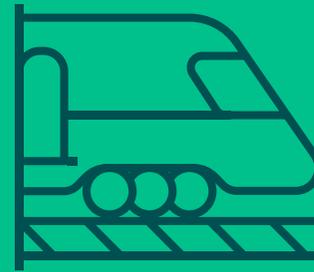
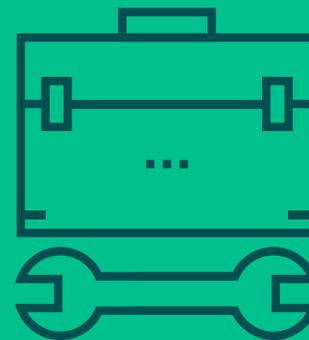


GREEN JOBS IN SCOTLAND



Written by
Transition
Economics and
commissioned
by STUC



stuc

EXECUTIVE SUMMARY

This report, commissioned by the STUC and researched and written by Transition Economics, sets out how Scotland can maximise green job creation, as well as Fair Work and effective worker voice in these jobs.

It considers what changes are needed if Scotland is to meet its decarbonisation needs, what job opportunities are associated with this, and what policies need to be put in place to ensure that these jobs provide Fair Work and enable effective voice demonstrated by high levels of union recognition and influence. Each chapter answers these questions in relation to a different industry: energy, buildings, transport, manufacturing / heavy industry, waste, and agriculture and land-use.

The report estimates - with the right policies and funding in place - Scotland could see job creation in the region of 156,000 - 367,000 jobs. The ranges below indicate the positive potential, depending on investment levels and time periods for delivery.

However, it is also possible for Scotland to decarbonise without significant domestic job creation - and that those jobs created could be primarily precarious and under-paid. For example, the same very ambitious roll-out of renewable energy could create up to 70,000 Scottish jobs - or less than 9,000. The difference depends on the policies put in place by government. Past experience would indicate the lower figure is a more likely outcome, with the latest figures showing that employment in Scotland's low-carbon and renewable energy economy actually fell from 23,200 in 2014 to 21,400 in 2019.¹

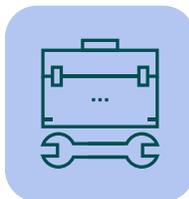
With the right policies, green job creation in different sectors **should** look like:



ENERGY

30,000 - 95,000 jobs

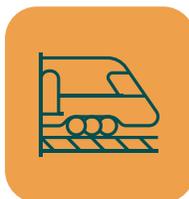
Over 15+ years in zero carbon energy (including renewables, hydrogen and storage) - but potentially only 16,000 without the right policies.



BUILDINGS

61,000 - 136,000 jobs

Over 10+ years in decarbonising buildings and broadband, plus a further 22,000 - 37,000 jobs over 3 years in building new social housing.



TRANSPORT

26,000 - 60,000 jobs

Over 10+ years in upgrading and expanding transport (railways, metros, EV charging and batteries, cycle and walking infrastructure, and zero-emissions freight & shipping), with a further 11,000 - 13,000 ongoing jobs in operations.



MANUFACTURING & INDUSTRY

5,000 - 9,000 jobs

New and ongoing jobs in manufacturing (including steel, CCS and re-manufacturing), alongside protecting existing employment numbers in chemicals and refining.



WASTE

17,000 - 23,500 jobs

New and ongoing jobs in circular economies and waste management.



LAND-USE

17,000 - 43,000 jobs

Over 12+ years in nature restoration, reforestation and sustainable farming.

¹ <https://www.ons.gov.uk/economy/environmentalaccounts/datasets/lowcarbonandrenewableenergyeconomyfirstestimatesdataset>

INTRODUCTION

THIS REPORT, COMMISSIONED BY THE STUC AND RESEARCHED AND WRITTEN BY TRANSITION ECONOMICS, SETS OUT HOW SCOTLAND CAN MAXIMISE GREEN JOB CREATION, AS WELL AS FAIR WORK AND EFFECTIVE WORKER VOICE IN THESE JOBS.

REPORT STRUCTURE

It considers what changes are needed if Scotland is to meet its decarbonisation needs, what job opportunities are associated with this, and what policies need to be put in place to ensure that these jobs provide Fair Work and enable effective voice demonstrated by high levels of union recognition and influence.

Each chapter answers these questions in relation to a different industry:

- 2 ENERGY**
- 3 BUILDINGS**
- 4 TRANSPORT**
- 5 MANUFACTURING/HEAVY INDUSTRY**
- 6 WASTE**
- 7 AGRICULTURE AND LAND-USE**

CHAPTER STRUCTURE

Each chapter begins with a summary page bringing together its key insights, job creation projections, and recommendations.

Thereafter the chapters follow the following structure:

1.CONTEXT

- Decarbonisation needs
- The existing numbers of jobs in the industry
- A future vision for the industry based on decarbonisation needs and development possibilities

2.OPPORTUNITIES FOR JOB CREATION

- Short-term infrastructure projects that can create an immediate-term jobs boost in the context of Covid-19 economic recovery
- Key policy and technological dilemmas that will shape job creation in the industry (these are only highlighted in some sectors)
- Long-term job creators, their potential geographical hubs, investment needs, and job creation estimates

3.WORKFORCE IMPLICATIONS

- Job quality and representation
- Skills shortages and other skills provision issues
- Supply chain challenges and opportunities

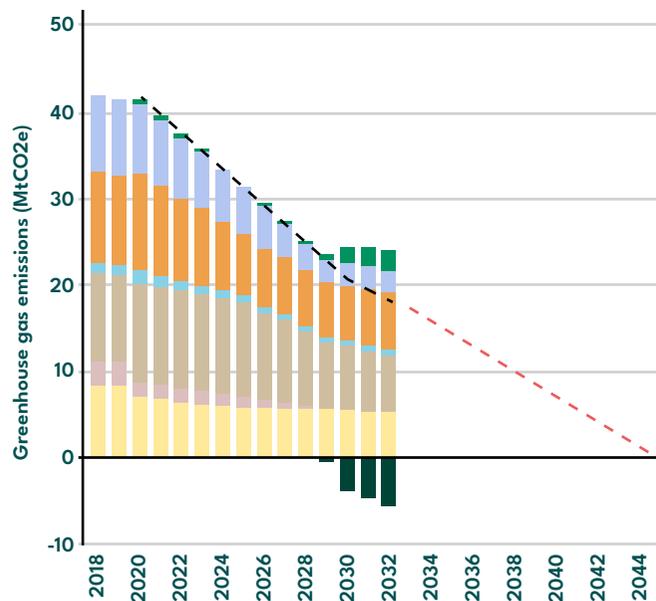
4.POLICY RECOMMENDATIONS

WHAT DO WE MEAN BY 'DECARBONISATION NEEDS'?

Each chapter of this report begins with an overview of Scotland's climate targets and the decarbonisation needs faced by a sector. We treat 'decarbonisation needs' as going over and above current industry and government commitments, for two reasons.

Firstly, to meet Scotland's net zero emissions by 2045 target, decarbonisation has to accelerate. The Scottish Government set out its sector-specific targets for emissions reduction in December 2020. As Figure 1.1 demonstrates, current targets to 2032 require much faster decarbonisation than was estimated in 2018-2020, and reaching net zero by 2045 (red dotted line) requires decarbonising at a steady and slightly increased rate following the targets to 2032 (black dotted line represents totals). The stacked bar columns represent existing sector-specific government targets to 2032.

Figure 1.1
SCOTLAND'S DECARBONISATION HAS TO ACCELERATE TO MEET NET ZERO BY 2045



Source:
Transition Economics graph using Scottish Government data

- Total emissions Pathway to net zero
- Total emissions 2020 targets
- Negative Emissions Technologies
- Land use, land use change & forestry
- Buildings
- Transport
- Waste
- Industry
- Electricity
- Agriculture

Secondly and more importantly, the gradual reduction in emissions described in government targets should not always be the goal. Certain interventions (for example, a large-scale household energy efficiency retrofit programme) can achieve a significant reduction in emissions in a relatively short amount of time, and will provide more economic benefit (e.g. boost to manufacturing and job creation) if done in a rapid coordinated fashion rather than a trickle.

For each sector, this report therefore provides an overview of current emissions, and uses the Scottish Government's 2018 Climate Change Plan, and its 2020 update, to indicate the lower end of ambition for sector-specific targets. But the interventions described in the report focus on the higher end of ambition, necessary to both meet the more stringent net zero emissions target, and to create economic benefit and jobs.

HOW IS FUTURE INVESTMENT AND JOB CREATION ESTIMATED?

For every short- and long-term job creation opportunity, cost estimates were sourced based on existing precedent where applicable (e.g. engineering companies' estimates of cost to electrify railways per track mile) and future needs (e.g. public transport think tanks' and public agencies' estimates of railway track length to be electrified). The level of public investment - for projects that are expected to be delivered by the private sector with public participation - was estimated based on recent precedent for proportions of public to private capital in similar programmes.

Future job creation is estimated using input-output based multipliers. Multipliers for direct and indirect (supply chain) jobs are sourced or calculated from ONS, Homes and Communities Agency, Scottish Government and other government sources and supplemented with data from published third-party economic modelling. For each project, we use a weighted average of a variety of estimated multipliers, prioritising government sources, recent estimates, and a close match to the project. Note that nearly every multiplier in the assessment relies on input-output modelling (top-down) methodology, which tends to slightly overstate job creation compared to empirical (bottom-up) methods. Due to the lack of exact precedent for many of the projects and due to the need to account for supply chain jobs, we consider input-output based multipliers the most appropriate methodology. For longer-term job creation opportunities, job creation multipliers were downgraded based on an estimated future increase in productivity (output per job).

OVERARCHING RECOMMENDATIONS

Recommendations on investments, policies and legislation made in this report span the competencies of Scottish, UK and local governments. The scale of public investment recommended exceeds what the Scottish Government alone would be able to access under current rules. In this context, Government may choose to prioritise some investments and leverage others at a local and/or UK level.

This report argues for a strong level of public sector investment and participation in decarbonising sectors throughout, as a way to both decarbonise at the necessary pace, and to maximise job creation and the application of Fair Work standards. Countries that implement more deliberate industrial strategies for decarbonisation, including public investment and/or local content rules, - for example Denmark, France, Turkey, and Taiwan in relation to renewable energy - appear to be more successful at ensuring local job creation. It is worth noting that many examples of such industrial strategies cited in this report come from countries bound by EU State Aid rules (including France, Spain, and Denmark).

Scotland needs a co-ordinated approach to skills provision for the climate transition. This report recommends the creation of a new public body - Climate Skills Scotland - to play a co-ordinating and pro-active role to work with existing providers (e.g. FE colleges) to quickly roll out the new qualifications required. As many of the occupations in the energy, construction, and manufacturing industries are disproportionately male-dominated, Climate Skills Scotland and other public bodies should also work with training providers and employers to make sure climate jobs and training programmes follow recruitment best practice, and prioritise promotion and incentives to historically marginalised groups, including women, BAME people, and disabled people.



2

ENERGY

SUMMARY

WHERE WE ARE NOW

ELECTRICITY

5% of Scotland's emissions

OIL & GAS

10% +downstream emissions

A FAILURE TO FULFIL PROMISES OF GREEN JOBS BOOM

According to ONS Low Carbon Economy statistics

6,300 Renewable energy

9,000 Oil & gas
Up to 40% job losses in 2020

16,000 Mining & energy services

2,400 Nuclear
With plants due to close 2022-2030

SKILLS SHORTAGES

- Engineering
- Technical roles
- Supply chain starved of investment

POTENTIAL TO PIONEER FOR EXPORT

- Tidal stream
- Hydrogen electrolysis
- Floating wind

FUTURE JOB CREATION POTENTIAL

(DIRECT & SUPPLY CHAIN)

Up to 95,000 jobs over 15+ years in zero carbon energy, with the right policies.

PROJECT	JOB CREATION ESTIMATES
Expand domestic supply chains	23,000 - 70,000 (based on substantial supply chain expansion)
Massively expand renewables	8,500 - 10,000
Hydrogen electrolyzers	Development and construction: 2,000 to 11,000 Operation: up to 2,000
Hydro pumped storage	Development and construction: 2,300 to 5,900 Operation: up to 200
Upgrade electricity and gas networks	Maintains existing network jobs
Decommission oil & gas infrastructure	2,900 - 8,000

Achieving this level of job creation will depend on active industrial strategy, public ownership and significant public investment into supply chains, as in other countries. Without the right policies, renewables job creation could total less than 10,000. Future job creation potential is concentrated in coastal areas.

TOP 5 RECOMMENDATIONS

- 1 Invest £2.5 billion - £4.5 billion (to 2035) in ports and manufacturing to supply large scale offshore renewables and decommissioning.
- 2 Set up a Scottish National Energy Company to build 35GW of renewables by 2050, run energy networks, coordinate upgrades. Between £164 billion - £262 billion in public and private investment expected to be needed over 30 years.
- 3 Expand local content (as practiced in France, Turkey, Taiwan and elsewhere) and local hiring requirements. Phase in a 90% lifetime local content target for National Energy Company.
- 4 Skills programmes to address shortages, and remove barriers to renewables jobs for oil and gas workers.
- 5 Fund quick scale-up of hydrogen electrolysis and tidal stream technology.

CONTEXT

DECARBONISATION NEEDS

The Electricity generation sector in 2018 accounted for only 5% of Scotland's greenhouse gas emissions, at 2.2MtCO_{2e}. Oil refining in 2018 accounted for 2.1MtCO_{2e}, and oil and gas extraction and distribution (including flaring and other related processes) 2.5MtCO_{2e}.

The Government aims for Scotland's electricity supply in 2029 to be zero-emissions¹ and largely to be fulfilled by renewable sources (onshore wind, offshore wind, hydro, solar, marine and bioenergy).

It also aims to:

- deploy smart grid technologies to improve connection and stability,
- develop pumped hydro storage,
- grow the community-owned electricity capacity to 1GW,
- develop Negative Emissions Technologies including Carbon Capture and Storage (CCS) projects, which it sees as necessary to reduce industrial emissions and possibly able to expand hydrogen production.²

By 2045 Scotland's electricity supply should be fully zero-carbon.

Scotland's oil and gas output is equivalent to an additional 180.3 MtCO_{2e} when used, more than four times greater than Scotland's own greenhouse gas emissions.³ Emissions from the consumption of oil and gas are usually accounted for by end user, but should be considered to plan a successful industrial policy that safeguards workers' interests.

While the UK and Scottish Governments have not yet set targets to reduce oil and gas output, a managed phase-out is increasingly likely at some point, to meet decarbonisation goals and accommodate shrinking demand (e.g. due to the shift from combustion engine vehicles to EVs, and the switch to low-carbon heating). The oil company BP has recently announced its intention to decrease production by 40% by 2030.⁴ The Royal Society of Edinburgh's enquiry Scotland's Energy Future found that "Continuing to burn substantial quantities of gas will exacerbate the problem faced by climate change and runs counter to the goal of reducing carbon emissions."⁵

The future trajectory of the oil and gas sector and its workforce are outside the scope of this report, but some implications for how to support skills, workers and supply chains will be considered.

GEOGRAPHICAL HUBS

Due to a lack of granularity in the Standard Industrial Classification used by ONS, it is harder to accurately depict energy sector employment hubs across Scotland. This is partly because categories like "Generation of electricity" hide the distinction between, for example, hydroelectric, wind, and nuclear power, and partly because a large proportion of the workforce is employed in supply chains that cannot be easily identified in ONS data. In renewable energy generation in particular, the bulk of the work involved is in the manufacturing and construction phases, both of which tend to be subcontracted to companies who won't appear as energy companies in the data.

With that caveat, Table 2.1 shows the energy industry geographical hubs that do appear in ONS data for Scotland.

¹<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/7>

²<https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/pages/10>

³Scotland's oil and gas output in 2018 was 77.2 million tonnes of oil equivalent (mtoe), equivalent to 180.3MtCO_{2e} in emissions using the World Bank's CO₂ intensity ratio. Sources: <https://www.gov.scot/publications/oil-and-gas-production-statistics-2018>, <https://data.worldbank.org/indicator/EN.ATM.CO2E.EG.ZS>

⁴<https://www.bp.com/en/global/corporate/news-and-insights/press-releases/from-international-oil-company-to-integrated-energy-company-bp-sets-out-strategy-for-decade-of-delivery-towards-net-zero-ambition.html>

⁵<https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf>

Table 2.1
GEOGRAPHICAL HUBS FOR ENERGY DEVELOPMENT

Does not reflect supply chains

		Industry	Jobs	% of jobs in Scotland	Key workplace
1	ABERDEEN CITY	Extraction of crude petroleum and natural gas	7000	80.4%	
2	PERTH & KINROSS	Production of electricity	2000	35.7%	SSE
3	GLASGOW CITY	Manufacture of gas; distribution of gaseous fuels through mains	1750	25.9%	
4	CITY OF EDINBURGH	Manufacture of gas; distribution of gaseous fuels through mains	1500	28.4%	
5	SOUTH LANARKSHIRE	Distribution of electricity	1500	28.4%	
6	NORTH LANARKSHIRE	Distribution of electricity	1500	22.2%	
7	FALKIRK	Manufacture of refined petroleum products	1000	71.9%	Grangemouth Refinery

Source:
ONS Business Register and Employment Survey; Transition Economics analysis

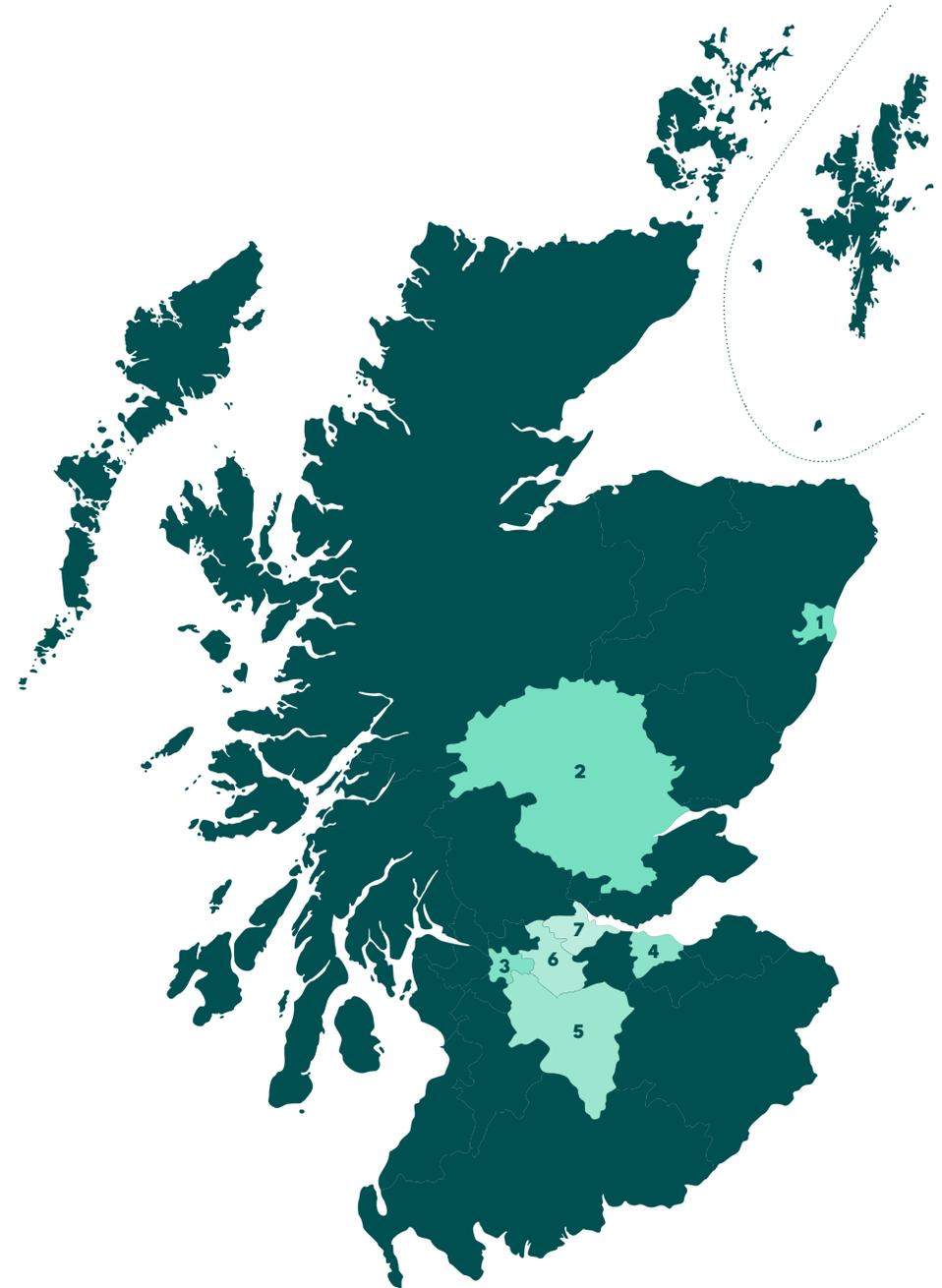


Table 2.2 uses a different ONS dataset (Low Carbon and Renewable Energy accounts) to estimate direct employment in some energy sectors: this also excludes supply chains.

Table 2.2
ENERGY SUBSECTOR EMPLOYMENT EXCLUDING OIL AND GAS ACROSS SCOTLAND

Does not reflect supply chains

Employment (FTE equivalent) in Scotland	2017	2018	2019
Offshore wind	2,000	1,700	1,400
Onshore wind	2,300	2,900	1,900
Solar photovoltaic	100	300	600
Hydropower	1,300	700	700
Other renewable electricity	100	100	~
Carbon capture and storage	~	0	~
Nuclear	2,700	2,000	2,400
Renewable heat	1,000	1,100	900
Renewable combined heat and power	200	100	~
Bioenergy	1,000	1,100	800
Alternative fuels	100	~	~
Fuel cells and energy storage	~	100	~
Total	10,800	10,100	8,700

Note: ~ indicates an estimate of less than 100.

