes and will displace GHG emissions from current fossil fuels. Provision of lower carbon fuel for carbon intensive industries. Development of CCUS infrastructure supports the production of low carbon hydrogen which can be used as a low carbon fuel for industrial purposes. Some leakage of hydrogen may occur during the hydrogen production process. Flood risk management avoids the GHG emissions associated with the clean up and replacement of property from flood events		Minor negative GHG balance from industrial processes due to high levels of embodied carbon in construction projects and ongoing fugitive emissions from hydrogen, natural gas, and carbon capture. Low confidence as the scale of fugitive emissions is uncertain, long-term reliability of carbon capture is untested, and scale of development is uncertain.
Waste	Negligible negative effects from construction waste balanced by the potential for reuse some of existing oil and gas infrastructure (such as pipelines).			Negligible negative effects from the disposal waste materials from production plant that cannot be reused or recycled.	Minor negative GHG balance from waste, high confidence due to assumed low levels of waste generated.
LULUCF	Negligible negative effects from the loss of soil and vegetation on brownfield and greenfield sites.	Minor negative effects from land use disturbance from biomass harvesting throughout the lifetime of the development.		Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	Minor negative GHG balance from the LULUCF, high confidence due to the reliance on biomass for biofuels production.
Negative Emissions Technologies		Minor positive effects from net carbon removal			Minor positive GHG balance from Negative Emissions Technologies. Low confidence as scale of NETs is uncertain and use of bioenergy with carbon capture or direct air capture is unknown.

Industrial Green Transition Zone					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Low confidence in moderate negative effects from transport due to the uncertainty on how majority of hydrogen and captured carbon will be transported for storage and distribution domestically and for export and the potential for leakage. ▪ Low confidence in minor positive effects for electricity, as this development supports low carbon energy generation but may increase electricity demand for some processes. ▪ Medium confidence in minor positive effects for heat, as this development supports heat networks but the scale is unknown. ▪ Low confidence in minor negative effects from industrial processes, due to high levels of embodied carbon and as the long-term reliability of carbon capture is untested. ▪ High confidence in minor negative GHG balance from waste due to assumed low levels of waste generated. ▪ High confidence in minor negative GHG balance from LULUCF, from land use disturbance from biomass harvesting releasing soil carbon ▪ Low confidence in minor positive GHG balance from NETs due to uncertain scale of development. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>This development is likely to enable low carbon hydrogen production as a lower carbon fuel for transport, heating and industry compared to use of fossil fuels without carbon capture and storage. Moreover, it is likely to displace the emissions from current energy sources and it is likely to enable carbon capture. The development is likely to result in a minor negative GHG balance from LULUCF, from land use disturbance from biomass harvesting releasing soil carbon .</p> <p>There is a low confidence in the scale of indirect positive effects due to uncertainty over the scale of bioenergy production, low carbon hydrogen production and extent to which the hydrogen will displace higher carbon energy sources in transport, industry and heating.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to support for the transition to hydrogen from direct fossil fuel dependency using low carbon hydrogen production with carbon capture, utilisation and storage.</p> <p>The scale of positive effect could range from low to very high. A low scale of effect would result from higher levels of increased transport emissions, lower levels of low carbon electricity generation, higher levels of fugitive emissions, smaller scale heat networks, and smaller scale NETs development. Conversely, if a greater amount of low carbon energy and hydrogen is produced, there are lower levels of fugitive emissions, more widespread heat networks and larger scale NETs development and wider deployment and use of hydrogen, this could result in a very high positive effect.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty over the scale of these effects means there is low confidence in this conclusion.</p>				
Additional mitigation and enhancement	<p>Prioritise use of existing infrastructure on and offshore which can be refurbished, ensure that technologies for minimising leakage are in place.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or recycled.</p>				

Table A.25: Islands Hub for Net Zero

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Islands Hub for Net Zero	Infrastructure to support	Transport		Negligible negative effects from	Negligible negative effects from maintenance		Negligible negative effects from	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
	renewable energy generation, including landside operations to support marine energy, and electricity transmission cables and converter stations.			transportation of staff, materials and equipment for the delivery of the development.	transportation and staff commute.		transportation of staff, materials and equipment after decommissioning.	
		Electricity				Significant positive effects from infrastructure to support renewable electricity provision will reduce the overall emissions from electricity generation and use.		Uncertain scale of the renewable energy projects
		Buildings/ Heat				Minor positive effects as supports increased use of renewable energy for heating and cooking		
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials required for the construction phase. Energy required for construction.	Negligible negative effects from carbon embodied in the materials required for maintenance.	Minor negative effects as supports increased renewable energy development and electricity transmission infrastructure which uses carbon intensive materials.	Negligible negative effects from energy required for decommissioning	
		Waste		Construction waste.	Operational waste.		Waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from loss of soil and vegetation during construction of renewable energy schemes and electricity transmission infrastructure; impact on seabed from towers' foundations, loss of		Negligible positive effects from potential for ecosystems regeneration and carbon sequestration on and offshore once renewable energy generation is operating	Negligible negative effects from disturbance to marine sediments and soil during decommissioning.	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				marine carbon.				
	Renewable hydrogen production, storage and transportation	Transport		Negligible negative effects from transportation of staff, materials and equipment for the delivery of the development.	Negligible negative effects from energy requirements for transportation of hydrogen and staff commuting to and from work or for maintenance purposes.	Minor positive effects as hydrogen provides a low carbon fuel for transport.	Negligible negative effects from transportation of staff, waste materials and equipment during decommissioning.	Low carbon fuel may include fossil fuel based or renewable energy-based production methods.
		Electricity			Negligible positive effects from use of surplus renewable electricity to generate renewable hydrogen.	Minor positive effects as low carbon hydrogen will facilitate greater efficiency of renewable electricity via renewable energy storage		It is uncertain how much renewable hydrogen will be produced.
		Buildings/ Heat				Negligible positive effects from production of lower carbon heating source		Impact will depend on the scale; how much renewable hydrogen will be produced
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the construction materials. Energy requirements during construction of hydrogen production and storage facilities.	Negligible negative effects from potential for hydrogen leakage. Potential for fugitive emissions from transport of hydrogen.	Minor positive effects from use of renewable hydrogen fuel for industrial purposes.	Negligible negative effects from energy required for decommissioning	Will depend on the scale of the activities.
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	
		LULUCF		Negligible negative effects from loss of and disturbance of soil and vegetation on brownfield and greenfield site			Negligible negative effects from disturbance to soils and vegetation during decommissioning.	
	Infrastructure to support shipping including freight at Arnish, Scapa Flow, and	Transport	Existing emissions from marine vessels primarily from diesel	Negligible negative effects from transportation of staff, materials and equipment for construction of shipping	Negligible negative effects from emissions arising from vessels travelling to the area		Negligible negative effects from decommissioning related transport of resources and waste for processing/	Uncertain as to the breakdown of refuelling by fuel type. Uncertain scale of impact on marine vessel