Source: ONS LCRE accounts; Transition Economics analysis

THE FUTURE OF ENERGY

Over the coming decades, Scotland could see:

- An enormous expansion in renewables generation capacity - primarily offshore and onshore wind, tidal stream, and wave power - to meet growing energy demand and for export.
- Significant quantities of zero-carbon hydrogen produced through electrolysis, used to power transport (HGVs, ferries, trains), heavy industry, some heat, and storage for electricity to cope with renewables intermittency.
- A thriving domestic supply chain for wind energy, and both domestic and export supply chain for tidal stream, wave, floating offshore wind and hydrogen electrolysis technology.
- Significant expansion in energy storage, including hydro storage.
- Buildings on the gas grid transitioned instead to district heating or hydrogen grid, and the electricity network reinforced and expanded, to support significant electrification of heat and transport and expansion of renewables.⁶
- Decommissioning of a significant proportion of oil and gas extraction infrastructure.
- Development of Carbon Capture and Storage.⁷

⁶ See Buildings chapter for discussion

⁷ See Manufacturing and Industry chapter for discussion.

OPPORTUNITIES FOR JOB CREATION

COVID-19 ECONOMIC RECOVERY

Our assessment recommends three shovel-ready projects costing £630 million in public investment that can create an immediate term boost of 9,000 direct and supply-chain jobs for two years (Table 2.3).

Table 2.3
SHORT-TERM INFRASTRUCTURE PROJECTS FOR ECONOMIC RECOVERY: ENERGY

Project	Score	Scotland jobs multiplier (direct & supply chain, jobs / £ million invested)	Public Investment (£ billion)	Avg jobs (direct & indirect) over 2-year stimulus period	Outcome
R&D for hydrogen electrolysis, tidal stream and wave energy	17	15.90	0.20	1,908	Develop Scottish technology for this decarbonisation pathway.
Upgrade ports and shipyards for offshore wind supply chain	17	22.24	0.33	5,782	One new port capable of handling towers and foundations for the upper range of wind turbine size; and upgrades to existing ports and shipyards.
Build manufacturing facilities for offshore (including floating) wind turbines	15	16.00	0.10	1,325	Campbelltown wind turbine towers factory upgraded to handle offshore contracts. A new nacelle factory built.
Total			0.63	9,015	

Source: Transition Economics analysis

POLICY CHOICE: WHAT TECHNOLOGIES TO USE TO LEVEL OUT SUPPLY?

A key policy question for the future direction of Scotland's energy mix is what method of electricity generation to use to address the intermittency of renewable energy sources.⁸ With the estimated levelised cost of wind energy projected to stay below that of gas power stations,⁹ wind energy is hard to rival as the mainstay of Scotland's future power supply. But the combination of intermittency in wind levels and fluctuations in demand for electricity - both seasonally and on a daily basis - mean that there is a need for electricity sources that can either produce a baseload constant or more flexible "on-demand" supply. Hydro is and will remain a significant zero-carbon source, but cannot resolve the challenge alone.¹⁰

Table 2.4
ENERGY BALANCING TECHNOLOGY OPTIONS

Option	Biomass burning	Hydrogen as energy storage	Nuclear (Small Modular Reactors)	Pumped hydro as storage	Tidal (barrage)	Tidal (stream)
What it looks like	Combined Heat and Power (CHP) plants burn purpose-grown crops or trees such as willow or poplar. ¹¹	Large scale electrolysis plants make hydrogen using offshore wind energy. A power station burns the hydrogen at times of peak demand.	Factory-made nuclear reactors producing up to 440MW energy each.	Pumps move water into higher reservoirs at times of oversupply of electricity. The hydro power station uses the stored water to generate electricity at peak demand.	A tidal range installation on the Solway Firth could provide an estimated 17.84 TWh, with capacity of 7.2GW. ¹²	Turbines generating up to 33 GW (116 TWh/year).
Potential for jobs created	Power station operation and biomass processing	Electrolysis and power plant construction; Electrolysis and power plant operations	Power station operation staff	Construction / civil engineering. Minimal maintenance / operation staff.	Construction / civil engineering. Minimal maintenance / operation staff.	Tidal Stream manufacturing and installation; operation / maintenance staff
Scottish supply chain potential	Agricultural suppliers, though on current energy prices biomass is not sufficiently profitable for a domestic supply chain. ¹³	Potentially significant, if enough R&D invested and Scotland can stay abreast of hydrogen development in France, Germany, South Korea and elsewhere.	Significant in hazardous waste management because of existing expertise. Unlikely in manufacturing. ¹⁴	Significant for construction.	Significant for construction.	Significant global first mover advantage. Export opportunity depends on deployment at scale and expanded R & D investment.
Quality of work implications	Current waste-to-energy plants obstruct union recognition and fail to meet construction industry-wide pay agreements. ¹⁵	Unclear as industry is in its infancy.	Will depend on the operator. Existing nuclear power plants are due for decommissioning in 2022 and in 2030. ¹⁶ Planning for a transfer of the existing workforce would be challenging.	Large one-off construction projects mean this is variable based on existing labour conditions within company, unless developed by public sector.	Large one-off construction projects mean this is variable based on existing labour conditions within company, unless developed by public sector.	Unclear as industry is in its infancy.

Cost implications - Levelised Cost of Energy	Current range: £46 to 224 / MWh ¹⁷	£77 to £154 / MWh ¹⁸	Uncertain (new technology, no prototypes built yet).	Expected £148/MW ¹⁹	Depends on the specific lagoon. For comparison, a 2014 estimate for Welsh tidal lagoons estimated £90 to £150. ²⁰	OREC estimates £80/MWh when there is 1GW installed. ²¹
Competitive advantage for Scotland? ²²	No	Yes (colocation with offshore wind)	No	Yes (large number of potential sites and established hydro industry)	No	Yes (first mover advantage and geography)
Likelihood of successful timely decarbonisation	Ready to deploy, but could undermine other aspects of decarbonisation because of intensive land use.	Medium likelihood. Electrolysis at the scale needed to store hydrogen for seasonal peak usage could be available in the 2030s-2040s. ²³	Very uncertain (Royal Society of Edinburgh: "There is a high level of uncertainty over how long this technology will take to sufficiently develop.") ²⁴ When developed, planning and safety process likely to be lengthy.	Likely. Technology is not new; challenge is financial viability, rural planning, and integration with electricity market and other forms of storage (eg. batteries).	Uncertain. Depends on complex process of studies, consultation and permission. ²⁵	Likely. Scaling up deployment could see a similar technology curve and cost reduction to offshore wind.
Other social justice implications	Land use intensive, and so could undermine food security, water supply, and/or biodiversity. ²⁶		Although SMRs are designed to be safer than existing larger plants through having fewer moving parts, ²⁷ risks of accidents leading to radioactive contamination remain. ²⁸ SMRs would produce waste similar to that of traditional reactors. ²⁹ Existing nuclear waste management programmes in Scotland have been criticised for releasing long-term hazardous waste into water bodies including the Clyde. ³⁰ Finding reliable long-term storage solutions for nuclear waste remains a challenge. ³¹	Possible negative impacts on rural landscapes and biodiversity, depending on location. ³²	Depending on design, could undermine local economy by hindering movement of vessels and/or bring benefit by providing a transport link as a bridge. May impact estuary wildlife. ³³	

In our assessment, priority technologies with the strongest chance of 1) successfully contributing to timely decarbonisation; 2) supporting job creation and supply chains; 3) building on Scotland's competitive advantages are: hydrogen electrolysis, pumped hydro storage, and tidal stream.

Note that we are considering hydrogen by electrolysis ('green hydrogen') as a long-term jobs creation opportunity. While hydrogen from natural gas ('blue hydrogen') will likely create jobs in the short- to medium-term, an excessive focus of investment and effort on this form of hydrogen may mean losing out on the longer-term job creation possibilities of electrolysis based hydrogen.

⁸ https://ec.europa.eu/energy/sites/ener/files/energy_storage.pdf

⁹ https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf

¹⁰ Scotland's hydropower capacity of 1,650 MW generated 5,362 GWh in 2019 - more than of Scottish electricity consumption. This proportion will fall.

<https://scotland.shinyapps.io/Energy/?Section=RenLowCarbon&Subsection=RenElec&Chart=RenElecCapacity>
<https://scotland.shinyapps.io/Energy/?Section=RenLowCarbon&Subsection=RenElec&Chart=RenElecGen>

¹¹ <https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf> p85

¹² <https://royalsocietypublishing.org/doi/10.1098/rsta.2012.0181>

¹³ Alexander, P; Moran, D; Rounsevell, M.D.A; Hillier, J; & Smith, P; Global Change Biology Bioenergy 6, 2014, Cost and potential of carbon abatement from the UK perennial energy crop market, pp 156–168. DOI: 10.1111/gcbb.12148.

¹⁴ Of the existing UK SMR consortium partners, only BAM Nuttall has a recent track record of carrying out nuclear industry relevant work - decommissioning / clean-up - in Scotland. Manufacturer Rolls-Royce has not announced where it intends to make the SMRs, but has an existing nuclear reactor manufacturing plant in Derby, England.

¹⁵ <https://resource.co/article/unions-allege-%E2%80%98deplorable%E2%80%99-treatment-migrant-workers-waste-facility-10423>

<https://resource.co/article/unions-protest-alleged-worker-exploitation-efw-developments-kent-and-yorkshire-11796>

¹⁶ <https://www.edfenergy.com/energy/power-stations/torness>

<https://www.edinburghlive.co.uk/news/edinburgh-news/east-lothians-torness-nuclear-power-18396921>

¹⁷ https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Power_Generation_Costs_2019.pdf

¹⁸ https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

¹⁹ <https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf> p85

²⁰ http://www.poyry.co.uk/sites/www.poyry.co.uk/files/tidallagoonpower_levelisedcoststudy_v7_0.pdf.

²¹ <https://ore.catapult.org.uk/?orecatapultreports=tidal-stream-and-wave-energy-cost-reduction-and-industrial-benefit>

²² Suggests likelihood of successful deployment

²³ https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf

²⁴ <https://www.rse.org.uk/wp-content/uploads/2019/06/Energy-Report-for-Web-2.pdf>

²⁵ <https://royalsocietypublishing.org/doi/10.1098/rsta.2012.0181>

²⁶ <https://www.sciencedirect.com/science/article/pii/S2211912418301366>

²⁷ <https://www.sciencemag.org/news/2019/02/smaller-safer-cheaper-one-company-aims-reinvent-nuclear-reactor-and-save-warming-planet>

²⁸ <https://www.iaea.org/newscenter/news/technology-neutral-safety-and-licensing-of-smrs>

²⁹ <https://www.iaea.org/newscenter/news/small-modular-reactors-a-challenge-for-spent-fuel-management>

³⁰ <https://www.scotsman.com/news/environment/mod-under-fire-over-plan-radioactive-waste-dump-clyde-2026720>

³¹ <https://www.iaea.org/newscenter/news/small-modular-reactors-a-challenge-for-spent-fuel-management>

³² For comparison: <https://www.tandfonline.com/doi/abs/10.1080/00049182.2019.1684625>

³³ <https://post.parliament.uk/research-briefings/post-pn-435/>

Table 2.5
LONG-TERM JOB CREATION OPPORTUNITIES IN DECARBONISING ENERGY

Project	Expand domestic supply chains	Massively expand renewables	Hydrogen electrolyzers	Hydro pumped storage	Upgrade electricity and gas networks	Decommission oil & gas infrastructure
Outcome	Significant expansion of manufacturing and construction supply chain for renewables (& hydrogen), particularly for tidal stream, wave and offshore wind. Including fabrication yards, ports and turbine manufacture.	Major expansion of renewables generation, primarily wind power onshore and offshore, tidal stream and wave (between 42-57GW new capacity to 2045 in total).	Construction of full-scale hydrogen electrolyzers, so that Scotland can take a lead in clean hydrogen generation.	60GWh in pumped hydroelectric storage capacity.	Electricity network expanded and reinforced to cope with significant electrification of transport and heat. Heat network upgraded to safely transport hydrogen. Expanded interconnectors to export excess electricity.	Decommissioning oil and gas wells and platforms in the North Sea, if 30% to 50% of decommissioning expenditure spent in Scotland.
Potential jobs created	Construction, fabrication, manufacturing supply chains, less significant operation jobs.		Research and Development: engineers, researchers, supply chain.	Construction, engineering, operations.	Construction, engineers - to deliver interconnectors	Technical, trades (e.g welders), and labourers, remediation and waste management. To a lesser extent engineering and scientific roles.
Jobs maintained	Existing fabrication yards, ports, marine.			N/A	Existing jobs in networks.	
Geographical hubs	Tidal: Highlands & Islands. Offshore Wind: Aberdeenshire, Fife, Edinburgh, Glasgow.		Near large offshore wind installations	Highlands		Aberdeenshire, Highland, Shetland, Dundee, Fife, Angus, Orkney
Investment scale (estimate, includes public and private sector)	£72 billion - £110 billion installation costs. Supply chain upgrades: £6 - £12 billion		£2.8bn to £12.6bn	£2bn to £4bn	£742 million (per year)	£51bn
Length of programme (estimate)	10-20 years with potential for export expansion in emerging technologies	20-25 years	15-20 years	12-15 years	ongoing	30 years +
Job creation (estimate)	23,000 - 70,000 thousand (based on substantial supply chain expansion)		Development and construction: 2,000 to 11,000. Operation: less than 2,000	Development and construction: 2,300 to 5,900. Operation: up to 200.	Maintains existing network jobs.	2,900 to 8,000

WORST CASE OUTCOMES FOR RENEWABLES JOBS

To date, Scotland has seen disappointingly low job creation from the growth of renewable power. Due to the capital intensity of renewable energy and the limited operating costs, the greatest potential for job creation in renewables lies during the manufacturing and construction phase.

Despite the significant deployment of onshore and offshore wind, employment in manufacturing and installation continues to fall below expectations.³⁴ This is largely due to a lack of a strong industrial strategy, long-term underinvestment into fabrication and manufacturing sites by both public bodies and private companies, and a lack of public and Scottish energy companies prepared to focus employment domestically. Instead, both the private multinationals and foreign public companies have chosen to site jobs overseas.³⁵ Other countries like France, Turkey and Taiwan have demonstrated greater success at increasing local manufacturing alongside wind expansions.

Given the important concerns, we've also modelled a worst case outcome for renewables job creation, if employment in wind, tidal and wave power is limited to the minimum of in-country pre-development, installation and operations & maintenance, with no supply chain employment whatsoever.

Even with a very large-scale roll-out of 42-57 GW of new offshore and onshore wind, tidal stream and wave power, Scotland could see only 9,000 - 14,500 resulting jobs. Because tidal stream and wave are newer technologies, they are expected to be more labour intensive. Despite providing the bulk of generation capacity in this model, it is possible that all forms of wind could deliver only 3,700 - 5,000 jobs, without the right policies.

MINIMAL MODEL FOR RENEWABLE JOB CREATION

	Fixed offshore wind	Floating offshore wind	Onshore Wind	Tidal Stream	Wave	Total
42 GW	1,091	1,734	867	3,663	1,660	9,015
57 GW	1,636	2,144	1,156	4,633	4,980	14,550

³⁴<https://www.heraldsotland.com/news/18173934.scotland-loses-2bn-wind-farm-boom-ministers-pledge-action/>

³⁵http://www.stuc.org.uk/files/Policy/Research-papers/Renewable_Jobs_Crisis_Covid-19.pdf

WORKFORCE IMPLICATIONS

JOB QUALITY AND REPRESENTATION

RENEWABLE GENERATION

Concerns have been repeatedly raised that employment in renewable energy - primarily in offshore and onshore wind and solar sectors - has been below standard. Jobs tend not to be unionised, and there have been reports of large multinational energy utilities like EDF trying to avoid unionisation of their (new) renewables divisions, despite union recognition across the rest of the company.³⁶ The wind power Sector Deal created by the UK Government excludes any provision for trade unions.³⁷ This adds to significant Health & Safety concerns with wind power, repeated violations³⁸, and recent deaths amongst onshore wind workers.³⁹

There's been a failure by the Scottish government to deliver jobs in renewables. Barely 2,000 jobs instead of 20,000. And many of these are low paid, exploitation of migrant labour.

Jackson Cullinane
Unite

If you live in Fife, worked in coal mining or Bifab yards and grew up around oil and gas, the 'renewables revolution' you were promised hasn't happened.

Gary Smith
GMB

³⁶<https://members.prospect.org.uk/news/id/2019/June/14/Waiting-wind-change>

³⁷<https://www.union-news.co.uk/offshore-wind-sector-deal-where-are-the-unions/>

³⁸<https://www.energyvoice.com/otherenergy/246599/contractor-had-no-plan-to-deal-with-emergencies-at-scottish-wind-project/>

³⁹<https://www.bbc.co.uk/news/uk-scotland-glasgow-west-43099751>

Maritime workers in particular are at risk of unacceptable labour conditions. An investigation revealed that migrant workers hired to work on crane ships and guard vessels for offshore windfarm construction and offshore cable-laying sites were paid a fraction of the minimum wage and made to work more than 12 hours a day - both at the Beatrice site and others.⁴⁰ Instead of ensuring acceptable labour standards, the UK government has now repeatedly extended a waiver work for permit requirements in the wind sector to facilitate the employment of foreign crews - raising concerns about poor safety and human rights conditions for migrant workers, as well as concerns about local jobs and training opportunities in the sector.⁴¹

There's a need to organise workers in offshore wind. We mustn't repeat failures of the fossil fuel industry, need to raise union recognition including access to workforce.

Dan Crimes
RMT

Crown Estate Scotland should specify provisions within a licence that dictate that Living Wage or collective agreements are already in place.

Jake Molloy
RMT

⁴⁰<https://www.theguardian.com/uk-news/2018/oct/21/migrants-building-beatrice-windfarm-paid-fraction-of-minimum-wage>

⁴¹<https://safetyatsea.net/news/2019/uk-extends-immigration-waiver-for-offshore-wind-construction-companies/>

COMMUNITY RENEWABLES

In the context of the Scottish Government target for 1GW of community-owned renewable energy generation by 2032, it is worth noting the job quality implications of this. The small scale of these installations and the often volunteer-run nature of their governance will at least in some cases preclude trade union representation and can lead to precarious working conditions for installers and operation and maintenance employees. Published evidence on job quality in community energy schemes in Scotland is lacking, but an international review of energy co-operatives published by Trade Unions for Energy Democracy suggests that co-operatives may make “space for worker voices in decision-making” or may “lock in anti-worker structures” depending on their set-up and mission.⁴²

Ownership is critical issue. New jobs in energy tend to be in smaller companies. Municipal energy companies would be better.

Stephen Smellie
UNISON

HYDROGEN PRODUCTION

The hydrogen production sector is in its infancy, so likely labour conditions remain unclear.

HYDRO STORAGE

The bulk of the costs and the employment involved in hydro storage projects is at the construction stage, with a single large proposed installation (Coire Glas) estimated to create 3,500 direct and 3,115 supply chain construction jobs over a 5-year construction period.⁴³ As with other large infrastructure investments, there is a risk that large construction contractor companies bring hired crews in from elsewhere rather than investing into skills and labour locally, so projects should meet local content and apprenticeship requirements to ensure economic benefit.

The quality of the operation jobs created will depend on the operator: for example, if operated by existing large hydroelectric power operators or within the public sector, these jobs will benefit from an existing unionised base.

SUPPLY CHAINS

The primary job quality challenge within Scottish energy supply chains is a lack of long term supply contracts, creating precarious working conditions at sites like BiFab. Additionally, the CfD auction process for awarding electricity price contracts to renewable energy projects leads to renewables developers squeezing their sub-contracting chains for ever lower costs to drive down prices - adding downward pressure on labour conditions and salaries.

ENERGY NETWORKS

Jobs maintaining and operating the electricity and gas networks tend to be well-unionised, well-paid and safe.⁴⁴

OIL & GAS DECOMMISSIONING

Conditions for offshore decommissioning jobs are likely to be similar to those in the existing oil and gas sector, with growing concerns in recent years about the transfer of staff from permanent positions to self-employed contractor status, and precarity, particularly in the context of COVID-19.⁴⁵ Offshore unions in Scotland have received reports of sub-minimum wage pay levels on individual decommissioning projects in Scotland.⁴⁶

A large portion of onshore decommissioning jobs are likely to be sited at the same shipyards and fabrication yards as possible offshore renewables contracts, where precarity is a dominant concern (see Supply Chains above).

⁴²<http://unionsforenergydemocracy.org/wp-content/uploads/2015/06/TUED-Power-to-the-Peoplefinal.pdf>

⁴³https://pureportal.strath.ac.uk/files/95186256/Turner_et_al_CEP_2020_What_is_the_role_of_pumped_hydro_energy_storage.pdf

⁴⁴Interviews with STUC affiliates.

⁴⁵<https://platformlondon.org/wp-content/uploads/2020/09/Oil-Gas-Workers-Report.pdf>

⁴⁶<https://scottishtuc.blog/2018/06/04/the-offshore-horizon-unions-and-the-future-of-oil-and-gas/>

SKILLS

ELECTRICITY GENERATION SKILLS SHORTAGES

An assessment by Energy & Utility Skills Limited for the Offshore Renewable Energy Catapult lists the following occupations as being in shortage in the UK-wide electricity sector (starred occupations also appear on the official UK Shortage Occupations list):⁴⁷

- Business and commercial
- Maintenance technicians
- Protection Engineer*
- Customer service and stakeholder engagement
- Marketing and communications
- Site Manager*
- Commercial capabilities
- Planners
- Substation electrical engineer*
- Commissioning engineers*
- Power System Engineer*
- Substation fitters
- Control Engineer*
- Planning / development engineer*
- Telecommunications and digitisation
- Data analytics
- Project Engineer*
- Quality, health, safety and environment engineer*
- Design Engineer*
- Project Manager*
- Quantity surveyors
- Jointers (HV and LV)
- Proposals Engineer*

OFFSHORE WIND ENERGY

The Energy & Utility Skills Limited assessment⁴⁸ highlights the shortage of graduate-level engineers (on a UK-wide level) and the expanded need for Operations and Maintenance technicians as more installations complete construction. The assessment notes the following skillsets as crucial to the sector's growth, although not in undersupply right now:

- Asset management, Project management, Leadership
- Technical skills – mechanical, electrical and control & instrumentation, blade and turbine technicians, including IT skills
- Scientists – marine biology, geophysics, hydrography, oceanography
- Advanced first aid and rescue
- Offshore skills – confined spaces, working at heights, team working, team living.

TIDAL STREAM

Scottish expertise in tidal stream energy is of global importance, with the world's first commercial scale tidal stream turbines installed as early as 2016.⁴⁹ However, on current levels of investment Scotland risks losing both the leading edge and the skilled engineers in tidal stream to Canada⁵⁰ or France,⁵¹ where governments are offering clearer financial support and more ambitious deployment plans.

OIL AND GAS DECOMMISSIONING

It should not be assumed that the occupations profile of decommissioning work is identical to that of the broader oil and gas industry: while some occupations are in greater demand in decommissioning projects (e.g. welders), others' roles are limited.⁵²

⁴⁷<https://ore.catapult.org.uk/app/uploads/2018/10/Aura-EU-Skills-UK-Offshore-Wind-Skills-Study-Full-Report-Oct-2018.pdf>

⁴⁸<https://ore.catapult.org.uk/app/uploads/2018/10/Aura-EU-Skills-UK-Offshore-Wind-Skills-Study-Full-Report-Oct-2018.pdf>

⁴⁹<https://www.crownstatescotland.com/what-we-do/marine/case-study/atlantis-and-meygen-turning-the-tide>

⁵⁰<https://www.bbc.co.uk/news/uk-scotland-scotland-business-50757550>

⁵¹<https://www.powerengineeringint.com/renewables/game-changing-tidal-energy-project-approved-for-channel-regions/>

⁵²Interviews with STUC affiliates.

TRANSFERABILITY FROM OIL AND GAS TO OTHER PARTS OF THE SECTOR

The oil and gas industry reportedly shed up to a third of its offshore workforce during the COVID-19 crisis.⁵³ It is likely to contract further in the decades ahead. All of the skillsets and many of the occupations named as shortage or essential for the electricity sector and the offshore wind sector above are present in the oil and gas workforce. Research by Arup for Scottish Enterprise identifies direct crossovers of skills from the oil and gas industry supply chain to geothermal, wind and tidal energy, water and wastewater services, and floods management.⁵⁴

Rather than the meagre Transition Training Fund focused on individual courses, we need a massive, pro-active training programme, enabling oil and gas workers to transfer to renewables. That could limit the negative impacts on livelihoods and job losses as the North Sea oil sector declines.

Dan Crimes
RMT

In some occupations and parts of the supply chain (e.g. scaffolding), companies⁵⁵ and individual workers already work interchangeably between oil and gas and offshore wind installations.

It is important to ensure workers do not face barriers based on skills and qualifications between oil and gas on the one hand and other energy sectors on the other. Such unnecessary barriers exist. Divers working in the oil and gas industry face unnecessary qualifications barriers, because of a mismatch between training qualifications required by industry bodies in oil and gas on the one hand, and in offshore wind on the other.

⁵³<https://www.constructionnews.co.uk/archive/offshore-wind-what-britains-boom-industry-offers-contractors-27-03-2018>

⁵⁴<http://www.evaluationonline.org.uk/evaluations/Documents.do?action=download&id=864&ui=browse>

⁵⁵E.g. CallMac and Petroblast <https://www.constructionnews.co.uk/archive/offshore-wind-what-britains-boom-industry-offers-contractors-27-03-2018>
<http://www.petroblast.org.uk/products.php?level=1>

OPITO and the Global Wind Organisation unilaterally set qualification standards required for employment on offshore wind farms. Divers are irked about having to pay an additional £1,700 for a first aid training that's pretty much identical to what they've already got. These are already atomised employment relationships, with divers working as sole traders on a contract by contract basis. Same for electricians, for rigging. Standards bodies are making money off of workers trying to transition.

Jake Molloy
RMT

Note that our assessment of job creation potential (above) does not have enough granularity to quantify the numbers of specific occupations or distinguish between offshore and onshore roles. This would be a necessary step in transition planning to enable appropriate policies and skills pathways for the existing oil and gas workforce.

SUPPLY CHAIN

WIND POWER (OFFSHORE AND ONSHORE)

Scotland has failed to capture any significant volumes of the supply chain for wind energy, despite large deployment. Very limited capital expenditure in offshore wind goes to domestic suppliers, with turbine blades, nacelles, onshore and offshore substations, foundation jackets and submarine cables almost entirely sourced from abroad.⁵⁶ This is in part due to a lack of a pro-active industrial strategy enforcing more local content in the manufacturing and construction phases, a lack of public and private investment leading to low levels of domestic capacity to deliver at the scales and pace required, and international competitors benefitting from public ownership and government support.

Some commentators argue that it is no longer possible for Scotland to secure a significant part of the supply chain, with offshore wind now a “mature industry”. However, a defeatist approach risks enabling the weak industrial strategies in the UK and Scotland that created this situation. Offshore wind is mature in terms of falling costs, but does not yet have global supply chains prepared to meet the growing international demand.

The Scottish Government owns two yards in Bifab. But no work has been done to make sure that it is a viable industry.

Gary Smith
GMB

Most Global North countries have very little offshore wind installed, and many are taking strong actions to ensure local manufacturing and industry is supported as deployment accelerates. For example, France, Turkey and Taiwan have all placed the domestic presence of a nacelle factory to assemble the generating components of turbines as a precondition for offshore wind licences and contracts. As a result, GE’s nacelle plant in Montoir-de-Bretagne employs 500 workers and produced its first nacelle in September 2020, for France’s first offshore wind farm.⁵⁷ After winning a contract to supply and commission turbines for Turkey’s first offshore wind farm in 2018, Siemens opened a nacelle factory in Izmir, to meet a tender requirement specifying 65% local content.⁵⁸ Siemens is also building a nacelle factory in Taiwan due to start production in 2021, to meet stringent local content rules for Orsted’s 900MW offshore wind farm.⁵⁹ In comparison, the UK’s lack of a nacelle factory has been highlighted repeatedly for years as a key failure.⁶⁰

Upgrading Scotland’s fabrication yards, ports and manufacturing sites could make them internationally competitive and able to handle much of the volume for the coming expansion in both onshore and offshore wind, including floating wind, and there is still time to do so. Scotland has 8.4 GW of onshore wind and 1 GW of offshore wind installed and operational, with some more under development. The modelling conducted by Transition Economics estimates that a further 33-43 GW of wind, primarily offshore, will be installed in the coming 25-40 years. Following this time period, the first generation of offshore windfarms will be due for re-powering.

A Crown Estates Scotland commissioned assessment highlights the following ports as potential sites to expand for the offshore wind industry:

- For Operations and Maintenance work, Montrose, Aberdeen, Peterhead, Scrabster, Kirkwall, Stromness and Lerwick.
- For large construction phase uses, Cromarty Firth and Inner Moray Firth, and Orkney and Caithness, with a future project pipeline dependent potential for Stornoway/Arnish, Lerwick, Hunterston, and the ports in the Forth and Tay area.
- For floating wind development, Cromarty Firth and Orkney (Scapa Flow) have “significant potential for semi-submersible assembly facilities”, and Loch Kishorn port for spars.⁶¹ Floating wind will require manufacturers to roll out large volumes of identical installations - a different business model to the offshore oil approach of building bespoke individual platforms.⁶²

The expansion of renewables will require a significant input of steel, enabling a joined up supply chain. Steel for wind turbine towers can be rolled at Liberty’s Dalzell plant in Motherwell, with towers fabricated at a potential new neighbouring wind turbine manufacturing facility⁶³

⁵⁶For example, the NNG wind farm is importing 45 of the windfarm’s 53 foundations, as well as substations and submarine cables.

<https://www.heraldsotland.com/news/18173934.scotland-loses-2bn-wind-farm-boom-ministers-pledge-action/>

⁵⁷<https://www.offshorewind.biz/2020/09/15/first-nacelle-for-frances-first-offshore-wind-farm-rolls-out/>

⁵⁸<https://renewablesnow.com/news/siemens-gamesa-to-soon-start-nacelle-production-in-turkish-factory-675717/>

⁵⁹<https://renews.biz/59056/work-starts-on-siemens-gamesa-taiwan-nacelle-plant>

⁶⁰E.g. <https://ore.catapult.org.uk/app/uploads/2017/12/SP-0012-The-Economic-Value-of-Offshore-Wind-1.pdf>

⁶¹<https://www.crownestatescotland.com/maps-and-publications/download/506>

⁶²Interview with Siemens, November 2018

⁶³<http://www.glenshero-windfarm.co.uk/>

TIDAL STREAM AND WAVE POWER

Unlike wind power (where Scotland's supply chains have to catch up with established competitors internationally), tidal stream and wave power remain at an early state. With prototypes still in development, Scotland has the opportunity to secure itself as a global leader in the development, manufacturing and installation of tidal stream and wave.

The Shetland Tidal Array at Bluemull Sound was built with 80% Scottish supply chain content⁶⁴, and Orbital Marine Power awarded the main manufacturing contract for its first commercial O2 tidal stream turbine to Scottish-based TEXO group, who carried out the work at the Dundee quayside.⁶⁵

A supply chain survey conducted on behalf of the Marine Energy Group found that a Scottish marine energy technology sector of 1GW installed capacity could generate around £2.4 billion of expenditure, of which £1.3 billion could be retained in Scotland.⁶⁶

On current levels of investment Scotland risks losing its tidal stream supply chain companies to Canada⁶⁷ or France,⁶⁸ where governments are offering clearer financial support and more ambitious deployment plans.

DECOMMISSIONING

There are concerns that a large proportion of decommissioning work in the North Sea is currently being outsourced to contractors abroad instead of benefitting Scottish workplaces. Shell recently announced that its Curlew vessel would be scrapped at a yard in Norway,⁶⁹ and the Scottish Environmental Regulation Agency (Sepa) has previously raised concerns about the environmental implications of rigs being towed to India and Bangladesh for decommissioning.⁷⁰ This problem may be exacerbated by significant numbers of supply chain firms failing following the COVID-19 economic crisis, according to recent statements from the Oil and Gas Authority and corporate spokespeople.⁷¹

The Scottish Government has recognised a need to support Scottish firms' capacity to take on decommissioning work, but has so far not made any significant commitments to rectify this, with funds of only £4 million available to companies in 2018-2019.⁷²

In order to maximise Scottish supply chains for decommissioning, more ambitious investment in port and fabrication yard capabilities would be needed.⁷³

⁶⁴<https://www.offshore-energy.biz/scottish-renewables-hails-bluemull-sound-tidal-lease-extension/>

⁶⁵<https://www.offshore-energy.biz/orbital-o2-tidal-turbine-manufacturing-contract-goes-to-texo/>

⁶⁶Sgurr Energy and IPA Energy and Water Economics (2009) Marine Energy Supply Chain Survey

⁶⁷<https://www.bbc.co.uk/news/uk-scotland-scotland-business-50757550>

⁶⁸<https://www.powerengineeringint.com/renewables/game-changing-tidal-energy-project-approved-for-channel-regions/>

⁶⁹<https://www.energyvoice.com/oilandgas/north-sea/246053/heartbreak-as-new-figures-suggest-north-sea-job-losses-surpass-4500/>

⁷⁰<https://www.bbc.co.uk/news/uk-scotland-highlands-islands-42717804>

⁷¹<https://www.energyvoice.com/oilandgas/north-sea/259678/decommissioning-spirit-energy-petrofac/>

⁷²<https://www.gov.scot/news/gbp-4-million-support-for-decommissioning/>

⁷³<http://www.gmbScotland.org.uk/assets/media/documents/pressreleases/GMB-SCOTLAND-REPORT-Status-capacity-and-capability-North-Sea-Decommissioning-Facilities-final-web-GMB-cover.pdf>

POLICY RECOMMENDATIONS TO CREATE FAIR WORK IN THE CLIMATE TRANSITION

1. Decarbonising electricity: renewable power, storage & supply chains

To ensure Scotland achieves social and economic benefits from the significant expansion of renewable energy and creates anywhere near the potential of 23,000-70,000 jobs in renewables and hydro storage (rather than our low case estimate of 9,000 in renewables), Scotland needs a strong set of public investment, skills and industrial strategy policies, including:

Public Investment	1.1.1	Public investment of £430 million in the coming two years to upgrade ports and manufacturing facilities, with further public supply chain investment of at least £2 to £4 billion by 2035 to build domestic capacity to supply large renewables deployment and oil and gas decommissioning.
	1.1.2	Immediate-term investment of £100 million into energy R&D - particularly tidal stream and wave.
	1.1.3	Equity investment by Scottish National Energy Company into renewables and hydro storage of £4.6 - £18 billion by 2050 depending on scale of ownership (20%-50%), and scale of renewables deployment.
Implementation	1.2.1	Establish a Scottish National Energy Company to develop, build and own large renewables installations, including offshore and onshore wind, tidal stream and wave power, and hydro storage. Initially investing alongside private sector partners.
	1.2.2	A hands-on industrial strategy by the Scottish Government, to ensure that Scotland's workers and economy benefit appropriately. Including targeted and sustained investment into expanding and upgrading the domestic renewables supply chain by SNIB and other Scottish public institutions.
	1.2.3	Gas and electricity network investment decisions to be guided and influenced by the Scottish government, to ensure appropriate reinforcement and conversion takes place.
	1.2.4	The Scottish National Energy Company to plan and co-ordinate with Local Authorities / municipal energy companies to manage the heat transition to a hybrid model combining hydrogen, electrification and district heating, delivering the transition in a timely manner that doesn't burden households.
	1.2.5	If the Community Energy sector expands beyond the current Scottish Government target, public support for community energy should be conditional on strong labour standards including collective bargaining.

Skills Delivery	1.3.1	Remove barriers to oil and gas workers' entry to renewable energy installation roles, by developing joint energy sector training and qualification standards with industry, trade unions, and HSE where relevant.
	1.3.2	A coordinated and pro-active training programme, to collectively prepare the oil & gas workforce for a transition to work in clean technologies, before and as North Sea extraction shrinks.
	1.3.3	In the short term, Skills Development Scotland to fund provision or individual course attendance for furloughed or laid-off energy workers to enable them to take on renewable energy or oil and gas decommissioning jobs where barriers exist.
	1.3.4	Skills programmes (e.g. apprenticeships) to attract new workers into the energy industry should follow recruitment best practice and prioritise promotion to attract historically marginalised groups, including women, BAME people, and disabled people.
Targets	1.4.1	The Scottish National Energy Company to deploy at least 35 GW of new renewable energy, alongside a phased-in target of 90% lifetime local content for renewables.
Supply Chain	1.5.1	Expanded use of Local Content Requirements for the renewables sector by Crown Estate Scotland and the Scottish Government ⁷⁴ , following practice in France and Turkey, including active monitoring and accountability measures to ensure developers support local industry.
	1.5.2	Public energy companies to prioritise the domestic supply chain, including giving long-range insight into deployment timelines and order books, encouraging suppliers to make long-term investment into production facilities.
Ownership	1.6.1	Ensuring most future renewable generation capacity is owned by Scottish national, municipal and co-operative entities. Reverse the ongoing privatisation of Scotland's wind, tide and waves, where only a minuscule fraction of the renewable resources are controlled by the public.
	1.6.2	Electricity and gas distribution and transmission networks should be in public ownership, to enable the gas and electricity upgrades necessary, as well as to prevent asset-stripping. ⁷⁵

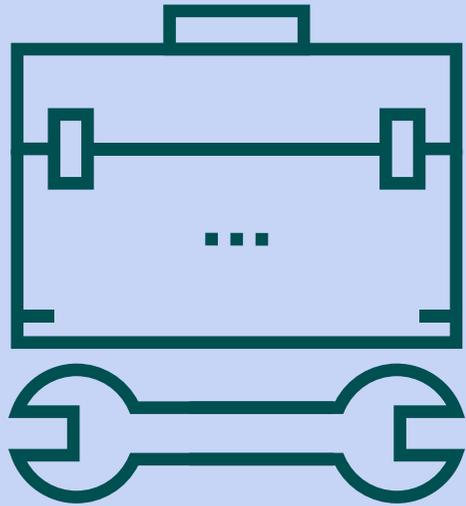
⁷⁴<https://www.offshorewind.biz/2020/01/16/scotland-to-impose-local-content-requirements-for-offshore-wind-projects/>

⁷⁵Given recent precedent of private sector investors loading debt onto infrastructure acquisitions, see e.g. <https://www.politicshome.com/news/article/row-breaks-out-as-government-completes-23bn-deal-to-sell-green-investment-bank-to-private-sector>; <https://www.thisismoney.co.uk/money/markets/article-4313638/Vultures-left-Thames-Water-10bn-debt.html>

2. Decarbonising energy: Hydrogen production & supply chains

To develop a competitive zero-carbon hydrogen production industry and create the potential of up to 11,000 jobs in transitional construction, and up to 2,000 in operations and maintenance, Scotland needs:

Public Investment	2.1.1	Investment into zero-carbon hydrogen R&D and full-scale hydrogen electrolysis plants. Immediate-term investment of £100 million in R&D in coming two years, followed by £3 billion to £12.6 billion by 2035.
Skills Delivery	2.3.1	National Manufacturing Institute Scotland to identify skills gaps for electrolysis plants and supply chains, and to work with Climate Skills Scotland and FE colleges to cover gaps.
Supply Chain	2.5.1	National Manufacturing Institute Scotland to work with Scottish Enterprise to identify potential electrolyser and related systems manufacturers, and strengthen the supply chain through targeted investment by SNIB.
	2.5.2	Use of Local Content requirements mandatory with public sector loans for electrolyser plant construction.
Ownership	2.6.1	Consider retaining a public stake in innovation businesses as a condition of large-scale R&D grants, in order to be able to influence local job creation and supply chains in the future.



3

BUILDINGS

SUMMARY

WHERE WE ARE NOW

21%
of Scotland's greenhouse gas emissions,
primarily from heat.

CURRENT EMPLOYMENT

122,000 Construction, architecture,
& trades

18,000 Manufacturing & timber
processing

43,000 Agents & wholesaler

SKILLS SHORTAGES

- Building envelope specialists
- Project managers
- Electricians
- Plumbers
- Plasterers

FUTURE JOB CREATION POTENTIAL

DIRECT & SUPPLY CHAIN

Up to 136,000 jobs over 10+ years in decarbonising buildings & broadband, plus 37,000 jobs over 3 years in building social housing.

PROJECT	JOB CREATION ESTIMATES
Retrofit all homes	32,000 - 98,000
Retrofit all public and commercial buildings	8,500 - 10,000
Build new homes	22,500 - 36,600
Install District Heating	14,000 - 23,000
Install heat pumps	Up to 2,500
Decommission oil & gas infrastructure	2,900 - 8,000
Fast broadband for every home	6,000 - 6,600

These future jobs are distributed nationwide, with potential materials and manufacturing hubs in Highland, Fife, Central and South Scotland.

TOP 5 RECOMMENDATIONS

- 1 Public investment of £10 - £13 billion by 2030 into a national energy efficiency upgrades programme; £5.5 - £10.5 billion into decarbonising heating (district heating, hybrid heat pumps and hydrogen-ready boilers); and £3.4 billion into new zero-carbon social and affordable homes. (Altogether attracting between £23 billion - £43 billion in private and other investment.)
- 2 Public skills programmes to cover building retrofits, offsite and timber frame construction, electricians, and shortage trades.
- 3 Research and Development funding to support development of sustainable construction and insulation materials.
- 4 Invest into and maximise use of Scottish manufacturers (e.g. heat pumps, pipes, offsite construction) and timber suppliers.
- 5 Social housing, district heating, and hydrogen networks to be run in the public sector. Local Authorities to set up Municipal Energy Companies to run district heating; National Energy Company to run hydrogen network.

CONTEXT

DECARBONISATION NEEDS

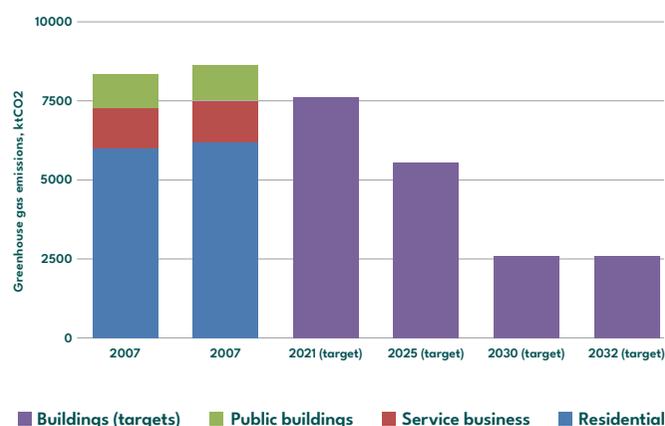
The Buildings sector (including homes and services) in 2018 accounted for 21% of Scotland's greenhouse gas emissions, at 8.6mTCO₂e. The majority of these emissions are generated through the use of energy (heating space and water in homes and workplaces, alongside cooling in the services sector). The Government's target for 2032 is to bring this down to 2.6mTCO₂e.

The government's targets for 2030 is for at least 50% of Scotland's building stock to be heated using zero emissions systems.⁷⁷ Previous Climate Change Plan versions also stipulated that by 2032:

- Domestic heat demand will be reduced by 15%, and non-domestic heat demand, by 20%
- 60% of walls will be insulated and 70% of lofts will have at least 200mm of insulation in the residential sector.⁷⁸

The 2018 targets for the Buildings sector are represented in Figure 3.1.

Figure 3.1
BUILDINGS SECTOR EMISSIONS AND SCOTTISH GOVERNMENT TARGETS



In addition to targets mentioned above, this chapter also considers changes to new build construction.

Under targets announced in 2019-2020, all new homes and public buildings in Scotland are to be supplied with renewable or low-carbon heat from 2024.⁷⁹ The Government has not yet published the draft regulations to meet this target, but it is likely to include: no new gas heated homes;⁸⁰ EPC A or Passivhaus standard on energy efficiency.