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
	Kirkwall.			and freight handling infrastructure.			recycling.	emissions overall.
		Electricity						
		Buildings/ Heat						
		Industrial, manufacture and construction processes	Carbon embodied within construction materials.	Minor negative effects from carbon embodied in materials for the development and infrastructure.	Negligible negative effects from energy requirements of shipping and freight handling activities and leakage/fugitive emissions. Carbon embodied in fuel and carbon losses during production process.		Negligible negative effects from decommissioning of development infrastructure	Uncertain as to the breakdown of refuelling by fuel type. Uncertain levels of leakage/fugitive emissions during refuelling
		Waste		Negligible negative effects from waste from construction of refuelling infrastructure	Negligible negative effects from waste material generated during shipping and freight handling operations		Negligible negative effects from waste material generated during the decommissioning phases	Uncertain how much waste will be produced.
		LULUCF	Land has previously been developed.	Negligible negative effects from parts of the development will include reuse of land that has been previously developed and it will also include development of greenfield land.			Negligible negative effects from disturbance to soils and vegetation during decommissioning.	
	Associated opportunities in the supply chain for fabrication, research and development	Transport		Negligible negative effects from transportation of machinery and materials required for the construction of the fabrication, research and development premises.	Negligible negative effects from transport related to the distribution (supply chain), work commuting.	Negligible positive effects from ensuring that the supply chain is sourced locally, and therefore will reduce emissions relating to the transportation of materials.	Negligible negative effects from decommissioning related transport of resources and waste for processing/ recycling.	
		Electricity			Negligible negative effects from electricity required for the operations.	Minor positive effects from supporting renewable energy development. More R&D within the field may lead to significant		

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
						improvements and innovation in renewable energy generation.		
		Buildings/ Heat			Negligible negative effects from heat required for the buildings.			
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials required for the construction phase. Energy required for construction.	Negligible negative effects from energy requirements during fabrication/assembly and the operation of warehouse activities.		Negligible negative effects from decommissioning of development infrastructure.	
		Waste		Negligible negative effects from waste from construction of development.	Negligible negative effects from waste materials generated from the supply chain.		Negligible negative effects from waste materials generated during the decommissioning phase.	
		LULUCF		Negligible negative effects from loss of soil and vegetation to development.			Negligible negative effects from disturbance to soils and vegetation during decommissioning.	
	Oil terminal modifications to support move towards net zero, including support for improved oil storage infrastructure for Stornoway with appropriate emissions abatement	Transport		Negligible negative effects from transportation of staff, materials and equipment for construction and upgrades to oil storage infrastructure.	Negligible negative effects from maintenance transportation and staff commute.	Mixed negative and positive effects as development will continue to provide fossil fuel for use in transport, however in the shift to net zero, low carbon fuels such as hydrogen provides a low carbon fuel for transport.	Negligible negative effects from decommissioning related transport of resources and waste for processing/ recycling.	
		Electricity						
		Buildings/ Heat						
		Industrial, manufacture and construction		Negligible negative effects from carbon embodied in the materials required for	Negligible positive effects as improvements to oil storage infrastructure will prevent	Negligible positive effects as upgrades to the oil terminal infrastructure, to facilitate a move towards net zero, will	Negligible negative effects from energy required for	Uncertainty surrounding how the upgrades will facilitate a shift

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		processes		constructing and upgrading existing infrastructure. Energy required for construction/upgrade works.	the leakage of oil and fugitive emissions. Upgrades to the oil terminal infrastructure will can be used to store lower carbon fuels. Emissions reduction facility will reduce greenhouse gas emissions.	promote the storage and use of low carbon fuels such as hydrogen.	decommissioning	towards net zero.
		Waste		Negligible negative effects from construction waste.			Negligible negative effects from waste from materials that cannot be recycled after decommissioning	
		LULUCF		Negligible negative effects from the disturbance to soil and vegetation.		Negligible positive from the reuse of a brownfield site and avoiding using greenfield site which development could lead to more significant emissions.	Negligible negative effects from disturbance to soils and vegetation during decommissioning.	

Table A.26: Islands Hub for Net Zero

Islands Hub for Net Zero						
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transportation of staff, materials and equipment for the delivery of the development.	Minor negative effects from the increased transportation due to new supporting infrastructure for renewable energy and hydrogen; workers commuting to/from work; ongoing transport for maintenance; any transport related to the distribution of goods produced in the warehousing or fabrication/assembly areas; transport of fuels for marine	Minor positive effects from hydrogen as it will provide low carbon fuel for transport because of the potential brought by hydrogen storage and distribution infrastructure. Ensuring that supply chain and fabrication are as local as possible will reduce potential emissions from transportation of materials and parts.	Negligible negative effects from transportation of staff, materials and equipment during decommissioning.	Moderate negative GHG balance from transport. Increased transport related to distribution and shipping activities will lead to an increase in overall emissions. Medium confidence as the level of renewable hydrogen fuel produced is uncertain. The provision of low carbon fuel will support decarbonisation of transport, however the level of lower carbon fuel provided is uncertain.	

Islands Hub for Net Zero					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
		vessels, and emissions arising from vessels travelling to the area to refuel with lower carbon fuel, and transport related to the supply chain; transport of natural gas for energy generation.			
Electricity		Minor positive from renewable energy production partly balanced by negative effects from increased demand for electricity during the operational phase of the development.	Minor positive effects as more research and development related to these technologies may lead to significant improvements and innovation in renewable energy generation. This development will provide support for the roll out of renewable energy, and through the production of renewable hydrogen will facilitate renewable energy storage		Minor positive GHG balance from electricity, as although this development will increase electricity demand, it will use surplus renewable electricity to generate hydrogen and support the roll out of renewable energy schemes. Medium confidence as it is unclear how much electricity will be required and what proportion of it will come from renewable energy sources.
Buildings (heat)		Negligible negative effects from heat required for buildings.	Minor positive effects from increased use of renewable energy and hydrogen for heating and cooking.		Minor negative GHG balance from buildings (heat), high confidence due to limited heat requirements.
Industrial, manufacture and construction processes	Minor negative effects from carbon embodied in the materials required for the construction phase of renewable hydrogen production and storage facilities. Carbon embodied in materials for the development and infrastructure.	Negligible negative effects from the potential for hydrogen fuels leakage. Potential for fugitive emissions during from production, distribution and storage of hydrogen fuels. However, upgrades to oil infrastructure will prevent leakage and fugitive emissions released from oil, and will provide future storage for lower carbon fuels.	Minor positive effects as use of hydrogen fuels will help reducing emissions from industrial processes.	Negligible negative effects from energy required for decommissioning.	Moderate negative GHG balance from the industrial processes, as this development will require a significant amount of carbon heavy materials for the construction phase of the development. Medium confidence , as levels of leakage from hydrogen storage are unknown.
Waste	Negligible negative effects from construction waste.	Minor negative effects from operational waste.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Minor negative GHG balance from waste. Medium confidence as it is assumed that recyclable materials will be recycled.
LULUCF	Minor negative effects from the loss of soil and vegetation; impact on seabed from		Negligible positive effects from the reuse of brownfield land and avoiding development on greenfield land.	Negligible negative effects from disturbance to soil, vegetation and marine sediments	Minor negative GHG balance from LULUCF. Medium confidence as it is assumed that the development will have a negative impact on soil, vegetation and marine life during

Islands Hub for Net Zero					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	towers' foundations, loss of marine carbon.			during decommissioning.	construction and decommissioning which will outweigh positive effects from recovery during operation, but the scale of the development is uncertain.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negative effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> Medium confidence in moderate negative effects arising from transport related emissions, due to an overall increase in emissions but uncertainty over the amount of hydrogen produced for transport, or levels of use of low carbon fuel. Low confidence in minor positive effects in relation to electricity as it is uncertain how much electricity demand there will be from the development, and what proportions of the development's electricity needs will be met by renewable and non-renewable sources. High confidence in minor negative effects from heat due to limited heat requirements. Medium confidence in major negative effects from industrial processes, due to the amount of carbon heavy materials required for this development and use of fossil fuels. Medium confidence in minor negative effects from waste due to assumed low levels of waste and high levels of recycling. Medium confidence in minor negative effects in relation to LULUCF as such scale of development will lead to disturbance of soil, vegetation and marine areas, although there is uncertainty over the scale of this effect. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The development includes hydrogen production. Hydrogen can provide low carbon fuel for transport, heating and industry compared to use of fossil fuels. Low confidence in indirect positive effects due to uncertainty over the scale of renewable hydrogen production.</p> <p>The development is likely to support R&D activities which have the potential to enhance innovation and efficiency for net zero developments at a national scale, both enabling further development and supporting new developments over the long term.</p> <p>Delivering developments on already developed land is likely to lead to reduced emissions from LULUCF as it is likely to avoid disturbance of soil and vegetation.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to uncertainty of the scale and type of renewable energy production, renewable hydrogen production, distribution and storage, supporting infrastructure, supply chain for fabrication and R&D, and the use of lower emission fuels for shipping. It is assumed that these developments will be large scale and long-term and would outweigh the negative effects from the embodied carbon in the infrastructure.</p> <p>Indirect positive effects from the support for the renewables industry and production of renewable hydrogen on balance is likely to outweigh the negative direct effects identified due to relatively minor nature of these direct effects, which during the construction and decommissioning phases would be short term in nature. The positive indirect effects identified would be experienced throughout the operational phase of the development.</p> <p>The scale of this effect could range from low to high positive, depending on the scale of renewable energy and low carbon fuels produced over time. For example, smaller scale renewable energy and hydrogen production will likely have low positive effects. However, if this is deployed at a large scale, and is utilised across sectors, it could have high positive effects.</p> <p>Depending on the nature of the projects taken forward and considering both the direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the nature and scale of these effects means that there is medium confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or recycled.				

Islands Hub for Net Zero					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	Provide low carbon transport options to the sites to reduce car dependency.				

Table A.27: National Walking, Cycling and Wheeling Network

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
National Active Travel Network	New/and or upgraded routes suitable for a range of users for walking, cycling and wheeling that help create a national network that facilitates short and longer distance journeys and linkages to multi-modal hubs.	Transport	Currently a small % of people commuting using active travel routes	Negligible negative effects from transportation of staff, materials and equipment for construction	Significant positive effects from potential for a significantly higher uptake of active travel reducing the overall emissions from transport. Furthermore, improved linkages and connections will enable more convenient travel using active travel paths and public transport as a result reducing the emissions from transport.			
		Electricity			Negligible negative effects from electricity required for lighting of the network.			
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials used for construction and as street furniture.	Negligible negative effects from carbon in maintenance materials			
		Waste		Negligible negative effects from construction waste.				
		LULUCF		Negligible negative effects from minor loss of soil and vegetation during construction.	Minor positive effects from carbon sequestration through green and blue infrastructure			

Table A.28: National Walking, Cycling and Wheeling Network

National Walking, Cycling and Wheeling Network					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transportation of staff, materials and equipment for construction phase of the developments.	Significant positive effects from increased uptake of active travel and public transport modes displacing emissions from private vehicles.		Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	Super positive GHG balance from transportation as this infrastructure can encourage a significant amount of people across all areas of Scotland to travel actively and use public transport. Medium confidence due to current low levels of active travel take up.
Electricity		Negligible negative effects from electricity required for lighting of the network and in the multi-modal hubs.			Minor negative GHG balance from electricity, with medium confidence based on an assumption that majority of the electricity will come from renewable sources.
Buildings (heat)					Neutral GHG balance from buildings (heat). High confidence as assumed the development has no heat requirement.
Industrial, manufacture and construction processes	Negligible negative effects from carbon embodied in the materials used.				Minor negative GHG balance from industrial processes, with medium confidence based on an assumption that this development will not require significant amounts of materials for the delivery.
Waste	Negligible negative effects from construction waste.			Negligible negative effects from waste materials that cannot be recycled after decommissioning.	Minor negative GHG balance from waste, with medium confidence as it assumed minimal waste will be generated.
LULUCF	Negligible negative effects from loss of soil and vegetation during construction of the links balanced against reuse of brownfield land.	Minor positive effects from the potential for carbon sequestration through green and blue infrastructure.			Minor positive GHG balance from LULUCF through expansion of green and blue infrastructure, with low confidence based on an assumption that this development can lead to a significant increase in carbon sequestration capacity, but that construction of the links will have some adverse effects on soil carbon and vegetation.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> Medium confidence in super positive effects for transport related to the assumed greater uptake of active and sustainable modes of travel facilitated by the construction and enhancement of the walking and cycling network across Scotland, in addition to better linkages with public transport and multi-modal hubs. However, there is uncertainty over levels of uptake of active and sustainable travel, and the extent and scale of the active travel network. Super positive effects would only arise with a high level of journeys made by active or sustainable modes of travel. Medium confidence in minor negative effects for electricity, industrial processes and waste, due to assumed low levels of demand for electricity and heat, low generate of waste and quantity of materials required. Medium confidence in positive effects for LULUCF from increased carbon sequestration, assuming there is increased vegetation planted along active travel routes, partly balanced by some negative effects during construction and decommissioning phases. 				
Summary of lifecycle GHG balance (indirect effects)	No indirect effects identified.				

National Walking, Cycling and Wheeling Network					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Overall summary of effect	<p>It is likely that this development will have a net positive effect on lifecycle GHG emissions due to the support for low carbon and active travel.</p> <p>The scale of this effect could range from high to very high positive assuming a high level of uptake and a long timeframe for the benefits. If this development facilitates a shift in travel behaviour, with a significant amount of people travelling through the network via active modes, very high positive effects are expected. These very high positive effects is likely to be further enhanced by opportunities for carbon sequestration linked to the provision of green and blue infrastructure. However if uptake of active travel is less, and there are fewer opportunities for carbon sequestration this may reduce to high positive.</p> <p>Depending on the nature of the projects taken forward and considering both the direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the nature and scale of these effects means that there is low confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	<p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused or recycled.</p> <p>Ensure that waste is minimised during the construction phase.</p>				