Scottish Government does not include reducing construction emissions (or “embedded emissions”) under its planning for the Buildings sector, nor does it report separately on construction sector emissions, but from the point of view of job creation it makes sense to view these alongside ongoing emissions reduction. Embedded emissions are estimated to make up 20-50% of new buildings' lifetime emissions.⁸¹ Research by commissioned by Zero Carbon Scotland indicates embodied carbon emissions savings of 30 to 50% from using less carbon intensive materials, 20 to 40% through design interventions and 7 to 10% through the reduction, re-use, and recovery of carbon-intensive construction materials.⁸² Policy Exchange estimates an overall 20 to 60% reduction in embedded emissions through changing construction methods.⁸³ Furthermore, with construction waste making up just over half of Scotland's waste arisings,⁸⁴ changes to construction methods are estimated to reduce construction waste by between 20-90%, depending on type of building.⁸⁵

⁷⁷<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/8>

⁷⁸<https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/pages/11>

⁷⁹<https://www.gov.scot/news/new-build-homes-to-be-more-energy-efficient/>; <https://www.architectsjournal.co.uk/news/sturgeon-all-new-public-buildings-in-scotland-to-be-zero-carbon>

⁸⁰http://existinghomesalliancescotland.co.uk/wp-content/uploads/2019/09/Pathway-to-zero-carbon-homes_EXHA_Sept2019.pdf

⁸¹<https://policyexchange.org.uk/wp-content/uploads/2019/12/BIGGER-BETTER-FORESTS.pdf>

⁸²Embodied Carbon: Status Quo and Suggested Roadmap

⁸³<https://policyexchange.org.uk/wp-content/uploads/2019/12/BIGGER-BETTER-FORESTS.pdf>

⁸⁴<https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/waste-data-for-scotland/>

⁸⁵http://www.modular.org/marketing/documents/WRAP_ModernMethodsConstruction_Report.pdf

GEOGRAPHICAL HUBS

Scotland has 122,000 jobs in construction, architectural services and related trades across Scotland according to ONS data for 2018. These jobs are evenly spread out across the country, with hubs in major cities. 7,600 jobs exist in timber products manufacturing across Scotland as well as 10,000 jobs in other relevant manufacturing sub-sectors and 43,000 jobs in relevant agents and wholesalers.⁸⁶

Table 3.1 shows an overview of construction and relevant supply chain employment across Scotland.

Table 3.1
EMPLOYMENT IN CONSTRUCTION AND RELEVANT SUPPLY CHAINS ACROSS SCOTLAND

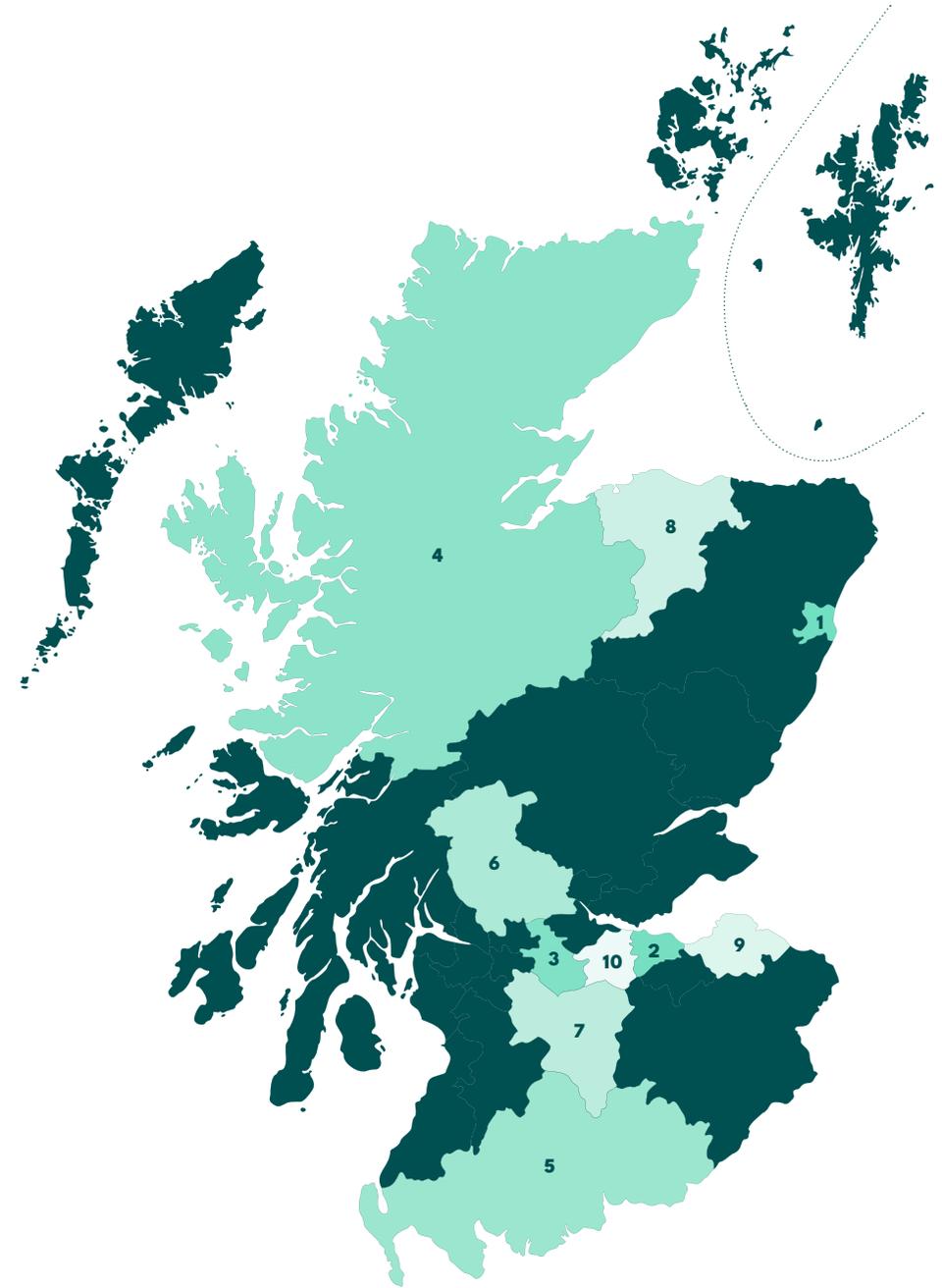
Region	Timber products manufacture	Manufacturing for construction (non-timber)	Offsite manufacture of structures, doors and windows	Construction, architecture and trades	Wholesale and agents	Total
Central Scotland	1145	1385	1375	24650	5815	34370
Glasgow	350	110	475	16400	6725	24060
Highlands and Islands	1410	445	770	13165	3495	19285
Lothian	485	420	315	15775	5010	22005
Mid Scotland and Fife	1425	790	400	13755	3200	19570
North East Scotland	1050	395	1620	17245	13850	34160
South Scotland	1500	325	855	12225	2720	17625
West Scotland	250	135	195	8865	2355	11800
Total	7615	4005	6005	122080	43170	182875

Source:
ONS Business Register and Employment Survey;
Transition Economics analysis

⁸⁶Note that these figures include some jobs in enterprises that currently supply to other sectors e.g. Aberdeen jobs in the construction of metal structures are likely mostly in the energy sector.

Table 3.2
GEOGRAPHICAL HUBS FOR CONSTRUCTION SUPPLY CHAINS

		Industry	Jobs	% of jobs in Scotland	Key workplace
1	ABERDEN CITY	Manufacture of metal structures and parts of structures	1000	19.3%	
		Other engineering activities (not including engineering for design for industrial process and production engineering related scientific and technical consulting activities)	8000	27.5%	
2	CITY OF EDINBURGH	Development of building projects	1750	24.3%	
3	NORTH LANARKSHIRE	Manufacture of articles of concrete, cement & plaster	400	22.9%	Cemex Plant, East Kilbride
		Manufacture of earthmoving equipment	300	93.8%	Volvo, Motherwell
4	HIGHLAND	Sawmilling and planing of wood	450	21.8%	
		Manufacture of veneer sheets and wood-based panels	200	20.8%	Norbord Mill, Dalcross
5	DUMFRIES & GALLOWAY	Sawmilling and planing of wood	600	29.1%	
6	STIRLING	Manufacture of veneer sheets and wood-based panels	300	31.3%	Norbord Mill, Cowie
		Manufacture of glass fibres	150	83.3%	Superglass Insulation
7	SOUTH LANARKSHIRE	Manufacture of doors & windows of metal	300	35.9%	Cemex Plant, East Kilbride
8	MORAY	Manufacture of other tanks, reservoirs and containers of metal	250	55.6%	
9	EAST LoTHIAN	Manufacture of cement	150	88.2%	Cemex Plant, Cardenden
10	WEST LoTHIAN	Manufacture of central heating radiators & boilers	150	93.8%	



THE FUTURE OF BUILDINGS

Scotland's 2.62 million existing dwellings, 20,000 public buildings, and 180,000 other buildings including 200 million square feet of office and retail space all need to be retrofitted to require minimal energy input.

- All heating will be provided using renewable resources;
- All existing domestic buildings will be retrofitted to reach EPC C as soon as possible, and aim for most to meet EPC A.
- All public buildings retrofitted to between EPC level B and Passivhaus standard; all commercial buildings retrofitted to EPC Level C

As home-working and tele-conferencing is set to increase permanently following the COVID-19 crisis, and contributes significantly to reducing transport emissions, all homes and premises should have fast Internet connections.

Scotland also needs new additions to the housing stock, including an estimated 10,600 new affordable (including social rent) homes per year over the next five years (2020-2025) to clear the backlog of unmet housing need.

In decarbonising new-builds:

- Compulsory strict energy efficiency standards such as PassivHaus must be phased in.
- Methods will change towards offsite manufacturing for construction.
- Materials will change away from masonry, concrete and steel, and towards timber and other sustainable materials, reducing the embodied carbon in buildings by 20-60%.⁸⁷
- Construction output will decrease over the long term, as buildings are designed to be more versatile and durable.

This year we saw a jump from 4% of people working from home to 40% of people. Scottish Gas have told workers that they're not coming back to the office, they're staying at home. Soon we'll see job adverts requiring fast broadband the way they now require a driving licence. Retrofitting homes and creating home offices is much more important now.

Stephen Low
UNISON

⁸⁷<https://policyexchange.org.uk/wp-content/uploads/2019/12/BIGGER-BETTER-FORESTS.pdf>

OPPORTUNITIES FOR JOB CREATION

COVID-19 ECONOMIC RECOVERY

Our assessment recommends seven shovel-ready projects costing £6 billion in public investment that can create an immediate term boost of over 86,000 direct and supply-chain jobs for two years (Table 3.3).

Table 3.3
SHORT-TERM INFRASTRUCTURE PROJECTS FOR ECONOMIC RECOVERY: BUILDINGS

Project	Score	Scotland jobs multiplier (direct & supply chain, jobs / £ million invested)	Public Investment (£ billion)	Avg jobs (direct & indirect) over 2-year stimulus period	Outcome
Build social housing (using domestic offsite manufacture)	15	22.59	1.54	34,772	10,600 new social homes / year in addition to existing plans
Retrofit social housing	21	28.98	2.93	34,005	All of Scotland's social housing retrofitted to EPC level C
EPCs and Building Renovation Passport for all homes	17	33.00	0.54	7,101	All properties in Scotland receive a retrofit plan
Retrofit public buildings	22	28.28	0.20	2,263	5.5 million m2 of public buildings retrofitted
District Heating	15	20.89	0.10	1,671	Delivering up to half of existing in-development heat networks.
Broadband upgrade	14	12.29	0.60	5,899	TBC
R&D for zero-carbon heating including expanding hydrogen pilots	17	15.90	0.10	954	Develop Scottish technology for this decarbonisation pathway
Total			6.01	86,663	

Source: Transition Economics analysis

POLICY CHOICE: HOW TO DECARBONISE HEATING?

In 2017, the Scottish government laid out two indicative scenarios for decarbonising Scotland's energy system: "An Electric Future" and "a Hydrogen Future",⁸⁸ while accepting that Scotland's actual energy system in 2050 was likely to be a combination of these.⁸⁹ We have thus included a third Hybrid option. Table 3.4 provides a comparison between the options based on job creation, cost, likelihood of decarbonising on time, and other social justice implications.

Regardless of scenario, the priority in decarbonising Scotland's domestic heat must be retrofitting homes and improving energy efficiency. Done right, this will dramatically reduce consumption and hence bills, regardless of the ultimate source of heat. Thanks to boiler or heat pump efficiency improvements, any of the options will deliver significantly cheaper heat for households than older inefficient boilers or electric radiators.⁹⁰

Further commonalities between pathways:

- All pathways require replacing gas boilers, hobs and ovens in homes.
- In all pathways, homes that are impractical to connect to the gas grid or heat networks will be supplied with electric heat pumps.
- All pathways require very significant investment into renewable generation, either to produce the required level of hydrogen or to power heat pumps or both. All pathways also rely on the development of hydrogen produced by electrolysis.

⁸⁸<https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/>

⁸⁹<https://www.strath.ac.uk/humanities/centreforeenergypolicy/newsblogs/2018/futureenergyscenariosinthescottishenergystrategywhatanweexpectin2050/>

⁹⁰<https://www.which.co.uk/reviews/ground-and-air-source-heat-pumps/article/air-source-heat-pumps-explained>

Table 3.4
POLICY CHOICE: HOW TO DECARBONISE HEATING?

	Option A: Hydrogen	Option B: Electrification & District Heating	Option C: Hybrid: District heating and hybrid heat pumps with hydrogen boilers
What it looks like	Transitioning the gas grid to hydrogen produced from electrolysis, switching homes from gas boilers and inefficient electric heating) to hydrogen appliances.	District heating where feasible; switching homes from gas heating and inefficient electric heating to heat pumps and efficient electric heating	District heating where feasible; hybrid heat pumps where feasible (using electricity to power heat pumps, alongside hydrogen or biogas through the gas network at peak times)
New jobs potential	Transition: Retrofitting hydrogen appliances to homes; Gas network conversion. Ongoing: Hydrogen production	Transition: District Heating installation; Heat pump installation. Electricity grid reinforcement. Ongoing: District Heat network maintenance; Heat pump maintenance; Hydrogen production for energy storage.	A combination of A and B.
Scottish supply chain potential	Pipes. Hydrogen boiler manufacturing (less likely).	Pipes, instrumentation, components, controls. Heat pump manufacturing	Pipes, instrumentation, components, controls. Hydrogen boiler manufacturing; Heat pump manufacturing (less likely)
Jobs maintained	Workers in gas grid (switched to hydrogen); Boiler maintenance engineers		Workers in gas grid (switched to hydrogen); Boiler maintenance engineers (partial)
Jobs at risk		Workers in gas grid; boiler maintenance engineers (partial)	Boiler maintenance engineers (partial)
Quality of Work	An important segment of the maintained workforce in Option A is well-unionised: workers in the gas grids.	A significant proportion of the workforce in B is and should be expected to be well-unionised, including workers installing and maintaining district heat networks. Quality of work in Heat Pump installation will depend on the policy measures used to drive deployment. Quality of work in Heat Pump Maintenance should be similar to that of existing boiler maintenance jobs with fewer health & safety risks, although the reduced qualifications required could create potential to water down labour conditions.	Combination of A & B.
Cost implications: Relative annual system costs to reach a zero carbon target⁹¹	102.7% - 132%	100%	108.5%
Conversion and appliance cost per household	£4,000 ⁹²	£6,000 ⁹³	£9,000 ⁹⁴
Likelihood of successful timely decarbonisation	Less likely. Timeline is “more susceptible to slippage”, with significant deployment only possible in the 2030s and 2040s, ⁹⁵ due to the significant scaling up of electrolysis required. The risk is exacerbated by the fact that heating infrastructure will compete for hydrogen supply with transport and heavy industry. Using natural gas to hydrogen conversion as a transitional measure would lead to unacceptable emissions of 20-70 MtCO ₂ e even assuming successful CCS deployment. ⁹⁶ Phasing out natural gas use faster would rely on deploying electrolysis at scale faster, upping the costs.	More likely. This pathway requires the highest investment in electricity networks, alongside massive renewables expansion and electricity storage, potentially including electrolysis-produced hydrogen to be burned in power plants at times of peak demand.	More likely. This pathway requires less grid reinforcement than B, and less hydrogen electrolysis expansion than A. Achieving zero emissions with a hybrid pathway depends on the availability of low-carbon biogas or hydrogen.

Security of Supply	OK: Hydrogen is stored and then supplied as fuel to heat homes. May require hydrogen imports if not enough produced domestically.	Good: Stored hydrogen is burnt in hydrogen-based CCGT/OCGT power plants, to power domestic heat pumps when renewable balancing and other storage is insufficient. Less likely to require significant imports as uses less hydrogen and energy.	Good: Stored hydrogen is either supplied as fuel to heat homes or burnt in CCGT power plants to power domestic heat pumps, when balancing and other storage is insufficient. Less likely to require significant imports as uses less hydrogen and energy.
Fuel poverty impacts: energy cost for households	Heat from hydrogen is less energy efficient and therefore more expensive than efficient electric heating. Assuming future boiler efficiency of 90%, likely price range is 5.4 to 20.4p / kW. ⁹⁷	As electricity prices fall with greater deployment of renewables, heat pump costs will fall. Assuming heat pump efficiency of 250%, likely future price is 6.8 p / kW. ⁹⁸ (Today, replacing a new A-rated gas boiler with a heat pump can increase annual bills by £35-£55, but save £400 compared to a G-rated boiler. ⁹⁹)	Price range between A and B.
Maintenance cost for households	Higher (hydrogen boilers need more maintenance and have a shorter life span than electric heat pumps)	Lower	Higher

⁹⁷Note: these costs do not match precisely to our scenarios, eg they don't include the deployment of significant district heating. They are UK (not Scotland) costs, based on modelling for the Committee on Climate Change by Imperial College comparing the costs of four pathways to decarbonise heating, including hydrogen, electrification and a hybrid pathway involving hybrid heat pumps backed up by hydrogen boilers. <https://www.theccc.org.uk/publication/analysis-of-alternative-uk-heat-decarbonisation-pathways/>

<https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf>

⁹⁸P136 <https://www.theccc.org.uk/publication/analysis-of-alternative-uk-heat-decarbonisation-pathways/>

⁹⁹P136 <https://www.theccc.org.uk/publication/analysis-of-alternative-uk-heat-decarbonisation-pathways/>

⁹⁴Transition Economics estimate based on <https://www.theccc.org.uk/publication/analysis-of-alternative-uk-heat-decarbonisation-pathways/>

⁹⁵<https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf>; <https://energysavingtrust.org.uk/blog/decarbonisation-heat-%E2%80%93-crossroads>

⁹⁶<https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf>

⁹⁷Sustainable Gas Institute <https://www.sustainablegasinstitute.org/wp-content/uploads/2017/07/A-greener-gas-grid-White-Paper-Summary-20th-July-2017.pdf>

⁹⁸Sustainable Gas Institute <https://www.sustainablegasinstitute.org/wp-content/uploads/2017/07/A-greener-gas-grid-White-Paper-Summary-20th-July-2017.pdf>

Note: heat pump efficiencies tend to be over 250%.

⁹⁹<https://www.which.co.uk/reviews/ground-and-air-source-heat-pumps/article/air-source-heat-pumps-explained>

LONGER TERM DECARBONISATION JOB CREATION OPPORTUNITIES

Meeting Scotland's climate targets and housing needs creates the potential for significant job creation through the following measures (Table 3.5):

Table 3.5
LONG-TERM JOB CREATION OPPORTUNITIES IN DECARBONISING BUILDINGS

Project	Retrofit all homes	Retrofit all public and commercial buildings	Build new homes	Install District Heating	Install heat pumps	Fast broadband for every home
Outcome	All homes retrofitted to reach EPC C asap, and aim for most to meet EPC A.	All public buildings retrofitted to between EPC level B and Passivhaus standard; all commercial buildings retrofitted to EPC Level C	Meet future homes needs with homes that meet EPC A or Passivhaus; maximise use of Scottish timber and offsite manufacturing. Starting from a programme to meet backlog of affordable housing need by 2025.	Up to 800,000 dwellings and 2.3 million m ² of commercial space connected to district heat networks delivering 8.4 TWh per year ¹⁰⁰	Hybrid heat pumps installed in all non-DH homes, with hydrogen boiler upgrades in on-gas network dwellings	Gigabit capable broadband delivered to all Scottish dwellings.
Potential jobs created	Retrofit jobs (construction trades and general labourers) + supply chain (insulation, windows, doors)	Timber processing; manufacturing	Construction; heating engineers	Heating engineers, Systems Engineers	Construction; civil engineering, fibre and telecoms engineers	
Jobs maintained	Construction trades: building envelope specialists, carpenters, plumbers, insulation installers. General labourers.	Construction jobs except some building trades (masonry, bricklaying)		Boiler engineers		
Jobs at risk	-	-	Cement manufacturing; some building trades (masonry, bricklaying)	Boiler engineers		
Geographical hubs	Retrofit jobs evenly distributed along population distribution	Concentrated in cities	Offsite manufacturing for construction can be located in areas that most need jobs near areas of housing shortage. Existing wood products manufacture centres that can expand are: Aberdeenshire, Dumfries & Galloway, Fife, and Highland.	Dense urban areas; rural former coal mining areas	Heat pump jobs evenly distributed along population distribution	Broadband jobs evenly distributed along population distribution
Investment scale (estimate)	£25bn -£45bn	£3 - £4 billion	£4 billion to £6.5 billion	£7-11 billion	£3.2 billion - £15.6 billion	£3.9 - £4.3 billion
Length of programme (estimate)	12 - 20 years	10 years	Indefinite but more output up to 2025-2030	10 years	12 - 20 years	8 years
Job creation (estimate)	32,000 - 98,000	8,500 - 10,000	22,500 - 36,600	14,000 - 23,000	up to 2,500	6,000 - 6,600

¹⁰⁰<https://www.districtheatingscotland.com/wp-content/uploads/2015/12/HeatRecoveryOpportunities.pdf>

WORKFORCE IMPLICATIONS

JOB QUALITY AND REPRESENTATION

In new builds: Shifting a significant proportion of construction employment towards factory based environments may be an opportunity for effective union representation. It is also an opportunity for better health and safety standards than traditional construction methods, both for workers in the more controlled factory environment and those on site. Benefits to workers onsite include minimising vibration related injuries, wood dust, general dust and silica risks (as materials are pre-cut), and less need for working at dangerous heights, depths, exposed or confined spaces.¹⁰¹

In retrofits: Retrofitting and insulation work is often undertaken by smaller and medium-sized companies with uneven terms and conditions for workers, in a construction sector that is dominated by sub-contracting, self-employment and agency labour. Work standards in large-scale retrofits programmes will therefore significantly depend on how they are implemented and what standards are enforced top down, e.g. through procurement provisions or direct labour.

City Building in Glasgow demonstrates how Scottish local authorities can use direct labour - in this case through an arms-length organisation still owned and controlled by the council - to retrofit housing, delivering both high labour standards and high sustainability standards.¹⁰² City Building maintains all Glasgow City Council's building stock and manages its new construction projects, with a directly employed and highly unionised workforce of 2,200 workers, an in-house training centre and a large apprenticeship scheme. Where subcontractors are used, a framework agreement sets strong standards, including that apprentices are employed, locally sourced materials are used, and Construction Skills Certification Scheme (CSCS) cards are up to date.

Retrofit programmes should be nationally funded and carried out by local councils. Councils are best placed to co-ordinate it all, liaise with housing associations and owner-occupiers.

Stephen Low
UNISON

SKILLS

Scotland is currently facing a shortage in skills in parts of the construction sector, in particular:

- There are significant regional shortages of construction site managers, building envelope specialists, electricians, plumbers, plasterers and dryliners, and to a lesser extent other occupations;¹⁰³ - On a UK level, 20-25% of the construction workforce is expected to reach retirement or transition out of the industry within the next decade, according to a Construction Leadership Council commissioned review;¹⁰⁴
- Large construction contractors often work with a mobile workforce, meaning that large construction investments fail to build skills locally.¹⁰⁵

Taking into account the need for retrofits, additional homes built, and the shift in methods as discussed above, a number of “under-supplied” occupations are likely to need a significant expansion in trained workforce. Based on a CITB-commissioned study of construction industry skills, the following table illustrates existing gaps that are likely to be exacerbated by the changes in the industry.

¹⁰¹https://www.buildoffsite.com/content/uploads/2015/04/HSE-off-site_production_june09.pdf

¹⁰²https://adaptingcanadianwork.ca/wp-content/uploads/2019/01/106_ClarkeLinda_City-Building-Glasgow.pdf

¹⁰³https://www.citb.co.uk/documents/research/local_construction_skills_needs_scotland_summary_july2018.pdf

¹⁰⁴https://www.citb.co.uk/documents/research/local_construction_skills_needs_scotland_summary_july2018.pdf

¹⁰⁵STUC affiliate interviews.

Table 3.6
RELEVANT CONSTRUCTION SHORTAGE OCCUPATIONS

Occupation	Gap (2018)	Gap as a % of supply (2018)
Senior, executive, and business process managers	-1,650	-11%
Construction project managers	-1,300	-39%
Other construction process managers	-500	-3%
Non-construction professional, technical, IT, and other office-based staff (excl. managers)	-5,850	-21%
Wood trades and interior fit-out	-1,200	-5%
Building envelope specialists	-4,350	-83%
Painters and decorators	-2,450	-27%
Plasterers and dry liners	-1,850	-59%
Glaziers	-1,050	-50%
Specialist building operatives	-1,100	-24%
Scaffolders	-300	-14%
Plant mechanics/fitters	-450	-13%
Plumbing and heating, ventilation, and air conditioning trades	-3,700	-32%
Architects	-150	-4%

Source: WLC, CITB¹⁰⁶

NEW BUILDS

The move to off-site construction, combined with existing trends towards digitalisation and automation in the industry¹⁰⁷ will mean:

- A need to grow offsite manufacturing specific skills as well as improving the skills and confidence of existing employers and clients to work with offsite construction methods;¹⁰⁸
- Overall less labour requirements per £ million invested. WPI economics estimates a 10 to 30% increase in per-job productivity (i.e. 10 to 30% fewer jobs per £ million output) compared to traditional construction methods. However, with a need to build more homes than in previous decades, this is not likely to lead to a significant shrinkage of the overall workforce requirements of the sector.

RETROFITS

Widespread energy efficiency retrofits require a significant growth in the number of qualified installers, plumbers and other tradespeople. A Scottish Government commissioned report highlights that certain kinds of insulation work, like External Wall Insulation, is currently not supported by recognised qualifications, training or apprenticeships¹⁰⁹ - a gap to be rectified by any energy efficiency programme.

HYBRID HEAT PUMPS AND HYDROGEN BOILERS

Installing these technologies en masse will require an upskilling programme for workers who currently install and maintain gas boilers.¹¹⁰

¹⁰⁶https://www.citb.co.uk/documents/research/local_construction_skills_needs_scotland_summary_july2018.pdf

¹⁰⁷<https://www.macegroup.com/-/media/mace-dotcom/files/perspectives/180125-construction-productivity-the-size-of-the-prize/mace-insights-2018---construction-productivity---the-size-of-the-prize.pdf>

¹⁰⁸<https://www.gov.scot/publications/new-housing-future-construction-skills-adapting-modernising-growth/pages/8/>

¹⁰⁹<https://www.gov.scot/publications/quality-assurance-short-life-working-group-report/pages/4/>

¹¹⁰Interviews with STUC affiliates

¹¹¹<https://www.cs-ic.org/media/3848/offsite-project-final-report-23-01-2020.pdf>

SUPPLY CHAIN

TIMBER

The switch to offsite construction and increased use of timber is a major opportunity for the Scottish timber and timber-based products industries. According to a Scottish Government commissioned survey of businesses, “The business-to-business supply chain relationships of [Scottish offsite construction manufacturers] were centred in Scotland, therefore [their] growth would have a positive effect on the Scottish supply chain such as roof truss and board materials manufacturers and suppliers.”¹¹¹

Today, the UK is one of the largest net importers of forest products by value in the world, second only to China. In total, 80% of wood consumed in the UK is imported.¹¹²

Structural Timber Association (STA) estimates on a UK level that currently there is capacity in the timber industry to immediately increase delivery to up to 100,000 timber frame houses per year or more in the UK if there is enough demand.¹¹³ The Scottish Forest and Timber Technologies Industry Leadership Group set out a target of doubling the wood-based products industry’s annual output – including timber products for construction – to £2 billion in 2030, in line with increased availability of mature trees thanks to tree-planting efforts in the 1970s and 1980s.¹¹⁴

However, beyond 2030 the availability of mature timber drops off, as tree-planting efforts were not sustained into the 1990s and beyond. To address this, tree-planting efforts need to be expanded now, and the industry needs to be prepared to expand the capacity of recycled materials processing and manufacturing.

NEW BUILDING MATERIALS (NON-TIMBER)

Existing Scottish-manufactured sustainable building materials include: recycled wool insulation, recycled timber particle board, linoleum, leather, thatch, recycled glass gravel, a variety of stone products,¹¹⁵ and hemp-based fibre insulation.¹¹⁶ Improving energy efficiency and reducing embedded emissions is an opportunity to develop and expand production, with possibilities for exports, particularly for innovative materials.

OFFSITE MANUFACTURERS

The Institution of Engineering and Technology estimates that a new volumetric housing production factory can deliver the kit required for approximately 500 houses / year with a factory workforce of 100.¹¹⁷

A research project sponsored by the Construction Scotland Innovation Centre, Scottish Government and Scottish Enterprise found that in 2018 there were 33 existing offsite manufacturing companies in Scotland, with an annual turnover of £291 million and directly employing 1,854 people.¹¹⁸

Offsite manufacturing companies are ready to expand significantly but unwilling to do so without certainty in a project pipeline, according to multiple industry sources.¹¹⁹

HEAT PUMPS

Scotland has at least two existing heat pump manufacturers – Mitsubishi Electric in Livingston which manufactures Ecodan Air Source heat pumps¹²⁰ and Star Renewable Energy, in Glasgow.¹²¹ Scottish Enterprise claims that Scottish companies have an international competitive edge in heat recovery, but the international market is dominated by Scandinavian and German companies.¹²²

DISTRICT HEATING AND HEAT PUMPS

Scottish oil and gas supply chain companies are well positioned to take up work on district heating expansion and heat pump installation, according to an analysis by Arup for Scottish Enterprise. The analysis highlights the following areas as “strong crossovers” between oil and gas services and district heating:

- Specialist hydraulic analysis,
- Sensors, controls and instrumentation,
- Pipe and components manufacturer,
- Specialist pipe services and design,
- Operation and maintenance.

The following services were identified as ones where oil and gas supply chain companies are “very well positioned” to deliver deep geothermal heat pumps:

- Well drilling and associated services,
- Geoscience studies,
- Operation and maintenance.¹²³

¹¹¹<https://www.cs-ic.org/media/3848/offsite-project-final-report-23-01-2020.pdf>

¹¹²<https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2018/international-forestry/world-trade-in-forest-products>

¹¹³<https://ttf.co.uk/download/how-the-timber-industries-can-help-solve-the-housing-crisis/?wpdmdl=32993&ind=1572961600704>

¹¹⁴<http://www.forestscotland.com/media/390514/roots%20for%20further%20growth%20-%20november%202018.pdf>

¹¹⁵https://materials.ads.org.uk/category/material/?material=&recommended_uses=&origin=SCO

¹¹⁶<https://www.indinature.co/>

¹¹⁷<https://www.parliament.uk/globalassets/documents/lords-committees/science-technology/off-site-manufacture-for-construction/off-site-manufacture-construction-ev.pdf>

¹¹⁸<https://www.cs-ic.org/media/3848/offsite-project-final-report-23-01-2020.pdf>

¹¹⁹<https://www.parliament.uk/globalassets/documents/lords-committees/science-technology/off-site-manufacture-for-construction/off-site-manufacture-construction-ev.pdf>

¹²⁰<https://les.mitsubishielectric.co.uk/the-hub/quiet-heatpump>
<https://www.youtube.com/watch?v=8ZdFyPJepIY>

¹²¹<http://www.neatpumps.com/about-us.aspx>

¹²²<https://www.districtheatingscotland.com/wp-content/uploads/2015/12/HeatRecoveryOpportunities.pdf>

¹²³ARUP, ‘Scottish Oil and Gas Diversification Opportunities: Heat & Cooling, Water and Energy Storage & Systems’

POLICY RECOMMENDATIONS TO CREATE FAIR WORK IN THE CLIMATE TRANSITION

1. Decarbonising buildings: Energy Efficiency

To accelerate the decarbonisation of Scotland's buildings, reduce fuel poverty and create 40,000-108,000 decent jobs, Scotland needs:

Public Investment	1.1.1	Public investment of £3.7 billion in the coming two years to retrofit social housing and public buildings, with further investment of at least £6-11 billion by 2030.
Implementation	1.2.1	Transforming Energy Efficient Scotland into a street-by-street programme of energy efficiency upgrades, run by local authorities, using direct labour, with national sectoral bargaining. Delivered initially to social housing, and extended to all private homes and commercial premises.
	1.2.2	Legally-binding targets and allocated funding for social landlords (both local authorities and housing associations) to retrofit the remaining social homes that are below EPC C as a priority, alongside legally-binding targets for private rentals and owner-occupied homes.
	1.2.3	A concerted public sector programme to bring 95% of Scotland's 20,000 public buildings to DEC level C by 2028, and zero carbon by 2040. Delivered through direct labour.
Skills Delivery	1.3.1	To build up a skilled workforce able to deploy retrofitting at pace, through a large-scale skills training programme run by Climate Skills Scotland, together with Energy Efficient Scotland, FE colleges and local authorities, including retraining and apprenticeship programmes. Apprenticeship programmes should follow recruitment best practice and target advertising and outreach to attract groups historically marginalised from relevant occupations and trades, including women, BAME people and disabled people.
Targets	1.4.1	All domestic buildings to reach EPC level C or better by 2030, and aim for the vast majority to be zero-carbon by 2040.
Supply Chain	1.5.1	Local authorities to source materials from Scottish manufacturers with high levels of sustainability and labour practices, with the supply chain adhering to Fair Work principles.
Ownership	1.6.1	No privatisation of the retrofitting process of public buildings and social housing.

2. Decarbonising buildings: Heat Switch

To ensure that zero carbon renewable heat keeps Scotland's buildings warm, and protect unionised labour in the heat sector, Scotland needs:

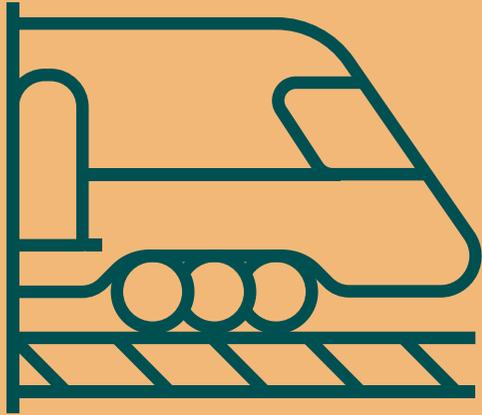
Public Investment	2.1.1	Investment into district heating. Immediate-term investment of £100 million in coming two years, followed by £3.5 billion - £5.5 billion by 2035.
	2.1.2	£2 billion - £5 billion investment into hybrid heat pumps and hydrogen boiler deployment, and £100 million investment by the SNIB into expanding existing domestic manufacture of heat pumps.
	2.1.3	£70 million investment into zero-carbon hydrogen heating R&D and large pilot programmes.
Implementation	2.2.1	Public energy companies to deploy district heat networks supplying 8.4 TWh annually by 2035, in urban areas with high demand density, and rural areas atop abandoned mine workings. ¹²⁴
	2.2.2	The local authority-led retrofit programme to install heat-pumps and hydrogen-ready hybrid boilers as part of the housing upgrades where appropriate.
	2.2.3	The Scottish National Energy Company to plan and coordinate with Local Authorities / municipal energy companies to manage the heat transition to a hybrid model combining hydrogen, electrification and district heating, delivering the transition in a timely manner that doesn't burden households.
Skills Delivery	2.3.1	Rapid deployment of district heating will require an expanded workforce. Climate Skills Scotland to work with public energy companies, FE colleges and universities involved in the HotScot programme, and ensure recruitment is targeted to and inclusive for groups historically marginalised from work in relevant occupations and trades.
	2.3.2	Climate Skills Scotland to co-ordinate a retraining programme for boiler maintenance engineers to service heat pumps and hydrogen-ready boilers.
Supply Chain	2.5.1	Local authorities to use procurement powers to maximise the use of Scottish-built heat pumps, e.g. by using local content requirements.
	2.5.2	Scottish Enterprise and SNIB to collaborate on supporting growth of existing Scottish heat pump manufacture, to support domestic supply.
	2.5.3	Energy companies deploying hydrogen conversion and district heat networks to work closer with the potential domestic supply chain (e.g. manufacturers of piping) to give clear indications of longterm demand and enable manufacturers to invest.
Ownership	2.6.1	District Heat networks - by necessity monopoly providers of heat - should be developed and owned by public energy companies.
	2.6.2	Hydrogen gas networks should be publicly owned, to prevent the profit extraction from a monopoly public good, as demonstrated by contemporary gas networks.

¹²⁴Scottish Enterprise on Heat Recovery Opportunities: <https://www.districtheatingscotland.com/wp-content/uploads/2015/12/HeatRecoveryOpportunities.pdf>
 Scottish Government on potential for deep geothermal energy, from mine water: <https://www.districtheatingscotland.com/wp-content/uploads/2015/12/StudyIntoThePotentialForDeepGeothermalEnergyInScotlandNovember2013.pdf>

3. New Homes

To meet Scotland's need for more homes while providing good, unionised jobs, expanding Scottish manufacturing, and minimising energy input and embedded carbon emissions of buildings.

Public Investment	3.1.1	Build approximately 10,800 extra zero-carbon council homes per year in the coming five years with a Scottish Government investment of £3.4 billion / year.
	3.1.2	Invest £30 million in Research and Development into sustainable building materials.
Implementation	3.2.1	New zero-carbon council homes to be built using direct labour through local authority-owned organisations, similar to City Building in Glasgow.
Skills Delivery	3.3.1	Skills Development Scotland with Construction Scotland Innovation Centre to coordinate sustainable, offsite & timber frame construction skills programme in collaboration with FE colleges, employers, and local authorities.
	3.3.2	Construction Scotland Innovation Centre to offer 'offsite confident' training to all relevant public procurement bodies, and at a subsidy to interested businesses.
	3.3.3	Council construction bodies to integrate apprenticeships in zero-carbon construction in all operations, and target recruitment to historically marginalised groups.
Targets	3.4.1	Legally binding target for all new homes to meet EPC A rating with zero-carbon heating by 2025, with phased interim targets.
	3.4.2	Legally binding targets to cut construction waste and embedded emissions by between 30-60% (for different categories of buildings) by 2025, with phased interim targets.
Supply Chain	3.5.1	Use procurement powers to maximise the use of Scottish timber and timber products, e.g. by using local content requirements.
	3.5.2	Encourage co-operation between local councils' and housing associations' planning and bidding processes, to ensure stable pipeline of projects.
Ownership	3.6.1	New social homes to be built and owned by local authorities.



TRANSPORT

4

SUMMARY

WHERE WE ARE NOW

LARGEST EMITTER

31% Primarily cars & road transport

HARDEST TO DECARBONISE

HGVs | Shipping | Aviation

CURRENT EMPLOYMENT

13,700 Manufacturing and shipbuilding

17,000 Freight by road and removals

30,000 Public and commercial transport

2,000 Shipping and ferry service

23,700 Car and motorcycle services

MANUFACTURING HUBS

Existing & potential

- Falkirk
- Glasgow
- Aberdeenshire
- Fife
- Renfrewshire
- South Ayrshire
- Dundee
- Thurso

FUTURE JOB CREATION POTENTIAL

DIRECT & SUPPLY CHAIN

Up to 60,000 jobs over 10+ years in upgrading transport, with a further 13,000 ongoing jobs in operations, with the right policies.

PROJECT	JOBS UPGRADES	JOBS OPERATION
Expand and electrify railways	4,400 - 13,100	750 - 1,125
Metro railways for cities	16,000 - 38,000	1,500 - 3,000
Expand bus services	2,000	5,900
EV charging available everywhere	1,600 - 2,700	< 500
Battery manufacturing	3,200	540
Walking and cycling infrastructure	2,000 - 2,500	N/A
Develop zero-emissions freight and shipping, decarbonised aviation	2,000 - 4,000	2,000+ (if Scotland builds a manufacturing base)

Future job creation depends on ambitious manufacturing, shipbuilding & public transport expansion. Car maintenance & sales jobs will likely decline with reduced ownership and maintenance needs.

TOP 5 RECOMMENDATIONS

- 1** Minimise the need for car journeys through public transport run in the public sector. Public investment of £660 million into electric bus fleets, £6-£11 billion in railway upgrades and electrification, and £2 billion in walking and cycling infrastructure, and £20-£30 billion in rapid urban transport (metro or tram) by 2040.
- 2** Invest £1.2-£1.6 billion to make EV chargers accessible to every home and business through ChargePlace Scotland.
- 3** Manufacture zero-carbon ferries and HGVs, and decarbonise aviation. R&D investment of £3 billion by 2035. Invest £100-£200 million into shipyard upgrades, with a public stake.
- 4** Source public transport vehicles from Scottish manufacturers where possible. Offer grants or loans for domestic manufacturers of rolling stock, electric buses, EVs and ferries to improve productivity and efficiency and boost international competitiveness. Tie investments to public stakes in companies.
- 5** Set binding targets for local labour content and apprenticeships on any procurement for transport upgrades.

CONTEXT

DECARBONISATION NEEDS

The transport sector is the largest contributor to Scotland's greenhouse gas emissions, with 12.8 Mtco2e domestic and 1.9 Mtco2e international transport and shipping emissions in 2018. Road transport (cars, lorries, motorcycles and buses) made up 73% of total domestic transport emissions, with cars alone accounting for just under 45%.¹²⁵

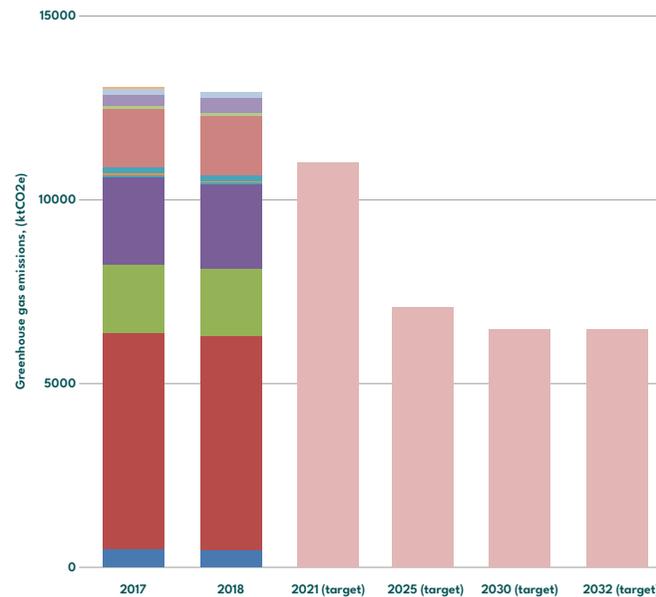
The Scottish Government's 2020 climate change plan aims to bring down domestic transport emissions by 50% on 2018 levels, to 6.5 Mtco2e by 2032, by:

- Having no new petrol- or diesel- powered cars on the roads;
- Reducing car miles by 20%;
- Almost fully decarbonising railways;
- Investing in decarbonisation of more challenging areas such as HGVs, ferries and aviation.¹²⁶

Note that the Scottish Government's climate plan does not set targets for reducing international shipping and international air travel emissions.

By 2045, land and water transport should see zero greenhouse gas emissions.

Figure 4.1
DOMESTIC TRANSPORT EMISSIONS AND SCOTTISH GOVERNMENT TARGETS



- All domestic transport - Scottish government target
- Non-energy products from fuels and solvent use:Other
- Lubricant Use
- Other:Mobile
- Fishing
- Other Transportation
- Railways
- Other road transport
- Motorcycles
- Heavy duty trucks and buses
- Light duty trucks
- Cars
- Domestic aviations

The accelerated net zero target (as well as the rapid decline in the cost of EVs, the rise of new forms of transport like car-sharing clubs, and the increase in public concern over air pollution) is likely to lead to:

- Faster emissions reduction targets for trains, ferries and buses;
- A faster shift from fossil fuelled cars to EVs (with EVs now commonly expected to reach price parity by the mid-2020s);¹²⁷
- A further reduction in car ownership.

¹²⁵Scotland's GHG Inventory by source (1990-2018)

¹²⁶<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/9>

¹²⁷See e.g. https://www.lowcvp.org.uk/news,deloitte-projects-ev-tipping-point-whenprice-parity-with-ice-vehicles-is-reached-in-2024_3905.htm; <https://about.bnef.com/electric-vehicle-outlook/>

GEOGRAPHICAL HUBS

Table 4.1 shows an overview of transport-related manufacturing and public and commercial transport operation employment across Scotland.