Table A.29: Pumped Hydro Storage

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Pumped Hydro Storage	Enhance capacity of the water holding reservoir and dam and provide new and/or upgraded electricity generating equipment, pumps and pipework.	Transport		Negligible negative effects from transportation of materials for construction phase of the development	Negligible negative effects from maintenance transportation		Negligible negative effects from transportation of waste after decommissioning	
		Electricity	Existing fossil fuel power stations provide power to supply surges in demand		Significant positive effects as use of excess renewable energy to pump water to upper reservoir allows more generation of energy from the hydro power plant.	Minor positive effect as enables additional renewable energy storage capacity.		Uncertainty over whether this involves construction of a new reservoir and dams or increasing the capacity of the existing infrastructure.
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Minor negative effect due to significant amount of concrete and steel is required to enlarge Cruachan power station or build new power stations elsewhere, and associated infrastructure. Energy requirements of construction processes.	Negligible negative effects from release of CO ₂ and CH ₄ during the operations of the dam		Negligible negative effects from energy requirements of decommissioning	
		Waste		Negligible negative effects from waste from construction processes	Negligible negative effects from waste from maintenance activities.		Negligible negative effects from waste from decommissioning	
		LULUCF		Minor negative effect due to loss of soil carbon and vegetation cover during construction	Negligible negative effects from production of methane from sediments in standing water.		Negligible negative effects from impact on land after decommissioning; Accumulation of sediments at the bottom of the reservoir consist of large quantities of carbon	Creation of a new reservoir would result in loss of greater land area than expansion of existing reservoir. Area of land to be inundated uncertain.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
							which is released after decommissioning.	
	New and/or upgraded substations, transformers and transmission cables required for the pumped hydro scheme.	Transport		Negligible negative effects from transportation of materials for construction phase of the development	Negligible negative effects from maintenance transportation		Negligible negative effects from transportation of waste after decommissioning	
		Electricity	Insufficient existing electricity infrastructure for upgrades to the hydro-power scheme.			Minor positive effect as enables additional renewable energy through providing additional energy storage capacity.		
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Minor negative effect due to high embodied carbon of materials required to construct supporting grid infrastructure including substations, transformer and transmission cables. Energy requirements of construction processes.	Negligible negative effects from release of CO2 and CH4 during the operations of the dam		Negligible negative effects from energy requirements of decommissioning	Uncertain how many supporting facilities would need to be upgraded or constructed.
		Waste		Negligible negative effects from waste from construction processes	Negligible negative effects from waste from maintenance activities.		Negligible negative effects from waste from decommissioning	
		LULUCF		Minor negative effect due to loss of soil carbon and vegetation cover during construction			Negligible negative effects from impact on land after decommissioning; Accumulation of sediments at the bottom of the reservoir consist of large quantities of carbon	Uncertain extent of new or upgraded infrastructure and impact on soils.

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
							which is released after decommissioning.	

Table A.30: Pumped Hydro Storage

Pumped Hydro storage						
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transportation of materials for construction phase of the development	Negligible negative effects from maintenance transportation		Negligible negative effects from transportation after decommissioning	Minor negative GHG balance from transportation. Medium confidence as the additional hydro power plants and supporting electricity infrastructure will require transportation of a significant quantity of materials for the construction and decommissioning phase of the development, in addition to maintenance and operational staff movement.	
Electricity		Significant positive effect from significant increase in hydroelectric power generation from low carbon energy, over a lifetime of 50-100 years	Minor positive effect as enables additional renewable energy development through providing additional energy storage capacity.		Super positive GHG balance from electricity. Medium confidence based on the assumption that the pumped storage energy will be provided by renewables and if hydro power plant capacity is not extended there will be a requirement for continued fossil fuel power generation which may lead to continued significant negative effects. There is uncertainty over the frequency of operation of the hydro plants, the scale of additional capacity constructed, and the scale of any additional upgrades/provision of electricity infrastructure. However due to trends of continued reliance on renewable energy it is assumed that there will be more frequent use of this power source.	
Buildings (heat)						
Industrial, manufacture and construction processes	Minor negative effect due to large quantity of materials required to enlarge existing power stations and construct new hydro power stations, and any associated electricity infrastructure required. Energy requirements of construction.	Negligible negative effects from release of CO ₂ and CH ₄ during the operations of the dam		Negligible negative effects from energy requirements of decommissioning	Minor negative GHG balance from industrial processes. Medium confidence based on the embodied carbon of the construction materials and assumption that operations of a hydro power plant lead to CO ₂ and CH ₄ emissions, but lack of certainty on the scale of construction of new or extended hydro power stations and their ancillary infrastructure.	
Waste	Negligible negative effects from waste from construction	Negligible negative effects from maintenance waste generation.		Minor negative effect due to large amount of waste after decommissioning	Minor negative GHG balance for waste as the development will lead to a significant amount of waste materials after decommissioning. Low confidence as extent to which project material would be removed from site or left in situ is unknown.	

Pumped Hydro storage					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
LULUCF	Minor negative effect on soil and land from dam construction/upgrades, and any associated upgrades or construction of electricity infrastructure. This will result in loss of vegetation and soil carbon.	Negligible negative effects from sediment production of methane and carbon dioxide.		Negligible negative effects from release of GHG from sediment after decommissioning.	Minor negative GHG balance from LULUCF. Enlargement of the existing hydro dams or construction of new hydro power plants will lead to loss of carbon from flooding of soil and inundation of vegetation. Operations lead to disturbance of sediments, releasing carbon dioxide and methane. Decommissioning will lead to additional carbon and methane emissions from the sediments that have been accumulating at the bottom of the reservoir. Medium confidence as this depends on the location and extent of the new reservoir and amount of vegetation inundated.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in minor negative effects in relation transport, due assumed transport impacts during construction and high volumes of construction material. ▪ Medium confidence in super positive effects in relation to electricity assuming that the energy required for pumping water will be renewable, and the development will operate over a long time period. ▪ Medium confidence in minor negative effects from industrial processes as this development is likely to require a significant amount of carbon heavy materials, but the scale of new hydroelectric development and potential releases of carbon dioxide and methane from operation is uncertain. The scale of effects will be dependent on whether the development relates to upgrades to existing facilities or construction of new infrastructure. ▪ Low confidence in minor negative effects from waste as it is unknown whether materials would be left in place after decommissioning or removed. ▪ Medium confidence in minor negative effects from LULUCF as the locations of a new reservoirs are unknown and may lead to a significant loss of vegetation and soil. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The development indirectly enables further renewable energy development across Scotland in the medium to long term by increasing storage capacity, and displacing fossil fuel emissions. There is low confidence in the scale of indirect positive effects due to uncertainty over the scale of other storage capacity for renewable energy, and the scale of increased pumped hydro-electric storage capacity.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to the facilitation and enabling of renewable energy development across Scotland from the provision of energy storage and rapid capacity during demand peaks.</p> <p>The scale of this effect could range from medium to very high depending on the project details, the location and frequency of use. If the development enables significantly more renewable electricity to be generated, whilst minimising energy associated with construction and decommissioning, and effects on soil carbon, a very high positive effect will be expected. However, if renewable electricity generation provided by the development is lower, and there are more significant amounts of energy and carbon intensive materials used during construction, this positive effect might reduce to medium. Furthermore, significant disturbance to soils and release of soil carbon is likely to reduce the effect to medium.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the nature and scale of these effects means that there is low confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that the design of the extension of the hydro power plant and extensions of other existing facilities will have minimal impacts on LULUCF.</p> <p>Ensure that sediment creation and build up is managed to reduce emissions.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or recycled.</p>				