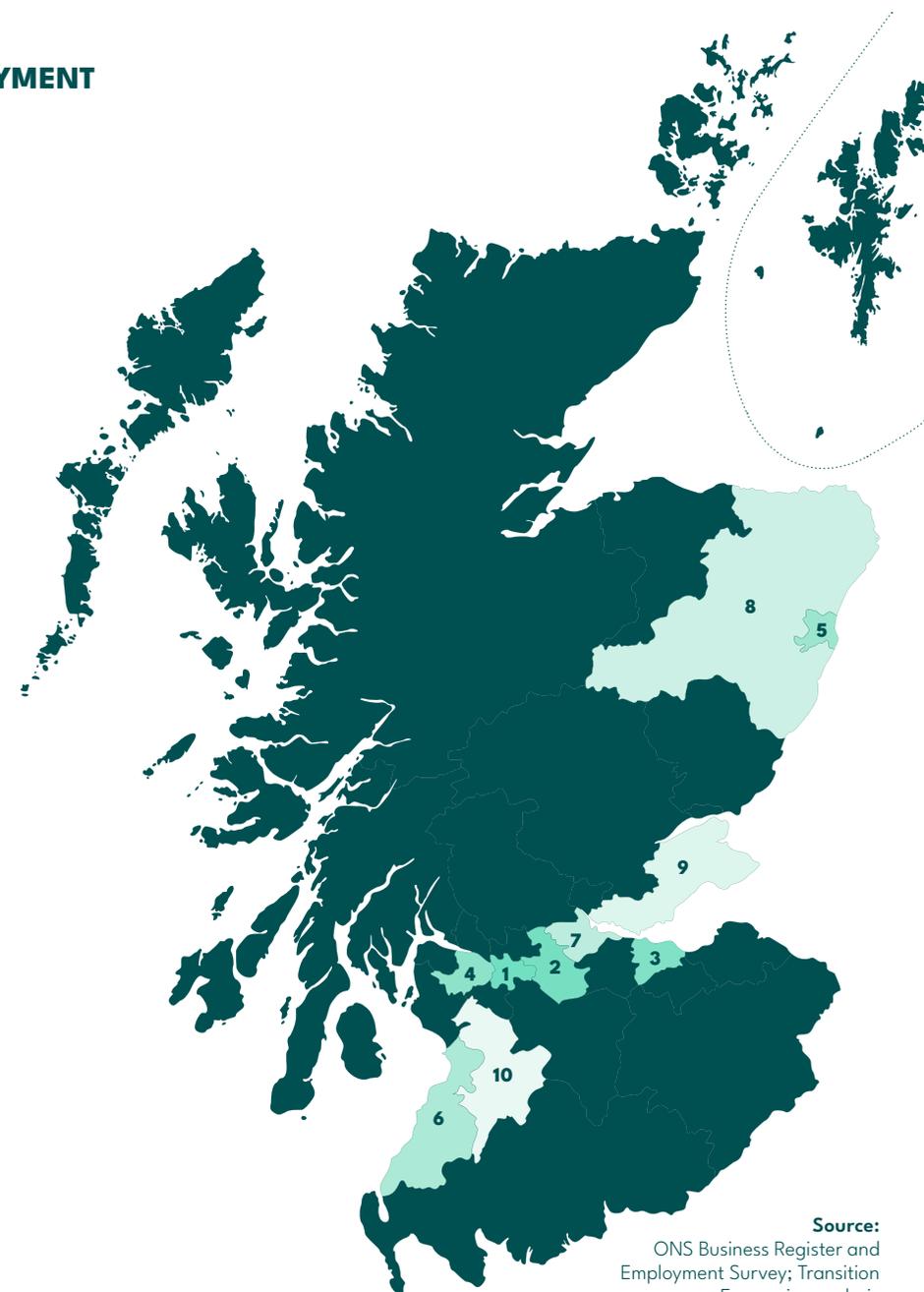
**Table 4.1
EMPLOYMENT IN PUBLIC AND
COMMERCIAL TRANSPORT AND RELEVANT
SUPPLY CHAINS ACROSS SCOTLAND**

Region	Manufacturing for road and rail transport	Shipbuilding	Manufacturing aircraft	Car and motorcycle services	Rail	Bus and other passenger transport	Taxi	Freight by road and removals	Shipping and ferries	Air transport	Total
Central Scotland	960	20	150	4,025	650	2,415	550	4,150	0	80	13,000
Glasgow	885	3,025	150	2,225	2,050	2,050	500	1,000	170	20	12,075
Highlands and Islands	20	530	10	2,360	370	1,685	430	2,500	840	320	9,065
Lothian	130	340	100	4,235	1,290	3,305	445	2,250	85	1,025	13,205
Mid Scotland and Fife	385	1,580	75	2,965	350	1,695	310	1,350	50	0	8,760
North East Scotland	675	1,060	40	3,115	400	2,455	475	2,525	255	1,060	12,060
South Scotland	390	100	1,035	2,835	410	1,775	240	2,250	250	50	9,335
West Scotland	80	435	1,500	1,900	270	1,205	345	870	375	1,530	8,510
Total	3,525	7,090	3,060	23,660	5,790	16,585	3,295	16,895	2,025	4,085	86,010

Source:
ONS Business Register and Employment Survey;
Transition Economics analysis

Table 4.2
GEOGRAPHICAL HUBS FOR TRANSPORT & RELEVANT SUPPLY CHAIN EMPLOYMENT

		Industry	Jobs	% of jobs in Scotland	Key workplace
1	GLASGOW CITY	Manufacture of motor vehicles	600	34.6%	
		Manufacture of parts and accessories for motor vehicles	225	34.6%	
		Building of ships & boats	3000	47.1%	
		Repair and maintenance of other transport equipment	225	26.9%	
		Passenger rail transport, interurban	1750	34.2%	
		Urban, suburban or metropolitan area passenger railway transportation by underground, metro and similar systems	300	100%	Glasgow Metro
		Other service activities incidental to land transportation, nec (not including operation of rail freight terminals, passenger facilities at railway stations or passenger facilities at bus and coach stations)	2500	35.3%	
2	NORTH LANARKSHIRE	Freight rail transport	250	67.6%	
		Operation of warehousing & storage facilities for land transport activities of division 49	4500	25.4%	
3	CITY OF EDINBURGH	Repair & maintenance of other transport equipment	300	48.8%	
		Passenger rail transport, interurban	1250	24.4%	
		Urban, suburban or metropolitan area passenger land transport other than railway transportation by underground, metro & similar systems	2500	27.1%	Lothian Buses
4	RENFREWSHIRE	Manufacture of air, spacecraft & related machinery	1500	49%	Rolls Royce
		Passenger air transport	1500	37.9%	
5	ABERDEEN CITY	Sea and coastal freight water transport	200	48.8%	
		Passenger air transport	1000	25.3%	
6	SOUTH AYRSHIRE	Manufacture of air, spacecraft & related machinery	1000	32.7%	
7	FALKIRK	Manufacture of motor vehicles	800	47.5%	Alexander Dennis
8	ABERDEENSHIRE	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semitrailers	500	52.6%	Stewart Trailers
9	FIFE	Building of ships & boats	300	24.6%	
10	EAST AYRSHIRE	Manufacture of parts & accessories for motor vehicles	150	23.1%	



Source:
ONS Business Register and
Employment Survey; Transition
Economics analysis

THE FUTURE OF TRANSPORT

In decarbonising the transport sector, Scotland will need to:

- Maximise walking, cycling, and homeworking;
- Use planning to minimise unnecessary journeys (e.g. by making sure local shopping is convenient and affordable);
- Expand railway and bus systems and improve linkages, so that public transport is able to replace most car journeys;
- Maximise the use of rail instead of trucks for freight;
- Entirely phase out fossil fuel powered cars and vans;
- Fully decarbonise the railway network;
- Upgrade some railway routes to high speed to replace domestic flight routes;
- Electrify the ferry fleet where technologically feasible, and switch to hydrogen elsewhere;
- Enable the conversion of shipping and freight fleets to zero-emissions;
- Invest in technological solutions to decarbonise necessary air travel.

In addition, two factors outside the transport sector will significantly reduce transport sector emissions: 1) shortening supply chains in all other sectors and 2) increased homeworking and decreased travel for work.

OPPORTUNITIES FOR JOB CREATION

COVID-19 ECONOMIC RECOVERY

Our assessment recommends seven shovel-ready transport upgrade projects costing £3.93 in public money billion that can create an immediate term boost of almost 34,000 direct and supply-chain jobs for two years (Table 4.3). We estimate that an additional £100 - £200 million is necessary to upgrade shipyards to enable fleet electrification.

Table 4.3
SHORT-TERM INFRASTRUCTURE PROJECTS FOR ECONOMIC RECOVERY: TRANSPORT

Project	Score	Scotland jobs multiplier (direct & supply chain, jobs / £ million invested)	Public Investment (£ billion)	Avg jobs (direct & indirect) over 2-year stimulus period	Outcome
R&D for zero-carbon HGVs, ships and planes	17	15.90	0.20	1,908	Develop Scottish technology for this decarbonisation pathway
Expand bus network (buy new electric buses from domestic manufacturers)	17	13.20	0.10	528	300 new buses for public transport fleets.
Expand and upgrade rail network	16	17.13	2.00	13,703	Platform upgrades, speed upgrades, and preparing older lines to re-open where shovel ready.
Commission new electric ferries for island travel	17	15.96	0.20	1,277	Ten new small electric ferries.
Build battery factories for EVs	18	16.00	0.17	3,187	A new battery factory to support EV manufacturing.
Electric car charging points (rural)	16	15.57	0.20	1,930	53% of rural businesses receive EV charging points; expanded grants to cover 100,000 rural homes receiving EV chargers; expansion of chargers alongside rural A roads.
Build cycle lanes & pedestrianisation	18	26.48	1.07	11,311	50% of Scotland's towns and cities implement upgrades to cycling and walking infrastructure.
Total			3.93	33,845	

Source: Transition Economics analysis

LONGER TERM DECARBONISATION JOB CREATION OPPORTUNITIES

Meeting Scotland's climate targets and transport needs also calls for the following measures (Table 4.4):

**Table 4.4
LONG-TERM JOB CREATION OPPORTUNITIES
IN DECARBONISING TRANSPORT**

Project	Expand and electrify railways	Metro railways for cities	Expand bus services	EV charging available everywhere	Battery manufacturing	Walking and cycling infrastructure	Develop zero-emissions freight and shipping, decarbonised aviation
Outcome	Rail network expanded to serve all major towns where this is feasible and runs entirely on electricity. Main lines operate high speed services. Freight service capacity expands to take freight off roads where possible.	Rapid transit lines for easy journeys within and across metropolitan areas.	Local bus services are increased by 50%, to enable reduced car use. All new buses are electric by 2022 and entire fleet is zero-carbon by 2030s.	Sufficient charging facilities to run every future car, within easy walking distance of every home and business.	Gigafactory produces EV batteries supplying EV manufacturers in Scotland and the North of England.	Remaining 50% of Scotland's towns and cities receive best-practice 'Mini-Holland' walking and cycling infrastructure.	Create Scottish manufactured technologies (hydrogen, electric, or hybrid) to upgrade fleets to zero-emissions vehicles and vessels. Develop options for low-carbon aviation for necessary flights.
Potential jobs created	Construction: civil engineers, construction trades, steel manufacturing, rolling stock manufacturing. Operation: train drivers, network and freight railway support staff.	Construction: civil engineers, construction trades, steel manufacturing, rolling stock manufacturing. Operation: train drivers, network and passenger railway support staff.	Bus drivers, bus manufacturing factory workers.	Construction: electricians and construction trades. Maintenance: electricians and customer service staff.	Production operators, equipment technicians, engineers	Construction, urban planners	Research and Development: engineers, researchers, supply chain. Manufacturing: production operators, equipment technicians, engineers, supply chain.
Jobs maintained	Passenger railway support staff	N/A	Bus mechanics.	N/A	N/A	N/A	Aerospace manufacturing. Shipyards.
Jobs at risk	Freight truck drivers	Car mechanics and salespeople. Significant reductions in fleets due to shared vehicles replacing private ones, and the reduced need for servicing for EVs, could reduce car maintenance employment from 16,000 down to between 5,400-7,500, and vehicle sales jobs from 7,000 down to between 1,200-3,000.			N/A	N/A	N/A
Geographical hubs	Nationwide, focused in cities. Rolling stock manufacturing: Fife.	Glasgow, Edinburgh, Aberdeen and/or Dundee plus surrounding areas. Rolling stock: Fife.	Operation: nationwide. Bus manufacturing: Falkirk.	Nationwide.	Dundee, Thurso	All urban areas	Existing relevant manufacturers in Falkirk, Glasgow, Aberdeenshire, Renfrewshire, South Ayrshire.

Investment scale (estimate)	Electrification: £2.5 to £5 billion. New track construction and 90 new or reopened stations: £2 to £4 billion.	Construction: £20 to £35 billion.	£570 - £660 million (capital costs for increasing Scotland's public buses by 50%)	£1.5-£2.1 billion	£400 million	£890 million	£3 billion
Length of programme (estimate)	Construction: 10 to 15 years. Operation: indefinite	Construction: 15 to 20 years. Operation: indefinite.	Indefinite	12 years	Indefinite	10 - 15 years	10 - 15 years
Upgrades job creation (direct + supply chain, estimate)	4,400 - 13,100	16,000 - 38,000	2,000 (manufacturing)	1,600 - 2,700	N/A	2,000 - 2,500	2,000 - 4,000
Ongoing job creation (direct + supply chain, estimate)	750 - 1,125	1,500 - 3,000	5,900	< 500	540	N/A	2,000 + (uncertain depending on new technology)

WORKFORCE IMPLICATIONS

JOB QUALITY AND REPRESENTATION

PUBLIC TRANSPORT - GENERAL

Expanding public transport services can create and/or maintain fairly paid, unionised and secure jobs, especially if this is done in the public sector. Expansion of services will also mitigate the impacts of switching to lower maintenance electric vehicles.

At the same time, jobs in passenger service, station operation, and to a lesser extent drivers' jobs are under threat from an increasing push to automate services, for example through unstaffed or driverless trains or buses.¹²⁸ To provide a safe and accessible service, retaining jobs from train guards to station staff is essential.

The move to driverless tech and unstaffed stations is a threat to both job quality and passengers' safety.

Dan Crimes
RMT

A fully staffed, accessible rail network would remove the barriers to those who currently don't feel confident to travel by rail.

Sophie Ward
RMT

BUS SERVICES

Job quality in bus services in Scotland is currently inferior to that in rail, due to the deregulation and privatisation of the sector. Bus drivers are under pressure to take on excessive extra hours to supplement their low baseline wage.¹²⁹

¹²⁸<https://www.thetimes.co.uk/article/all-not-aboard-glasgow-set-for-unmanned-trains-Ofkjm27mm> ; <https://www.bbc.co.uk/news/uk-scotland-edinburgh-east-fife-46309121>

¹²⁹Interviews with STUC affiliates.

SKILLS ISSUES

PUBLIC TRANSPORT (BUS, FERRIES)

Switching to zero-emissions vehicles and vessels would likely require the existing fleet maintenance workers to undertake some retraining. Additionally, electric motor buses require less maintenance than ones with an internal combustion engine. However, the reduced workload would likely be balanced out by the necessary increase in fleets.

CONSTRUCTION (RAIL UPGRADES AND RAPID TRANSIT)

A massive programme of rail upgrades is likely to face skills challenges. CECA, the industry body representing Scotland's civil engineering contractors, notes in its Q4 2019 Workload Trends report that "63% of firms, on balance cited issues with the supply of skilled operatives."¹³⁰ Based on a CITB-commissioned study of construction industry skills, the following table illustrates existing gaps that are likely to be relevant to transport network upgrades.

Table 4.5
RELEVANT CONSTRUCTION SHORTAGE
OCCUPATIONS FOR TRANSPORT UPGRADES

Occupation	Gap (2018)	Gap as a % of supply (2018)
Senior, executive, and business process managers	-1,650	-11%
Other construction process managers	-500	-3%
Non-construction professional, technical, IT, and other office-based staff (excl. managers)	-5,850	-21%
Specialist building operatives	-1,100	-24%
Plant mechanics/fitters	-450	-13%

Source: WLC, CITB¹³¹

Although not noted as a current skills shortage by the WLC / CITB (with a 3% oversupply), electrical trades are also likely to need an expansion in skilled workforce. According to an Electrotechnical Skills Partnership assessment, on a UK level "an additional a total of 8,500-10,000 electricians and 4,000-5,000 new apprentices will be needed" between 2018-2023 only to meet forecast economic growth and sector expansion with electrification, and do not account for workforce retirement.¹³²

¹³⁰<https://cecasotland.co.uk/workloads-decline-but-outlook-remains-positive/>

¹³¹https://www.citb.co.uk/documents/research/local_construction_skills_needs_scotland_summary_july2018.pdf

¹³²<https://www.the-esp.org.uk/wp-content/uploads/2019/11/TESP-LMI-Report-2019.pdf>

EV CHARGING NETWORKS

The ESP analysis cited above highlighted a looming shortage of skills amongst electricians with expertise in smart meters, EVs and batteries, with employers citing concern about a lack of skilled capacity to cope with the growing volume of demand for electric charging.¹³³ A further survey showed 69% of electricians felt they did not have the necessary skills and knowledge to install EV charging equipment confidently.¹³⁴

The £6 million net-zero emissions skills training programme as part of the Edinburgh and South East Scotland City Region Deal will help address this, but not fill the gap.¹³⁵

VEHICLE MAINTENANCE

The maintenance needed for electric vehicles is very different than for traditional combustion engine vehicles - electric engines don't require oil changes, have far fewer moving parts and rarely break down.¹³⁶ Instead, electric vehicles are more likely to need digital calibration - and the high voltage batteries create a greater level of risk and danger - requiring a skills transition for mechanics. In 2019, the Institute of the Motor Industry assessed 95% of active mechanics as not suitably qualified to work on electric vehicles.¹³⁷

Norway's car servicing industry has rapidly certified Norwegian mechanics to be able to handle the high-voltage batteries and other diagnostic tools required to repair and maintain the vehicles¹³⁸ - but a similar process has not happened in Scotland. Bus and fleet maintenance staff will also need to be reskilled.

BATTERY MANUFACTURING

Expanding battery production in Scotland will require substantial investment in Scottish skills. Manufacturing battery packs instead of internal combustion engines requires breadth and depth of knowledge - in particular multi-skilled engineers, who are as comfortable with chemistry as they are with electrical and mechanical engineering.¹³⁹

¹³³<https://www.the-esp.org.uk/wp-content/uploads/2019/04/TESP-LMI-Report-2019-1.pdf>

¹³⁴https://www.learninglounge.com/social/blog/post/107964022/nearly_70_electricians_feel_prepared_electric_vehicle_revolution

¹³⁵<https://www.napier.ac.uk/about-us/news/city-region-deal-construction-engineering>

¹³⁶<https://www.washingtonpost.com/news/innovations/wp/2017/12/11/people-are-freaking-out-why-electric-vehicles-might-doom-your-neighborhood-auto-mechanic>

¹³⁷<https://www.autoexpress.co.uk/electric-cars/96082/just-5-mechanics-can-work-electric-cars>

¹³⁸<https://www.fleetnews.co.uk/news/fleet-industry-news/2020/03/17/lack-of-ev-trained-repairers-may-pose-a-problem-for-fleets-uptime>

¹³⁹Skills and Training Needs for the UK Transition to Electric Vehicles. The Faraday Institution. 25 April 2019

SUPPLY CHAIN ISSUES

JOB QUALITY AND REPRESENTATION

CONSTRUCTION (NEW TRANSPORT ROUTES, EV CHARGING NETWORKS)

STUC affiliates have expressed concerns that currently, large-scale infrastructure projects such as railway or road upgrades are commonly carried out by large construction companies who fail to create jobs locally, contribute to developing skills, or leave any other meaningful benefit to local economies other than through temporary use of hospitality.

We are increasingly concerned about the economic value of infrastructure projects, such as the new Forth bridge. Construction workers came up, stayed in B&Bs, flew back down to England. For two years of works on the M72, senior managers came from England and labourers from Ireland. The economic benefit of this work wasn't concentrated in Scotland. If we're going to see infrastructure as a way of creating local jobs & local benefit, projects need to factor in local supply agreements and apprenticeships. And more local infrastructure, like cycling upgrades or accessible bus shelters can all be done locally.

Stephen Smellie
UNISON

ELECTRIC VEHICLES

Siting a gigafactory in Scotland could help to attract electric vehicle manufacturers, and parts of the chemicals supply chain required for battery production. Scotland's current automotive strengths lie in public transport and specialist vehicles, rather than car manufacturing. However, a gigafactory could strengthen the position of electric bus manufacturing in Scotland.

SHIPBUILDING

The prospects of building low- or zero-emissions ferries are subject to some scepticism among STUC's affiliates, primarily because of Glasgow's Ferguson shipyard's notoriously protracted work on hybrid fuel (LNG and electric) ferries for CalMac.¹⁴⁰

Chronic underinvestment in shipbuilding and the ferry fleet is seen as a problem by both trade unions¹⁴¹ and CMAL¹⁴² - the company that manages the CalMac ferry fleet on behalf of the Scottish Government. Significant investment will be necessary if Scottish shipyards are to lead the production of new zero-carbon vessels.

The cost of the two Calmac vessels at Ferguson blew up from £93 million to £250 million, no wonder it's become a controversy. The Scottish Government had to step in to rescue the shipyard - and this puts public ownership of shipyards on the agenda.

Jackson Cullinane
UNITE

¹⁴⁰<https://www.bbc.co.uk/news/uk-scotland-49042833>

¹⁴¹<https://www.heraldscotland.com/news/15101460.major-investment-scrapped-at-upper-clydes-last-yards/>

¹⁴²<https://www.iod.com/events-community/regions/scotland/news/details/lm-not-in-this-game-to-make-waves>

RAILWAY ROLLING STOCK

A new rolling stock factory at Longannet, Fife, is slated to be opened in 2020-2021 to build trains for HS2.¹⁴³ Regardless of the scale of the HS2 contract, the facility could build rolling stock for expanded services in Scotland.