Table A.31: Stranraer Gateway

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Stranraer Gateway	Redevelopment of Stranraer harbour east pier and development of sustainable road, rail and freight infrastructure for access to Stranraer and or Cairnryan.	Transport	Existing vessel emissions	Negligible negative effects from transportation of staff, materials and equipment for construction.	Mixed effects from maintenance transport, transport related to the use of the renovated harbour east pier and new infrastructure including sustainable road, rail, and freight.		Negligible negative effects from transportation of staff, materials and equipment after decommissioning	Unclear about scale of change to freight handling and impact on change to carbon emissions
		Electricity			Negligible negative effects from electricity required for operations of the harbour and sustainable transport.			
		Buildings/ Heat			Negligible negative effects from heat required for the buildings and offices of the harbour			
		Industrial, manufacture and construction processes	Embodied carbon in existing infrastructure	Negligible negative effects from carbon embodied in the materials and equipment. Energy required for construction.	Negligible negative effects from maintenance of the pier and sustainable transport.		Negligible negative effects from energy required for decommissioning.	
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operational waste.		Negligible negative effects from waste of materials that cannot be recycled after decommissioning.	Waste from operations will depend on the nature of operations and the timeframes of the project (whether the port is for freight or passengers or both)
		LULUCF	Carbon in marine environment	Negligible negative effects from disturbance to seafloor.	Negligible negative effects from carbon release during maintenance dredging			Carbon values of the marine environment uncertain.
	High quality place-based regeneration,	Transport		Negligible negative effects from transportation of staff, materials and equipment for	Negligible negative effects from increased transport movements resulting from		Negligible negative effects from transportation of staff,	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
	including marina expansion and reuse of vacant and derelict land including regeneration of Blackparks industrial estate			the construction	regeneration, including business and residential movements.		materials and equipment after decommissioning	
		Electricity			Negligible negative effects from electricity requirements during the operations of businesses located at the industrial estate			
		Buildings/ Heat			Negligible negative effects from heat requirements during the operations of businesses located at the industrial estate			
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials from construction. Energy required for construction.	Negligible negative effects from business operations' emissions		Negligible negative effects from energy required for decommissioning.	Business operations' emissions will depend on the nature of the business
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operational waste.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects form disturbance to soil and vegetation.				
	New and/or upgraded infrastructure for transportation and use of low carbon fuels	Transport		Negligible negative effects from transportation of staff, materials and equipment for the construction	Negligible positive effects from transportation and use of low carbon fuels	Minor positive effects from transportation of low carbon fuels enabling emissions reduction in other locations.	Negligible negative effects from transportation of staff, materials and equipment after decommissioning	
		Electricity						
		Buildings/ Heat						

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		Industrial, manufacture and construction processes		Negligible negative effects from production and processing of low carbon fuels	Negligible positive effects from use of low carbon fuels in industrial, manufacture and construction processes.		Negligible negative effects from energy required for decommissioning.	
		Waste						
		LULUCF		Negligible negative effects from the disturbance to soil and vegetation during construction.			Negligible negative effects from the disturbance to soil and vegetation during decommissioning.	

Table A.32: Stranraer Gateway

Stranraer Gateway						
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects for transportation of staff, materials and equipment for the construction phase of the project	Negligible positive effects overall as increased transport to and from ports/pier, stations, industrial estate and residential developments is balanced by the provision of sustainable transport and the use of low carbon fuels.	Negligible positive effects from supporting the distribution of low carbon fuels.	Negligible negative effects for transportation of waste materials and machinery after decommissioning	Minor positive GHG balance from transport. Although increased transport from port, rail stations and staff travel will lead to carbon emissions, this is balanced by provision of sustainable transport and use of low carbon fuels. Low confidence as will depend on the scope of the development (residential and employment sites), the balance between increased efficiency of travel from sustainable connectivity and increased number of journeys, and the scale of low carbon fuel use.	
Electricity		Negligible negative effects from increased demand for electricity from transport and regeneration, assumed partially sourced from renewables.			Minor negative GHG balance from electricity. Increased electricity use during operational phase of the development will lead to emissions despite measures taken to ensure energy efficiency. Medium confidence due to uncertainty over the extent to which electricity is provided by renewable sources, and scale of increased energy use.	
Buildings (heat)		Negligible negative effects from an increased demand for heat from residential and business premises.			Minor negative GHG balance from buildings (heat) as it is expected that this development will result in an increase in the overall heat demand. Medium confidence, as uncertain as to what extent low carbon heat will be incorporated.	

Stranraer Gateway					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Industrial, manufacture and construction processes	Negligible negative effect from the carbon embodied in the materials used for infrastructure	Negligible negative effects for emissions from business operations	Negligible positive effects from use of low carbon fuels in industrial, manufacture and construction processes.	Negligible negative effects from energy required for decommissioning.	Minor negative GHG balance for industrial processes. Low confidence as the quantity of materials required for the delivery of the developments is uncertain due to lack of detail on the scale of the development, there is also uncertainty over the use of low carbon fuels in industrial, manufacture and construction processes.
Waste	Negligible negative effects from construction related waste, reuse of existing materials and infrastructure will be minimal.	Negligible negative effects from waste produced by business operations		Negligible negative effects from materials that cannot be recycled after decommissioning	Minor negative GHG balance from waste. Medium confidence based on assumptions over levels of increased waste from construction, operation phase waste from businesses and residential units will lead to negative overall emissions and assumed low level of waste generated.
LULUCF	Negligible negative effects from use of a brownfield site and land take and soil carbon loss from construction of road and rail.	Negligible negative effects from carbon release during maintenance dredging.		Negligible negative effects from disturbance to soil and vegetation during decommissioning.	Minor negative GHG balance from LULUCF. Medium confidence as it is assumed that some development will be on brownfield sites, but there will be overall soil carbon loss from development of road and rail links, with some carbon sequestration during operational phase.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net negligible effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Low confidence in minor positive effects from transport due to uncertainty over the scale of the development and impact on journeys generated, balanced by some assumed increase in rail transport and scale of use of low carbon fuels. ▪ Medium confidence in increased electricity and heat demand due to assumed low levels of increased demand and uncertainty over the extent of renewable energy or heat generation. ▪ Low confidence in effect from industrial, manufacture and construction processes due to uncertainty over the scale of development. ▪ Medium confidence in emissions from waste due to assumed net increase in waste but uncertainty over quantity of waste generated. ▪ Medium confidence in minor negative effects from LULUCF due to assumed net loss of soil carbon from development, despite some assumed development on brownfield land. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a negligible positive effect on indirect lifecycle GHG emissions. The development is likely to support low carbon fuels distribution. The scale of indirect effects is likely to be negligible, however there is low confidence as it is uncertain how much low carbon fuel will be distributed via this development.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that the development will have a net positive effect on lifecycle GHG emissions due positive effects from use and distribution of low carbon fuels, increased transport efficiency from new rail facilities and transportation which is judged to outweigh the negative effects from increased transport emissions.</p> <p>The scale of this effect is likely to be low.</p> <p>Depending on the nature of the projects taken forward and considering both the direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the nature and scale of these effects means that there is low confidence in this overall conclusion.</p>				

Stranraer Gateway					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Additional mitigation and enhancement	Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused or recycled. Ensure that energy efficiency solutions are in place within the developments. Support low carbon fuel for marine vessels. Minimise disturbance to marine sediments.				

Table A.33: Strategic Renewable Electricity Generation and Transmission Infrastructure

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Strategic Renewable Energy Generation and Transmission Infrastructure	Electricity generation, including electricity storage, from renewables of or exceeding 50 Megawatts capacity	Transport		Negligible negative effects from transportation of staff, materials and equipment for construction in a wide number of locations.	Negligible negative effects from staff commuting to work and for maintenance.	Minor positive effects as additional renewable energy provides low carbon fuel/energy for transport/industry.	Negligible negative effects from transportation of staff, materials and equipment for decommissioning.	Number and extent of developments.
		Electricity			Minor positive effects from large scale production of renewable energy in multiple locations on and offshore.	Minor positive effects as large scale renewable energy production supports battery storage and hydrogen production		Uncertain whether hydrogen will also be produced using renewable energy.
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Minor negative effects as embodied carbon in the carbon heavy materials needed for this development. Energy required for construction.		Minor positive effects as renewable energy availability will have indirect benefits on reducing emissions associated with industrial processes.	Minor negative effects from potential for energy demand for recycling materials after decommissioning; decommissioning of the development; recycling of copper has a higher carbon footprint that production of the cable.	
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from waste from maintenance activities.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from land take and loss of vegetation and carbon stored in soils/marine sediments and vegetation due to construction activities.			Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	Electricity transmission grid reinforcement	Transport		Negligible negative effects from transport of staff, materials (cables) and equipment for construction	Negligible negative effects from transport for maintenance purposes.		Negligible negative effects from transport of staff, materials (redundant cables) and equipment after decommissioning.	
		Electricity				Significant positive effects from the		

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
						facilitation of transmission of renewable energy and increases use of surplus of energy from wider transmission and through connectivity to energy storage facilities.		
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Minor negative effects from carbon embodied in the carbon heavy materials used for this development (transmission cables). Energy requirements of construction processes.	Negligible negative effects from energy losses through transmission infrastructure. Maintenance requirements of transmission infrastructure.	Negligible positive effects as improved energy transmission infrastructure will enable wider use of renewable energy.	Minor negative effects from potential for energy demand for recycling materials after decommissioning; decommissioning of the development; recycling of copper has a higher carbon footprint than production of the cable	
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from waste from maintenance activities.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from loss of soil carbon from pylons and when underground cables installed, land take for substation and switching stations. Impacts from construction tracks to pylon locations and temporary construction compounds.	Negligible positive effects due to potential for regeneration of soil and vegetation after construction works are completed.		Negligible negative effects from disturbance to soil and vegetation during decommissioning.	
	New infrastructure to support on and off-shore electrification in order that electricity generated can be transmitted to consumers in Scotland the rest	Transport		Negligible negative effects from transportation of staff, materials and equipment for construction.	Negligible negative effects from increased transport due to improved infrastructure. .		Negligible negative effects from transport of staff, materials and equipment after decommissioning.	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
	of the UK and beyond							
		Electricity			Negligible negative effects from electricity required for operation of infrastructure	Significant positive effects from the facilitation of transmission of renewable energy and increases use of surplus of energy from wider transmission and through connectivity to energy storage facilities.		
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Minor negative effects from carbon embodied in the carbon heavy materials used for construction, including concrete and metals such as aluminium or copper. Energy requirements of construction processes.			Minor negative effects from potential for energy demand for recycling materials after decommissioning; decommissioning of the development; recycling of copper has a higher carbon footprint than production of the cable. Where cables are left in situ, this represents a carbon loss.	
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from operation waste.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	
		LULUCF		Negligible negative effects from land take and loss of vegetation and carbon stored in soils/marine sediments and vegetation due to construction activities.	Negligible positive effects from potential for minor carbon sequestration and land regeneration of areas surrounding the supporting infrastructure		Negligible negative effects from disturbance to soil and vegetation after decommissioning.	

Table A.34: Strategic Renewable Electricity Generation and Transmission Infrastructure

Strategic renewable energy generation and transmission infrastructure					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects from transportation of staff, materials and equipment for construction in a wide number of locations.	Negligible negative effects from staff commuting to work and maintenance.	Minor positive effects from renewable energy and hydrogen provides low carbon fuel for transport.	Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	Minor negative GHG balance from transport as this development will increase the overall emissions linked to transport. Medium confidence as it is uncertain as to the travel generated by the renewable energy delivered, due to the potential variations from the type and location of development, although assumed large scale and in numerous locations both on and offshore.
Electricity		Significant positive effects from large scale production of renewable energy.	Significant positive effects from energy storage to increase reliance on renewable energy, from transmission of renewable energy, potential for using surplus of energy by distributing it across the country, and from more efficient use of renewable energy through Smart grids.		Major positive GHG balance in relation to electricity as this development will deliver large scale renewable energy generation and transmission infrastructure, enabling on and offshore renewable energy development. Medium confidence in the scale of the renewable energy delivered and enabled due to uncertainty as to how many large-scale developments will be delivered.
Buildings (heat)			Negligible positive effects from production of lower carbon heating source		Neutral GHG balance from buildings (heat). High confidence as assumed the development has no heat requirement.
Industrial, manufacture and construction processes	Minor negative effects from carbon embodied in the materials used for this development. Energy requirements of construction processes.	Negligible negative effects from energy losses through transmission infrastructure and from maintenance requirements of transmission infrastructure.	Minor positive effects from availability of renewable energy which will have indirect benefits on providing renewable energy and reducing emissions associated with industrial processes.	Minor negative effects from the potential for energy demand for recycling materials after decommissioning; decommissioning of the development; recycling of copper has a higher carbon footprint that production of the cable	Moderate negative GHG balance from industrial processes. Low confidence as although it is certain that this development will require a significant amount of carbon heavy materials which may also be energy intensive to recycle, there is uncertainty over the quantity required and associated GHG balance.
Waste	Negligible negative effects from construction waste.	Negligible negative effect from waste from maintenance activities.		Negligible negative effects from waste from materials that cannot be recycled after decommissioning.	Minor negative GHG balance from LULUCF, medium confidence as it is assumed that no significant or ongoing waste is produced.
LULUCF	Negligible negative effects	Negligible positive effects		Negligible negative effects from	Neutral GHG balance from LULUCF as the development will result in soil and vegetation disturbance both onshore and

Strategic renewable energy generation and transmission infrastructure					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
	from land take and loss of vegetation and carbon stored in soils and marine sediments due to construction activities.	from the potential for regeneration of soil and vegetation after construction works are completed.		disturbance to soil and vegetation during decommissioning.	offshore. Low confidence as it is assumed that some land restoration will occur.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in major positive effects arising from electricity, as this development will deliver large scale renewable energy generation displacing emissions from current fossil fuel energy sources, however there is uncertainty how many such developments will be delivered. ▪ Medium confidence in minor negative effects from transport, as it is uncertain how many transport journeys will be generated. ▪ Medium confidence in minor negative effects from waste due to assumed low levels of waste produced. ▪ Low confidence in moderate negative effects in relation to industrial processes due to uncertainty over the extent and GHG emissions of the materials required, although high confidence in the carbon intensity of the materials. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The proposed national development facilitates renewable energy generation which may support hydrogen production and provide low carbon fuel for transport, heating and energy for industrial processes compared to use of fossil fuels.</p> <p>The indirect effect is judged to be of super scale, but with medium confidence due to uncertainty on the actual scale of renewable energy and hydrogen production.</p>				
Overall summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to potential for substantial generation and transmission of renewable electricity.</p> <p>The scale of positive effect is assumed to be between medium and very high positive, depending on the scale of renewable energy generation and the role of the development in facilitating further renewable energy development. A medium scale of effect would result from higher embodied carbon in construction infrastructure, and lower levels of renewable energy generation and use. Conversely, lower embodied carbon in construction infrastructure, and higher levels of renewable energy generation would result in a very high scale of effect.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Greater certainty about the nature and scale of these effects means that there is medium to high confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	<p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused again or recycled.</p> <p>Ensure that cabling and supporting infrastructure avoids carbon rich soils and vegetation that store or absorb significant amounts of carbon.</p>				