Expanded services would also support work for rail services workplaces such as Glasgow's Springburn rail services yard, mothballed in 2019.¹⁴⁴

RMT research highlights that the current set-up of privatised Rolling Stock Companies (ROSCOs) acts to siphon off private profit from the management of rolling stock, and has forced successive UK governments (both Labour and Conservative) to bypass ROSCOs entirely when upgrades or expansion to rolling stock is needed.¹⁴⁵ Public ownership of Scottish rolling stock (e.g. through a Scottish National Infrastructure Company) could strengthen the role of Scottish manufacturing in railway rolling stock

BUSES

Scotland is home to Alexander Dennis Ltd, the largest bus and coach manufacturer in the UK. Through its collaboration with Chinese-owned BYD, ADL has the largest share of the UK and London electric bus market.

ADL is planning a restructuring process, including significantly cuts to its Scottish workforce, claiming a fall in orders due to the Covid crisis.¹⁴⁶ However, Unite has revealed that ADL's parent company is outsourcing bus building contracts for Berlin to a Turkish manufacturer - creating further uncertainty around the long-term manufacturing in Scotland.¹⁴⁷

DEVELOPING HYDROGEN FUELLED FERRIES, SHIPPING AND ROAD FREIGHT

Hydrogen fuel cells are currently being developed as a solution for transport modes where electrification is harder to achieve, for example, long-range ferries or road freight where the required battery weight is prohibitive.

Electricity from offshore wind farms can be used to produce hydrogen to fuel a new generation of ferries, container ships, and freight trucks. A pilot project is already developing hydrogen-powered ferries using a small-scale electrolysis plant in Orkney.¹⁴⁸ Note that successful application at scale requires successful scaling-up of electrolysis plants.

Scotland's strong specialist shipbuilding and vehicle manufacturing sectors¹⁴⁹ could be in a good position to develop zero-emissions freight and shipping technologies. Lower down the supply chain, "around 200 local supply chain companies were identified which could have an interest in [hydrogen fuel cell development]" in Scotland, according to University of Strathclyde research.¹⁵⁰

AEROSPACE

Unlike other modes of transport, there is currently no full decarbonisation pathway for air travel. It is clear that the number of flights will need to drop, and that technological advancements are needed to decarbonise the necessary air travel that remains.

Aerospace manufacturing employed approximately 3,000 people in Scotland as of 2018, according to ONS data. Of these, 1,500 jobs were in Rolls Royce's Inchinnan facility, which makes compressor blades and seals for planes. Rolls Royce recently announced the loss of about half of the jobs due to COVID-19's impact on the aerospace industry.¹⁵¹ South Ayrshire also hosts approximately 1,000 jobs in manufacturing for aerospace, according to ONS data: these are split between a number of manufacturing and engineering companies such as Spirit AeroSystems, GE Aviation, and Vector Aerospace.

Research and Development investment is needed to determine pathways towards low- or zero-emissions aircraft, which could determine the future of many of these jobs.

¹⁴³<https://www.globalrailwayreview.com/news/75166/fife-talgo-factory-location/>

¹⁴⁴<https://www.fleetnews.co.uk/news/fleet-industry-news/2020/03/17/lack-of-ev-trained-repairers-may-pose-a-problem-for-fleets-uptime>

¹⁴⁵<https://www.rmt.org.uk/news/publications/the-roscos-racket-why-its-time-to-take-control-of-uk-rolling/>

¹⁴⁶<https://fleet.ie/adl-begins-consultation-on-manufacturing-integration-for-uk-facilities/>

¹⁴⁷<https://www.heraldsotland.com/news/18670937.alexander-dennis-cuts-quarter-workforce-got-8-3m-job-securing-scots-public-funds>

¹⁴⁸<https://www.ft.com/content/2da8745a-0287-11e9-99df-6183d3002ee1>

¹⁴⁹http://www.h2fcsupergen.com/wp-content/uploads/2015/08/J5214_H2FC_Supergen_Economic_Impact_report_WEB.pdf

¹⁵⁰<https://pureportal.strath.ac.uk/en/publications/supply-chain-chapter-4>

¹⁵¹<https://www.the-gazette.co.uk/news/18492803.rolls-royce-confirm-700-jobs-axed-inchinnan-factory/>

POLICY RECOMMENDATIONS

1. Expanding and upgrading public transport and freight networks (rail, rapid transit, bus, ferry, road freight, aviation) and walking and cycling infrastructure

To create secure, unionised jobs running a zero-carbon, accessible public transport system that minimises the need for car journeys, and to maximise the use of Scottish supply chains for the transport system.

Public Investment	1.1.1	Invest £100 million to expand electric bus fleets in the coming two years, and an extra £470 - £560 million to increase the Scottish bus fleet by 50% by 2030.
	1.1.2	Invest between £20 - 30 billion to build rapid transit (metro) rail services for the biggest cities over 15-20 years.
	1.1.3	Invest £2 billion to electrify and upgrade railways in the coming two years, and £4 billion to £9 billion by 2030 to fully electrify and expand the rail network.
	1.1.4	Invest £200 million in small electric ferries in the immediate term, with £100 - £200 million investment into shipyards to ensure capacity to build and develop zero-carbon ferries for the future. Upgrade the full ferry fleet to hydrogen-electric hybrid engines by 2045 at the latest.
	1.1.5	Invest £200 million in Research and Development to create Scottish manufactured hydrogen-fuelled freight trucks and hydrogen-electric hybrid ferries, and to develop technological pathways to slash emissions from necessary air travel.
	1.1.6	Invest £2 billion, including £1.07 billion in the next two years, into walking and cycling infrastructure improvements to towns and cities.
Implementation	1.2.1	As part of the National Transport Strategy Delivery Plan, Transport Scotland to co-ordinate planning and delivering a programme of upgrades and service expansion between Network Rail and local authorities, leading to accessible, co-ordinated bus, rail, and rapid transit (metro) services sufficient to replace most car journeys (except for remote areas).
	1.2.2	As part of the National Transport Strategy Delivery Plan, Transport Scotland to plan for maximising rail freight instead of road freight.
	1.2.3	Local authorities in towns and cities, working with Transport Scotland and other bodies where appropriate, to develop plans for infrastructure improvements that facilitate walking, cycling, and public transport travel over car journeys.

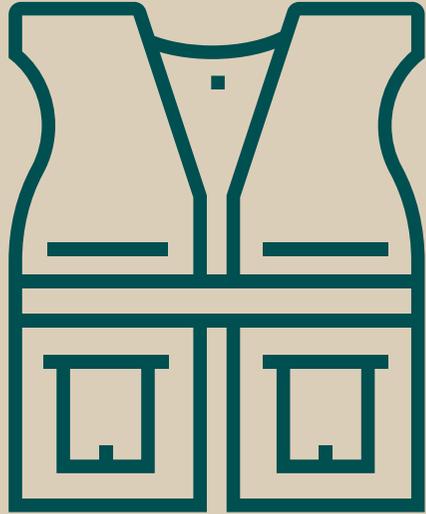
Skills Delivery	1.3.1	To ensure that infrastructure projects deliver local benefit and skills, set binding targets for local labour content and apprenticeships on any procurement process for transport upgrades.
	1.3.2	Skills Development Scotland / Climate Skills Scotland to ensure adequate training provision for relevant construction and civil engineering occupations (including electricians, skilled operatives) for the long-term upgrades programme.
Targets	1.4.1	Increase bus services by 50% to minimise car use.
	1.4.2	All small new ferries in fleet to be electric immediately; all new large ferries and publicly procured heavy vehicles (e.g. lorries) to be electric-hydrogen hybrid by 2033, with the full fleet upgraded to zero carbon by 2045 at the latest.
Supply Chain	1.5.1	Local authorities and rail and ferry operators to source fleets from Scottish manufacturers where possible, with the supply chain adhering to Fair Work principles.
	1.5.2	Offer grants or loans for domestic manufacturers of electric vehicles and ferry vessels to improve productivity and efficiency and boost international competitiveness (including increasing production capacity at the Alexander Dennis bus plant at Falkirk, Ferguson shipyard in Glasgow, and expanding electric bike manufacturing). Guided by Scottish Enterprise.
Ownership	1.6.1	Bus and rapid transit networks run by local authorities with sectoral collective bargaining.
	1.6.2	Bring the ScotRail franchise back into public ownership, if necessary by bidding for the franchise.
	1.6.3	Retain a public stake in shipyards and other transport manufacturing sites.
	1.6.4	Invest into R&D and development of electric and hydrogen transport, in return for a public stake.

2. Electrification of all non-freight vehicles (cars, vans, motorcycles)

To expand the domestic manufacturing base of electric vehicles and expand the public electric charging infrastructure in Scotland.

Public Investment	2.1.1	Electric chargers: Invest £200 million in immediate two years and £1.2 - £1.6 billion by 2032 - for on-street public charging, domestic and workplace chargers, and motorway ultra-fast charging.
	2.1.2	Electric vehicle manufacture: £170 million in immediate two years to support a gigafactory manufacturing EV batteries in Dundee (or other location), guided by Scottish Enterprise.
Implementation	2.2.1	Accelerated rollout of on-street electric vehicle chargers by publically-owned ChargePlace Scotland ¹⁵² , together with local authorities. Subsidised domestic and work-place chargers installed alongside.
	2.2.2	Installation of 535 ultra-fast 150 KV charging stations (each with >6 chargepoints) along motorways in Scotland by ChargePlace Scotland.
Skills Delivery	2.3.1	Climate Skills Scotland to invest into expanding the body of available electricians, to enable the required rapid deployment of EV chargers by 2032.
Supply Chain	2.5.1	Scottish Enterprise to actively target investment towards expanding the EV supply chain in Scotland.
Ownership	2.6.1	Retain public ownership of public EV charging networks through ChargePlace Scotland and local authorities.
	2.6.2	Hold public stakes in manufacturing where granted investment to expand and upgrade.
	2.6.3	Local authorities to develop public car-sharing or car-hire services.

¹⁵²<https://www.transport.gov.scot/media/47397/chargeplace-scotland-cps-charge-your-car-frequently-asked-questions-faq.pdf>



5

MANUFACTURING AND INDUSTRY

SUMMARY

WHERE WE ARE NOW

22% of Scotland's total GHG emissions

HARDEST TO DECARBONISE

Refining | Chemicals | Steel | Cement

CURRENT EMPLOYMENT

46,000 Food & drink

22,000 Metals & metal products

27,000 Machinery & equipment

24,000 Non-metallic minerals & chemicals

13,000 Transport equipment

13,000 Wood, paper & products

SKILLS SHORTAGES

- Re-manufacturing
- Digitalisation

FUTURE JOB CREATION POTENTIAL

DIRECT & SUPPLY CHAIN

Up to 9,000 new and ongoing jobs in manufacturing alongside protecting existing employment numbers in chemicals and refining

PROJECT	TRANSITIONAL JOB CREATION	ONGOING JOB CREATION
Biorefining	1,000 - 3,500	Maintaining current levels
Hydrogen-derived chemicals	4,800 - 5,600	Maintaining current levels
Clean steel	500 - 800	500 - 1,200
Carbon Capture and Storage	Insufficient data	1,000 - 3,125
Expanded re-manufacturing	-	3,300 - 4,700

TOP 5 RECOMMENDATIONS

- Invest £1.1 - £3.75 billion into refining, chemicals and steel conversions and expansions, including 3 biorefineries using forestry, cellulosic and whisky waste, a plastics-to-oil refinery, hydrogen-based chemicals production, appropriate Carbon Capture and Storage infrastructure, and an electric arc furnace. (Between £2 billion - £2.8 billion private co-investment assumed.)
- Active and long-term government participation in ensuring survival of Grangemouth's manufacturing activities through a pro-active process of decarbonisation, including trade union representation in bodies like the Grangemouth Future Industry Board.
- Support businesses to develop remanufacturing. Set public procurement standards to favour remanufactured or refurbished goods where appropriate (e.g. ICT, railway rolling stock, medical equipment), and work with the private sector to develop similar standards.
- Investment into biorefineries, zero-carbon chemicals and clean steel should lead to public stakes in the plants.
- Maximise the use of Scottish manufacturing and industry in proposals outlined for other sectors, e.g. through local content requirements, procurement policy.

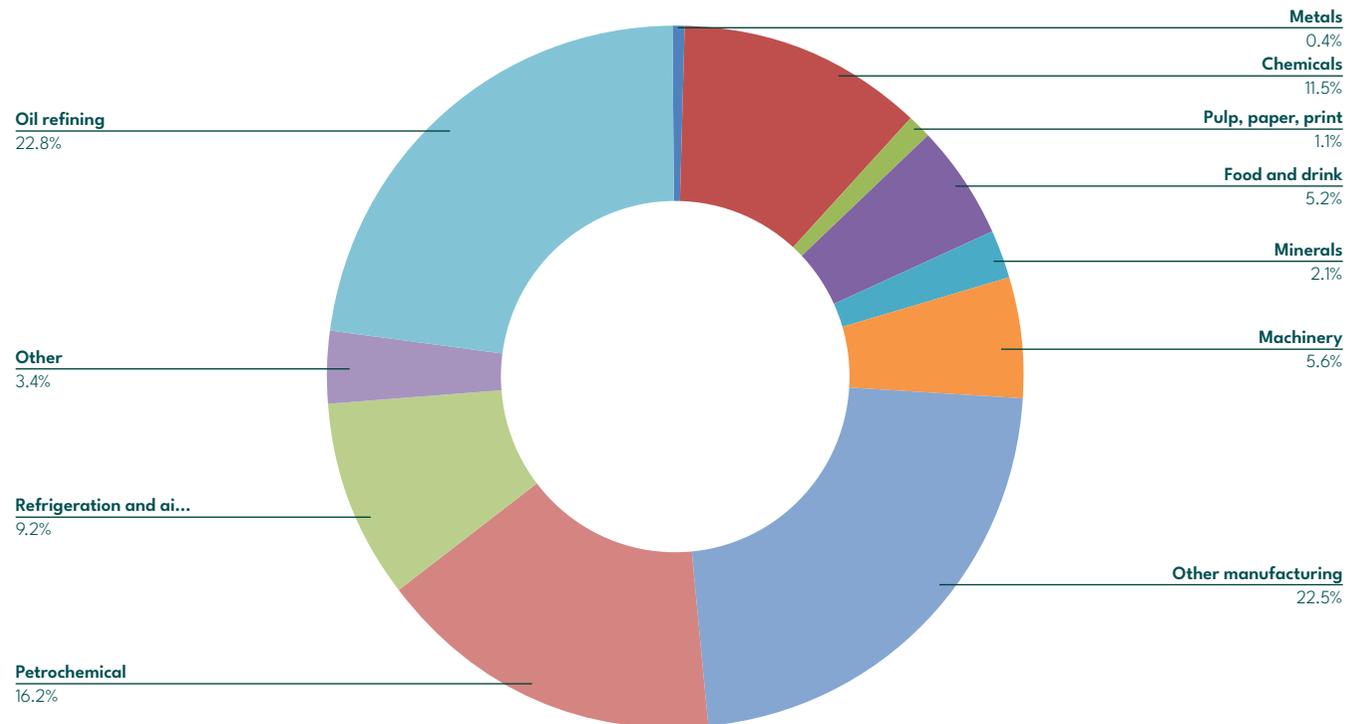
CONTEXT

DECARBONISATION NEEDS

Industrial and business emissions¹⁵³ accounted for 9.2 MtCO₂e greenhouse gas emissions in 2018, or 22% of Scotland's total emissions. 'Hard to abate', or carbon-intensive industries (steel, petrochemicals, cement, and chemicals / fertilizers) play a significant part, with 1.5 MtCO₂e emissions from the petrochemical industry alone and 1 MtCO₂e from other chemical industries.

The Scottish Government aims for an overall 44% emissions cut in this sector by 2032.¹⁵⁴ Concrete policies in the 2018 version of the Climate Change Plan include improving industrial and commercial energy productivity and emissions intensity by at least 30% by 2032, through fuel diversification, energy efficiency improvements and heat recovery.

Figure 5.1
SCOTLAND'S INDUSTRIAL AND MANUFACTURING EMISSIONS



Source: NAEI.

Note: emissions discounted through carbon trading are not represented

¹⁵³We include oil refining in this sector (as does the Scottish Government), although it appears under the Energy sector in national emissions accounting. Due to different sources and definitions in use, figures may not completely match up.

¹⁵⁴<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages>

GEOGRAPHICAL HUBS

According to ONS data, the largest manufacturing sub-sectors in Scotland are: food and drink (46 thousand jobs), machinery and equipment (27 thousand jobs), non-metallic minerals and chemicals (24 thousand jobs), metals and metal products (22 thousand jobs), transport equipment (13 thousand jobs) and wood, paper and products (13 thousand jobs).

Table 5.1 shows the distribution of manufacturing jobs around Scotland.

Table 5.1
EMPLOYMENT IN MANUFACTURING
ACROSS SCOTLAND¹⁵⁵

Area	Food and drink	Textiles, leather and apparel	Wood, paper and products	Printing and recorded media	Non-metallic mineral products	Metals and metal products	Machinery and equipment	Transport equipment	Furniture	Other	Total
Central Scotland	9,900	745	2,020	925	6,100	4,085	4,020	1,320	750	1,005	30,870
Glasgow	5,000	525	900	1,250	1,100	1,535	2,150	3,900	500	500	17,360
Highlands and Islands	7,650	1,370	1,560	155	1,825	2,580	540	355	70	285	16,390
Lothian	3,275	610	1,200	1,025	1,675	2,670	6,025	515	325	510	17,830
Mid Scotland and Fife	5,300	675	1,980	305	2,995	2,330	4,785	1,955	495	1,600	22,420
North East Scotland	7,140	1,320	2,010	600	3,925	5,170	5,125	1,575	420	325	27,610
South Scotland	5,225	2,345	2,200	455	3,930	3,130	1,470	1,455	60	515	20,785
West Scotland	2,310	960	965	645	2,495	1,075	3,025	1,970	280	1,180	14,905
Total	45,800	8,550	12,835	5,360	24,045	22,575	27,140	13,045	2,900	5,920	168,170

Source:
ONS Business Register and Employment Survey

¹⁵⁵The source ONS dataset does not include self-employed contractors if they are not registered for VAT or PAYE schemes, and therefore may underestimate employment where significant numbers of individual self-employed contractors do not use those schemes, e.g. construction, oil and gas.

Among 'hard-to-abate' sectors:

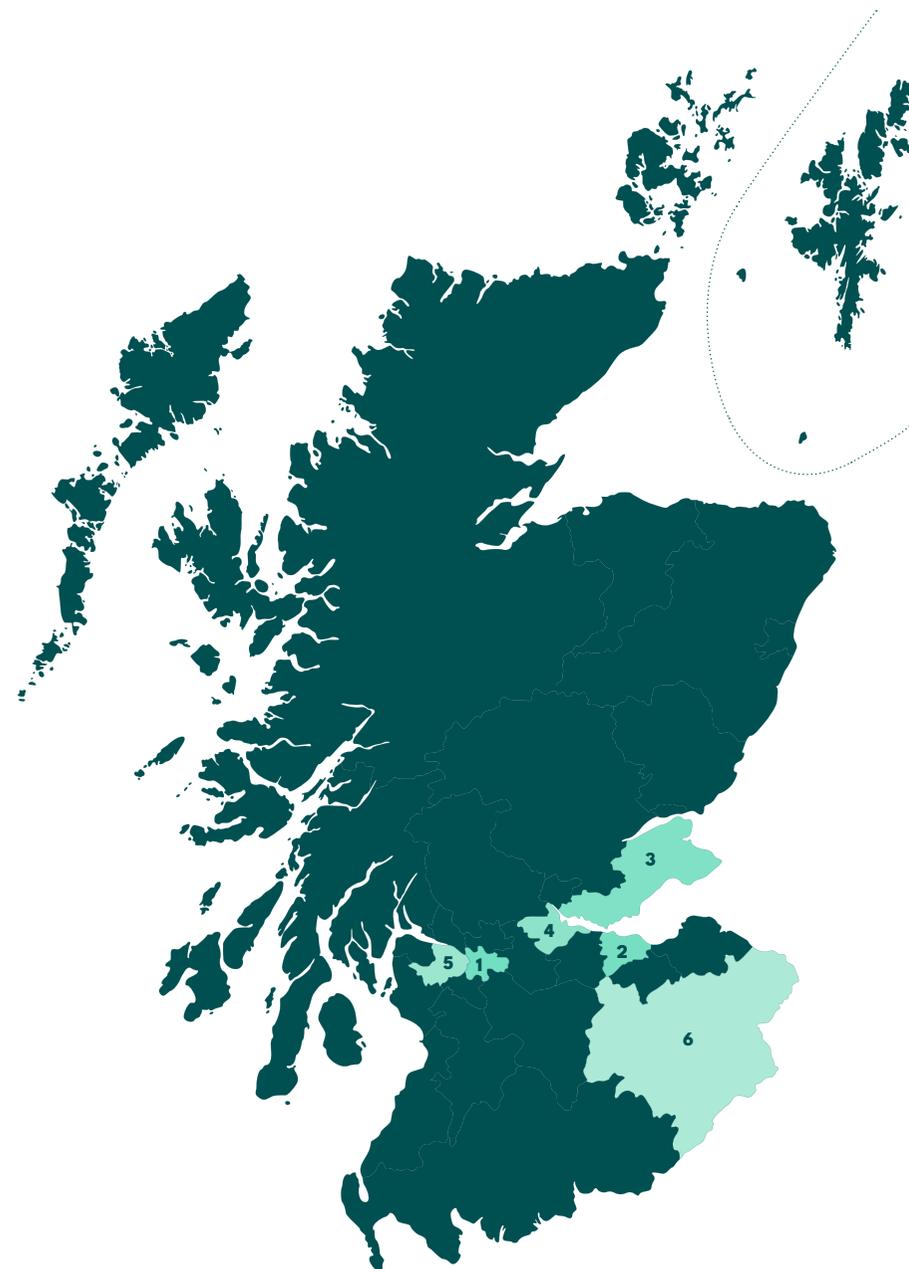
- The petrochemical and chemical industries provide 24,000 jobs, including around 2,000 in Falkirk where the Grangemouth refinery is located, and 1,250 jobs in chemical manufacturing in Renfrewshire;
- Liberty Steel owns plants in Motherwell (North Lanarkshire) and Clydebridge (South Lanarkshire), and employs around 150 workers.¹⁵⁶ ONS records 500 jobs in manufacturing basic iron, steel, and ferro-alloys across Scotland in 2018;
- Cement manufacturing employs 150 people in Dunbar, East Lothian (where Scotland's only cement plant is located), alongside 1,000 jobs across Scotland in cement products for construction.

Table 5.2 highlights the manufacturing centres in Scotland that have over a 20% share in their respective sector.