Table A.35: Urban/Mass Rapid Transit Networks

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Urban Mass/Rapid Transit Networks	Edinburgh – Edinburgh mass transit system. It would complement and integrate with the current bus, tram and heavy rail networks.	Transport	Existing tram line from Edinburgh Airport to York Place, with extension to Newhaven (under construction)	Negligible negative effects from transportation of machinery and materials required for the construction of the mass transit system such as tram lines, tracks, and stops.	Minor positive effects as more journeys will be made via the tram network, reducing transport related GHG emissions. Transport (including bus rapid transit (BRT) and trams) will be substituting fossil fuelled buses and private cars. This advantage may decrease over time if EVs are increasingly used, and the bus fleet is converted to low carbon fuels.		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Level of passenger use unknown
		Electricity		Negligible negative effects from electricity required during construction of tram tracks/stops.	Negligible negative effects from increased electricity demand to power the transit modes.		Negligible negative effects from electricity required during decommissioning phase.	
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in new infrastructure and energy required during construction of transport infrastructure (e.g., extensive use of cement for trams)	Negligible negative effects from embodied carbon in energy and material requirements for maintenance.		Negligible negative effects from energy requirements for decommissioning of the infrastructure.	Whether hydrogen fuel is produced by renewable or low carbon hydrogen. Whether hydrogen fuel is used.
		Waste		Negligible negative effects from waste materials generated during construction phase.			Negligible negative effects from waste materials generated during the decommissioning phases.	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		LULUCF	Tram lines / BRT primarily run along main roads and would not result in significant loss of greenspace	Negligible negative effects from development may result in loss of undeveloped land at least for some of the required new infrastructure.			Negligible negative effects from disturbance to soil and vegetation during decommissioning,	
	Glasgow – Glasgow Metro mass transit system	Transport	Existing metro system operating in Glasgow	Negligible negative effects from transportation of machinery and materials required for the upgrading and reopening of heavy rail lines to accommodate light rail, and construction of new light rail to strategic locations.	Minor positive effects as more journeys will be made via sustainable modes of transport, reducing transport related GHG emissions. New transit modes will be substituting fossil fuelled buses and private cars. This advantage may decrease over time if EVs are increasingly used, and the bus fleet is converted to low carbon fuels		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Future levels of passenger use unknown.
		Electricity		Negligible negative effects from electricity required during construction of new light rail and any required upgrades to the existing heavy rail lines for use by light rail.	Negligible negative effects from increased electricity demand to power the new transit modes.		Negligible negative effects from electricity required during decommissioning phases	
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in new infrastructure and energy required during construction/ upgrade of infrastructure.	Negligible negative effects from energy and material requirements for maintenance.		Negligible negative effects from energy requirements during decommissioning of infrastructure.	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
		Waste		Negligible negative effects from waste material generated during construction/ upgrading phases.			Negligible negative effects from waste material generated during the decommissioning phase.	
		LULUCF	Heavy rail line in place	Negligible negative effects from development may result in loss of undeveloped land at least for some of the required new infrastructure.			Negligible negative effects from disturbance to soil and vegetation during decommissioning,	
	Aberdeen - rapid transit system	Transport	Existing reliance on private vehicle, buses etc. as no existing light rail/tram networks operating	Negligible negative effects from transportation of machinery and materials required for the construction of the new tram lines/ stops.	Minor positive effects as more journeys will be made via sustainable modes of transport, reducing transport related GHG emissions. New transit modes will be substituting fossil fuelled buses and private cars. This advantage may decrease over time if EVs are increasingly used, and the bus fleet is converted to low carbon fuels		Negligible negative effects from decommissioning related transport of resources and waste for processing.	Unsure as to the extents of the tram network, and how many journeys it would provide each year.
		Electricity		Negligible negative effects from electricity required during construction of the rapid transit system	Negligible negative effects from increased electricity demand to power rapid transit system.		Negligible negative effects from electricity required during decommissioning phases	
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from embodied carbon in new infrastructure and energy required during construction of transport and ancillary development	Negligible negative effects from energy and material requirements for maintenance.		Negligible negative effects from energy requirements during decommissioning of infrastructure	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				infrastructure (e.g., bus stops).				
		Waste		Negligible negative effects from waste material generated during construction phase.			Negligible negative effects from waste material generated during the decommissioning phase.	
		LULUCF	Main city centres where tram would be located are already developed.	Negligible negative effects as development may result in loss of undeveloped land at least for some of the required new infrastructure			Negligible negative effects from disturbance to soil and vegetation during decommissioning,	Uncertain as to the exact locations/routes of the rapid transit system

Table A.36: Urban/Mass Rapid Transit Networks

Urban Mass/Rapid Transit Networks					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Transport	Negligible negative effects arising from the transportation of machinery and materials required for the upgrade to existing rail infrastructure and construction of the new tram/ light rail/ bus tracks and stops.	Significant positive effects in relation to transport GHG emissions due to more journeys being taken via sustainable modes of transport including BRT, light rail and tram, and displacement of fossil fuelled buses and private cars. This advantage may decrease over time if EVs are increasingly used, and the bus fleet is converted to low carbon fuels		Negligible negative effects for transportation of waste materials and machinery during decommissioning	Major positive GHG balance from transport due to extensive increase in sustainable travel facilitated by the expansion and development of light rail in Edinburgh and Glasgow, and the rapid transit system (buses) in Aberdeen. Medium confidence as this will depend on the rate of uptake of these sustainable modes of transport, and the extent of the networks developed.
Electricity		Neutral effects arising from increased demand for electricity to power light rail and tram networks, which is assumed to be renewable.			Neutral GHG balance relating to electricity, due to the greater demand of low carbon and renewable electricity to power light rail across some of Scotland's biggest cities. Medium confidence as it would depend on electricity being sourced from low carbon/ renewable sources.

Urban Mass/Rapid Transit Networks					
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Buildings (heat)					Neutral GHG balance from heat, high confidence as it is assumed no is heat required.
Industrial, manufacture and construction processes	Negligible effects relating to embodied carbon and energy requirements during construction.	Negligible negative effects from energy and material requirements for maintenance.		Negligible negative effects for energy used during decommissioning phase.	Minor negative GHG balance from carbon embodied in building materials and energy demand during construction/ decommissioning. Medium confidence due to assumed moderate overall energy requirements of construction.
Waste	Negligible negative effects of waste produced during construction and upgrading activities			Negligible negative effects of waste disposed of after decommissioning	Minor negative GHG balance from waste produced during construction and decommissioning. High confidence due to waste being limited to construction and decommissioning.
LULUCF	Negligible negative effects will arise from loss of soil carbon due to the required development.			Negligible negative effects from disturbance to soil and vegetation during decommissioning,	Minor negative GHG balance from LULUCF during construction and decommissioning as new infrastructure will be required. Medium confidence due to assumed level of construction on previously developed land.
Summary of GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions.</p> <ul style="list-style-type: none"> Medium confidence in major positive effects from transport related to the assumed greater uptake of sustainable travel and journeys facilitated by the construction and enhancement of the light rail network across Scotland's main cities over the long term. However, there is uncertainty over levels of future passenger use, and the full extent of the networks. Medium confidence in minor negative effects during construction and decommissioning phases in relation to industrial, manufacture and construction processes. High confidence in minor negative effects from waste during construction and decommissioning due to assumed low levels of waste produced. Medium confidence in minor negative from LULUCF during construction and decommissioning due to assumed new infrastructure required. 				
Summary of lifecycle GHG balance (indirect effects)	No indirect effects identified.				
Overall summary of effect	<p>It is likely that this proposed national development will have a net positive effect on lifecycle GHG emissions as the long-term positive effects of three of Scotland's major cities using sustainable transport powered by low carbon electricity will outweigh the short-term negative effects.</p> <p>The scale of this effect could range from medium to very high positive depending on the network extent and level of uptake. If this development facilitates a shift in travel behaviour, with a significant amount of people travelling via the mass/rapid transit networks very high positive effects are expected. However if uptake is less, and positive effects may reduce to medium positive.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets. Uncertainty about the nature and scale of these effects means that there is medium confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	<p>Commitment to the use of low carbon/renewable sources of energy to power the trams and light rail developments.</p> <p>Ensure integration of the mass transit networks with active travel networks.</p> <p>Increase the roll out of mass transit networks to other major towns and cities in Scotland.</p>				

Table A.37: Urban Sustainable, Blue and Green Drainage Solutions

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
Urban Sustainable, Blue and Green Drainage Solutions	Water and drainage infrastructure investment	Transport		Negligible negative effects from transportation of staff, materials, and equipment for construction of different elements of drainage infrastructure.	Negligible negative effects from staff and maintenance travel for infrastructure development.		Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	
		Electricity						
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials used for construction of drainage solutions. Energy requirements of construction.	Negligible negative effects from carbon embodied in materials required for maintenance.	Negligible positive effects from improved climate resilience will reduce flood damage and the embodied carbon in replacement materials following flood damage.	Negligible negative effects from energy requirements of decommissioning.	
		Waste		Negligible negative effects from construction waste.				
		LULUCF		Negligible negative effects as infrastructure will be on previously developed land. Minor impact on soil and vegetation.			Negligible negative effects from disturbance to soil and vegetation during decommissioning,	
	Nature based solutions	Transport		Negligible negative effects from	Negligible negative effects from maintenance travel.		Negligible negative effects from transportation of staff, materials and equipment for	

Development	Sub-category	Source of emissions	Baseline	Stage of development				Uncertainty
				Construction	Operations (direct)	Operations (indirect)	Decommissioning	
				transportation of staff, materials and equipment			decommissioning.	
		Electricity						
		Buildings/ Heat						
		Industrial, manufacture and construction processes		Negligible negative effects from carbon embodied in the materials and equipment used.	Negligible negative effects as carbon embodied in materials required for maintenance.			
		Waste		Negligible negative effects from construction waste.	Negligible negative effects from waste from bins along the green networks.			
		LULUCF		Negligible negative effects from minor impact on soil and vegetation.	Minor positive effects from enhanced soil and vegetation, carbon sequestration.		Negligible negative effects from soil and vegetation disturbance.	

Table A.38: Urban Sustainable, Blue and Green Drainage Solutions

Urban Sustainable, Blue and Green Drainage Solutions						
Summary of significant effects from all project components including cumulative effects	Construction/ establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector	
Transport	Negligible negative effects from transportation of staff, materials, and equipment for construction.	Negligible negative effects from staff and maintenance travel.		Negligible negative effects from transportation of staff, materials and equipment after decommissioning.	Minor negative GHG balance from transport, as this development will lead to increases in the emissions from transport. Medium confidence as it assumes that this development will deliver water and drainage infrastructure.	
Electricity					Neutral GHG balance from electricity, high confidence as minimal electricity should be required to deliver this development.	
Buildings (heat)					Neutral GHG balance from buildings, high confidence as no heat should be required to deliver this development.	

Urban Sustainable, Blue and Green Drainage Solutions					
Summary of significant effects from all project components including cumulative effects	Construction/establishment	Operation (direct)	Operation (indirect effects not included in GHG balance by sector)	Decommissioning	GHG balance by sector
Industrial, manufacture and construction processes	Negligible negative effects from carbon embodied in the materials used for construction.		Minor positive effects as improved climate resilience will reduce flood damage and the embodied carbon in replacement materials following flood damage.		Minor negative GHG balance from industrial processes, as considering the scale of this development it should not require significant amount of carbon heavy materials for the construction. . Low confidence due to uncertainty over the carbon intensity of the drainage infrastructure, the extent to which this is applied in other regions.
Waste	Negligible negative effects from construction waste.	Negligible negative effects from waste from bins along the green networks.			Minor negative GHG balance from waste, medium confidence as this development is unlikely to produce significant amounts of waste.
LULUCF	Negligible negative effects from infrastructure will be part of already developed land. Minor impact on soil and vegetation.	Minor positive effects from enhanced soil and vegetation, carbon sequestration.		Negligible negative effects from soil and vegetation disturbance.	Minor positive GHG balance from LUULCF, medium confidence as green infrastructure will enhance carbon sequestration, but the scale and extent of this is unknown.
Summary of lifecycle GHG balance (direct effects)	<p>This proposed national development is likely to result in a net positive effect on direct lifecycle GHG emissions. This is based on:</p> <ul style="list-style-type: none"> ▪ Medium confidence in minor negative effects in relation to transport due to minor levels of maintenance travel. ▪ Low confidence in minor negative effects from industrial, manufacture and construction processes due to uncertainty over the carbon intensity of the materials used. ▪ Medium confidence in minor negative effects from waste due to assumed limited waste produced. ▪ Medium confidence in minor positive effects in relation to LULUCF as this development is likely to enhance carbon sequestration, although the scale of the effect is uncertain. 				
Summary of lifecycle GHG balance (indirect effects)	<p>This proposed national development is likely to result in a net positive effect on indirect lifecycle GHG emissions.</p> <p>The proposed national development reduces flood risk, and there is medium confidence in minor positive effects due to reduced flood damage and embodied carbon in replacement materials due to uncertainty on the scale of flood damage avoided.</p>				
Summary of effect	<p>When direct and indirect effects are combined, it is likely that this development will have a net positive effect on lifecycle GHG emissions due to reduced flood risk and delivery of more green spaces that are likely to enhance carbon sequestration.</p> <p>The scale of effects could range from low to medium positive depending on how much flood damage is avoided and how many green spaces are delivered. A low scale of effect would result from minimal use of nature-based drainage solutions and the greater use of materials which contain higher embodied carbon. Conversely, if the drainage solutions are widespread and deliver green infrastructure, they are likely to reduce greenhouse gas emissions due to limiting flood damage, with a medium positive effect.</p> <p>Depending on the nature of the projects taken forward and considering both direct and indirect effects, the lifecycle greenhouse gas emissions assessment concludes this development will likely have an overall net positive impact on achieving national greenhouse gas emissions reduction targets.</p> <p>Greater certainty about the nature and scale of these effects means that there is medium confidence in this overall conclusion.</p>				
Additional mitigation and enhancement	<p>Ensure that green infrastructure is fully exploited to enhance carbon sequestration.</p> <p>Prioritise the reuse of materials in construction, use of low carbon construction materials and ensure upon decommissioning waste materials are reused or recycled.</p>				