Table 5.2
GEOGRAPHICAL HUBS FOR MANUFACTURING EMPLOYMENT

		Industry	Jobs	% of jobs in Scotland	Key workplace
1	GLASGOW CITY	Printing & reproduction of recorded media	1250	23.3%	
		Manufacture of motor vehicles, trailers & semi-trailers	900	24.9%	
		Manufacture of other transport equipment	3000	31.8%	
2	CITY OF EDINBURGH	Manufacture of computer, electronic & optical products	2500	23.6%	
3	FIFE	Manufacture of electrical equipment	1000	20.2%	
		Other manufacturing	1250	21.1%	
4	FALKIRK	Manufacture of coke and refined petroleum products	1000	71.9%	Grangemouth
		Manufacture of motor vehicles, trailers & semi-trailers	1000	27.7%	Alexander Dennis
5	RENFREWSHIRE	Manufacture of leather and related products	500	54.1%	Scottish Leather Group
		Manufacture of chemicals & chemical products	1250	23.5%	
6	SCOTTISH BORDERS	Manufacture of wearing apparel	700	30.7%	

Source:
ONS Business Register and Employment Survey; Transition Economics analysis



¹⁵⁶<http://www.stuc.org.uk/media-centre/news/1582/stuc-welcomes-commitment-to-scotland-s-steel-and-aluminium-plants>

THE FUTURE OF MANUFACTURING

Over the coming decades, Scotland could see:

- A large expansion of domestic clean tech manufacturing - covering transport (ferries, trains, buses and batteries), energy (e.g. hydrogen, cables, pipes, blades, nacelles, turbines), construction (off-site construction, insulation, and sustainable construction materials including timber).¹⁵⁷
- Decarbonisation of existing heavy and energy intensive industries.
- Expanded steel manufacturing and processing.
- Machinery, vehicle parts, tools, medical equipment, and electronics remanufactured, with up to 50% of overall manufacturing turnover attributable to remanufacturing.

¹⁵⁷These are addressed in the respective transport, energy and buildings chapters.

OPPORTUNITIES FOR JOB CREATION

COVID-19 ECONOMIC RECOVERY

Our assessment recommends immediate-term R&D investment of £500 million to create 4,800 direct and supply-chain jobs for two years (Table 5.3).

Table 5.3
SHORT-TERM INFRASTRUCTURE PROJECTS FOR ECONOMIC RECOVERY: INDUSTRY AND MANUFACTURING

Project	Score	Scotland jobs multiplier (direct & supply chain, jobs / £ million invested)	Public Investment (£ billion)	Avg jobs (direct & indirect) over 2-year stimulus period	Outcome
R&D for zero-carbon refining, chemicals, steel, CCS and re-manufacturing	17	15.90	0.5	4,770	Develop Scottish technology for decarbonisation pathways for these sectors

LONGER TERM DECARBONISATION JOB CREATION OPPORTUNITIES

Most job creation potential in manufacturing is not described here, but in the chapters on Energy, Transport, and Buildings. Table 5.4 below summarises estimates on manufacturing or plant jobs created as part of some of the projects described in other sectors. Note that these are not all the manufacturing jobs supported, only those that follow most directly from the proposed investments and are therefore most straightforward to reliably estimate. Our level of granularity does not allow us to estimate the full spectrum of manufacturing jobs that appear as part of supply chains, producing everything from construction insulation, to pipes for district heating networks, to railway infrastructure components. Furthermore, some infrastructure projects required for manufacturing (e.g. hydrogen transmission lines necessary for chemical plants) are not included as their scale and shape depends on technological and policy choices further down the line.

The imminent transition to electric vehicles poses a fundamental threat to the future commercial viability of the Grangemouth refinery, with the expected decline in demand for petrol and diesel. Petrochemicals plants at Grangemouth also face a challenging pathway to decarbonise. By upgrading refining and chemicals plants at Grangemouth to focus on high value products where future demand is expected to be sustained, while expanding biological feedstock from waste, it should be possible to maintain existing employment in the long-run.

Table 5.4
ESTIMATES OF MANUFACTURING AND PLANT JOBS SUPPORTED
BY SOME PROJECTS PROPOSED IN OTHER CHAPTERS

Project	Manufacturing or plant jobs supported	Hubs
Build new homes (offsite construction jobs - excludes timber processing etc)	2,800-5,700	Offsite manufacturing for construction can be located in areas that most need jobs near areas of housing shortage.
Expand bus services (bus manufacturing jobs)	1,000	Bus manufacturing: Falkirk.
Battery manufacturing	540	Dundee, Thurso
Develop zero-emissions freight and shipping, decarbonised aviation	> 2,000	Existing relevant manufacturers in Falkirk, Glasgow, Aberdeenshire, Renfrewshire, South Ayrshire.
Hydrogen electrolyzers	< 2,000	Near large offshore wind installations
Rare metals recycling plants	1,000-2,000	Can be co-located with relevant industry e.g. Gigafactory

The decarbonisation employment opportunities focused on here include how to protect jobs in energy intensive industries (primarily refining and petrochemicals), and the potential to expand in steel and re-manufacturing. These will require ambitious industry and government action to position Scotland as a leader in zero-carbon manufacturing. (Table 5.5):

Table 5.5
LONG-TERM JOB CREATION OPPORTUNITIES IN
DECARBONISING INDUSTRY AND MANUFACTURING

Project	Open a Plastics-to-Oil Refinery	Decarbonise refining	Decarbonise chemicals	Decarbonise steel	Expand remanufacturing	Carbon Capture and Storage
Outcome	Build a plastics-to-oil pyrolysis plant	Expand and convert to biorefining, including three commercial-scale biorefineries, using forestry, cellulosic and whisky byproducts as feedstock	Transitioning to a zero carbon chemicals industry, with clean hydrogen as a feedstock.	Expanding and decarbonising steel production by building an Electric Arc Furnace	Remanufactured and repaired goods replace new goods wherever possible. By 2030, 40% of manufacturing turnover is generated from remanufacturing (up from 16% in 2018) ¹⁵⁸	Carbon emissions from hard-to-abate sectors (potentially aluminium, cement, chemicals) are captured, transported and stored in subsea reservoirs. ¹⁵⁹
Potential jobs created	Engineers, Process Technicians	Biochemists, industrial scientists, bioresource advisers. ¹⁶⁰		Furnace Operator	Manufacturing, particularly in ICT, medical equipment, offshore energy supply chains. Disassembly operatives, test engineers, remanufacturing engineers, fabrication specialists, technicians, procurement officers, logistics managers.	Industrial, pipeline, and offshore roles.
Jobs maintained		Engineers, Process Technicians and Operatives	Engineers, Process, Electrical and Mechanical Technicians	Engineers, Machinist, Furnace Operators	Manufacturing, particularly in: Automotive; Marine; Rail; Pumps, fans and compressors, Catering; Vending machines; Ink and toner cartridges; Medical equipment; Tyre re-treading; White goods; Office furniture.	Cement and chemicals manufacturing.
Jobs at risk	N/A	N/A	N/A	N/A	N/A	N/A

¹⁵⁸https://www.zerowastescotland.org.uk/sites/default/files/Jobs_Scotland_online6.pdf p16

¹⁵⁹Our low case calculations assume CCS capacity is only created for capturing industrial emissions; high case, capacity is also created for storing emissions from power generation and natural-gas-to-hydrogen. Wood McKenzie estimates 12,500 CCS jobs (direct & supply chain) across the UK by 2030-2050 based on a scenario equivalent to our high case. https://www.woodmac.com/press-releases/net_zero_roadmap_north_sea

¹⁶⁰<https://www.zerowastescotland.org.uk/sites/default/files/ZWS1543%20Future%20of%20Work%20-%20Emp%20%26%20Skills%20report%20FINAL.pdf>

Geographical hubs	Grangemouth	Grangemouth	Grangemouth, Mosmorran	Motherwell	Existing manufacturing centres	Aberdeenshire
Investment scale (estimate)	£40-60 million	£750 million - £2.2 billion	£3 - £3.5 billion	£100 - £150 million	Further research needed.	£0.5 - £1.9 billion
Length of programme (estimate)	2 years to construct	10 years	10 years from 2030	ongoing	ongoing	ongoing
Upgrades job creation (direct + supply chain, estimate)	300 - 500	1,000 - 3,500.	4,800 - 5,600	500 - 800	N/A	Not enough information.
Ongoing job creation (direct + supply chain, estimate)	100	Protect operations jobs at current levels.	Protect operations jobs at current levels.	500 - 1,180	3,300 - 4,700	1,000 - 3,125

WORKFORCE IMPLICATIONS

JOB QUALITY AND REPRESENTATION

REFINING AND CHEMICALS

The Grangemouth and the Mossmorran chemical plants remain well unionised and jobs are comparatively well-paid. This despite labour conditions at Grangemouth are no longer what they once were, after Jim Ratcliffe and Ineos pushed through pay freezes, an end to final salary pensions and the end to full-time union convenors on site in 2013.¹⁶¹ Health & Safety concerns have been raised by Unite members at Shell's Mossmorran, due to proposed redundancies by a contractor.¹⁶²

New biorefineries running off cellulosic, forestry and whisky waste could be situated anywhere in Scotland. Analysis by Zero Waste Scotland suggested that cellulosic biorefineries might be more suited to a distributed model, nearer waste sites (e.g. Aberdeen rather than Grangemouth).¹⁶³ However, strong job conditions are more likely to be maintained if manufacturing jobs are centralised and biorefineries are developed at the existing Grangemouth site. At the same time, Ineos can be expected to use the disruption caused by decarbonisation and investment needs to attempt to water down job quality. Government investment and public stakes can be used to defend future job quality.

REMANUFACTURING

Expanding remanufacturing will maintain or expand jobs in existing manufacturing operations, where (UK-wide) trade union density is higher than in most private sector dominated industries at 17%,¹⁶⁴ and job tenure (UK-wide) tends to be longer than average.¹⁶⁵ ONS estimates that 71.4% of Scottish manufacturing employees are in quality work, with assessment components as follows: 80% work satisfactory hours (i.e. less than 48 hours a week and not less than they'd like), 84.4% are not in low pay, and 98.5% have a desired contract (defined as "employees either in a permanent contract or who did not accept a non-permanent contract because they could not find a permanent one").¹⁶⁶

Where proposed expansion of remanufacturing goes significantly beyond existing Scottish manufacturing capacity - i.e. in ICT and electronics and in medical equipment - working conditions are more uncertain and will depend on employers and mechanisms used to ensure job quality.

¹⁶¹<https://www.theguardian.com/commentisfree/2013/nov/09/ineos-unite-union-grangemouth-oil-refinery>

¹⁶²<https://www.thecourier.co.uk/fp/news/local/fife/1664911/shells-plans-to-slash-maintenance-staff-at-mossmorran-would-put-lives-at-risk-warns-union/>

¹⁶³<https://www.sdi.co.uk/media/2092/biorefinery-roadmap-for-scotland-building-a-sustainable-future.pdf>
<https://www.zerowastescotland.org.uk/sites/default/files/ZWS1543%20Future%20of%20Work%20-%20Emp%20%26%20Skills%20report%20FINAL.pdf>

¹⁶⁴https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/887740/Trade-union-membership-2019-statistical-bulletin.pdf

¹⁶⁵<https://green-alliance.org.uk/resources/Job%20quality%20in%20a%20circular%20economy.pdf>

¹⁶⁶<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/jobqualityindicatorsintheukhourspayandcontracts/2018/relateddata>

SKILLS

REFINING AND CHEMICALS

Scotland's existing skilled workforce in refining and petrochemicals is well-placed for a transition to high value biorefining and zero-carbon hydrogen-driven chemicals.¹⁶⁷

REMANUFACTURING

The Scottish Government's circular economy strategy recognises that expanding skills provision to support remanufacturing is a priority to enable manufacturers to grow in this direction, and has tasked the newly created Scottish Institute of Remanufacturing with leading collaborative innovation programmes between industry and higher education institutions, but so far no specific plans have been laid out for further education and professional development skills provision.¹⁶⁸

Recent research by Zero Waste Scotland and Circle Economy suggests changes to existing manufacturing and engineering skills provision (from apprenticeships through to CPD courses) that are needed to enable remanufacturing and repurposing, including digital skills, "elimination of waste from production processes, complex problem-solving and life-cycle engineering."¹⁶⁹

SUPPLY CHAIN

REFINING AND CHEMICALS

Decarbonising Scotland's current chemicals production of ethylene, polypropylene and LLDPE by using clean hydrogen as a feedstock will require large quantities of hydrogen. Ensuring this is local supply and Scotland's chemicals industry does not become dependent on international hydrogen imports will require significant deployment of zero-carbon hydrogen production. It will also depend on the scale of demand for hydrogen from other sectors - most particularly, whether domestic heat is also consuming significant volumes of hydrogen.¹⁷⁰

Scotland already produces high enough levels of biological feedstock to meet the demands for three commercial biorefineries, using cellulosic, forestry and whisky residue and waste.¹⁷¹

To achieve the maximum desired employment during construction of new biorefineries, components and materials should be sourced from within Scotland. However, Scotland's first biorefinery - a prototype being built by Celtic Renewables in Grangemouth to use waste and residue - sourced its six purpose-built fermentation tanks from the Netherlands.¹⁷²

REMANUFACTURING

The 2015 Oakdene Hollins assessment of Scottish remanufacturing identifies a large number of supply chain challenges for the expansion of remanufacturing in different sectors. It is worth highlighting several here.

- Scottish healthcare institutions (both NHS and, to a lesser extent, private providers) can potentially benefit significantly from purchasing refurbished medical equipment and from selling end-of-life equipment to be refurbished, but existing procurement practice and policy prevents this. Similarly, many large companies stipulate a requirement for "new" equipment when procuring ICT equipment.
- In some sectors, particularly mobile phones, it is a challenge to convince users to trade used products in for new or refurbished ones.
- Lack of refitters' capacity is identified as a barrier for both rail and marine sectors. I.e. both rolling stock refit depots and shipyards need upgrades.
- Access to core or spare parts from original manufacturers is a challenge across many sectors.

STEEL

Scotland currently exports 500,000 tonnes of scrap steel every year.¹⁷³ This will increase over the coming two decades, with the decommissioning of North Sea oil & gas rigs. Exported scrap steel is processed into secondary steel in electric arc furnaces in other countries. A local electric arc furnace could process Scotland's scrap domestically, significantly increasing domestic production of steel.

¹⁶⁷<https://www.sdi.co.uk/media/2092/biorefinery-roadmap-for-scotland-building-a-sustainable-future.pdf>

¹⁶⁸<https://www.gov.scot/publications/making-things-last-circular-economy-strategy-scotland/pages/9/>

¹⁶⁹<https://www.zerowastescotland.org.uk/sites/default/files/ZWS1543%20Future%20of%20Work%20-%20Emp%20%26%20Skills%20report%20FINAL.pdf> p47

¹⁷⁰https://dechema.de/dechema_media/Downloads/Positionspapiere/Technology_study_Low_carbon_energy_and_feedstock_for_the_European_chemical_industry.pdf

¹⁷¹<https://www.zerowastescotland.org.uk/sites/default/files/Biorefining%20Potential%20for%20Scotland%20Final%20report.pdf>

¹⁷²<https://news.stv.tv/east-central/six-130000-litre-fermentation-vessels-arrive-at-biorefinery?top>

¹⁷³<https://www.zerowastescotland.org.uk/sites/default/files/ZWS1543%20Future%20of%20Work%20-%20Emp%20%26%20Skills%20report%20FINAL.pdf>

RECOMMENDATIONS

1. Decarbonising manufacturing: refining, chemicals and steel

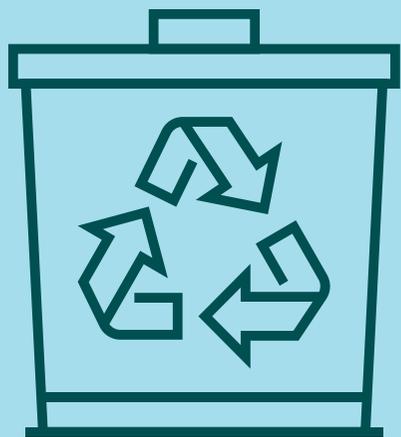
To maintain employment in heavy industry sectors like refining, chemicals and steel in the long-run, Scotland needs an effective pathway to decarbonisation through:

Public Investment	1.1.1	Public investment of £200 million - £1.1 billion into construction/conversion of three full-scale biorefineries.
	1.1.2	Public investment of £750 million - £1.75 billion into the zero-carbon hydrogen-based chemicals production.
	1.1.3	Public investment of £10-30 million into a plastics-to-oil refinery.
	1.1.4	Public investment of £25-£75 million into a new electric arc furnace.
	1.1.5	R&D investment of £300 million into biorefineries, zero-carbon hydrogen and clean steel.
	1.1.6	Public R&D financing of £100 million into Carbon Capture and Storage, and longer-term public investment of £300 - £760 million into future Carbon Capture and Storage infrastructure, with an emphasis on connecting high-carbon industry clusters.
Implementation	1.2.1	Active and long-term government role in ensuring survival of Grangemouth's refining and chemicals production through a pro-active process of decarbonisation, including through investment and regulation.
	1.2.2	The Grangemouth Future Industry Board should include trade union representatives, and be replicated at other energy intensive sites such as Mosmorran.
	1.2.3	Direct Research and Development and business development programmes to link up energy-intensive industries into proposed CCS infrastructure, particularly Acorn project at Peterhead.
	1.2.4	Scottish government needs to collaborate with steel companies to ensure domestic construction of an electric arc furnace.
Supply Chain	1.3.1	A supportive regulatory environment for using waste from whisky, forestry and agriculture as biological feedstock for biorefining.
	1.3.2	Government policies to reduce exports of scrap steel, and increase domestic recycling at steel plants.
	1.3.3	Government policies and support to direct on-shore decommissioning activities to Scottish ports.
Ownership	1.4.1	Investment into biorefineries, zero-carbon chemicals and clean steel should lead to public stakes in the plants.

2. Decarbonising manufacturing: remanufacturing

To maximise product life, value and jobs retained in Scotland's manufacturing industry while minimising waste and emissions, Scotland needs:

Public Investment	3.1.1	£100 million in R&D funding for developing business models, industrial processes and supply chains for remanufacturing.
Implementation	3.2.1	Set procurement standards in the public sector to favour remanufactured or refurbished goods where appropriate (e.g. ICT, railway rolling stock, medical equipment), and work with private sector to develop similar standards.
	3.2.2	Expanded Deposit Return Schemes to collect goods where core or parts gaps exist (e.g. mobile phones, printer cartridges).
	3.2.3	Offer loans to support manufacturers' business development towards remanufacturing.
	3.2.4	Scottish Institute of Remanufacturing and National Energy Company (see Energy chapter) to convene and fund Research and Development in refurbishment or remanufacturing of wind turbine parts ahead of the need to recommission Scotland's first generation of onshore wind turbines.
Skills Delivery	3.3.1	Scottish Institute for Remanufacturing to work with FE colleges, universities and employers to update apprenticeship, FE and HE programmes to reflect skills needed for remanufacturing.
	3.3.2	Scottish Institute for Remanufacturing to develop and offer workplaces CPD training on digitalisation and remanufacturing-specific skills.
Targets	3.4.1	Set sector-appropriate targets for the use of remanufactured or refurbished goods in procurement, and in the total Scottish market, in line with 40% of manufacturing turnover being generated by remanufacturing and refurbishment by 2030.
Ownership	3.5.1	Consider taking into public ownership struggling shipyards and rolling stock refurbishment depots such as Springburn in Glasgow in order to invest into upgrading them for future refurbishment needs.



6

WASTE

SUMMARY

WHERE WE ARE NOW

Waste management produces

4% of Scotland's emissions

Scotland exports

13% of its waste

Including 17% of waste destined for recycling

CURRENT EMPLOYMENT

6,400 Waste collection

5,400 Waste treatment & disposal

2,200 Materials recovery

11,000 Repair

SKILLS SHORTAGES

- Repair
- Maintenance
- Re-manufacturing

FUTURE JOB CREATION POTENTIAL

DIRECT & SUPPLY CHAIN

Up to **23,500** new and ongoing jobs in circular economies and waste management, with the right policies.

PROJECT	JOB CREATION ESTIMATES
Reuse packaging (expanded Deposit Return Scheme)	10,800
Workshops and tool libraries as a public service	400+
Expand reverse logistics services	1,400 - 3,300
Rare metals recycling plants	Construction 700-1,400 Ongoing 1,000 - 2,400
Expand product-as-service and second hand retail	3,300 - 6,600

Future job creation depends on strong action to expand the circular economy, including a much larger-scale deposit return scheme.

Employment is likely to be distributed largely in line with Scotland's existing population, with hubs in existing manufacturing and logistics centres.

TOP 5 RECOMMENDATIONS

- 1 Invest £80 million immediately to boost plastics recycling capacity, £160 million - £340 million in the medium term to recycle Scotland's rare metals domestically (with £340 million - £660 million private investment assumed), and approximately £250 million to scale up the Deposit Return Scheme once well established.
- 2 Improve waste collection to maximise recycling, direct food waste to anaerobic digestion, and minimise hazards in waste sorting.
- 3 Develop remanufacturing, reuse, product-as-service, and second-hand sales, through procurement standards, R&D funding, and supporting reverse logistics services.
- 4 Expand qualifications in repair, maintenance, and remanufacturing.
- 5 Waste sorting, recycling or incineration, as well as logistics services (postal service) run in the public sector.

CONTEXT

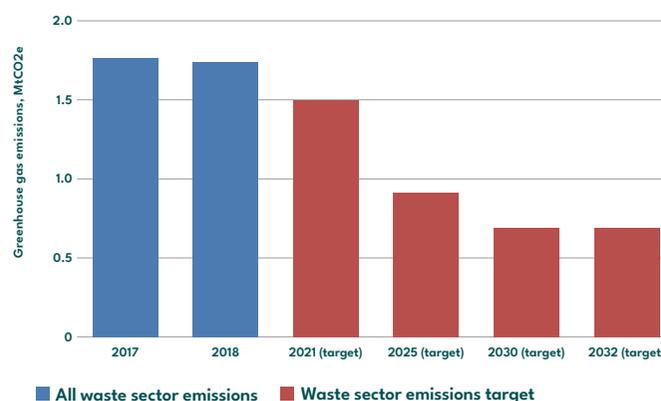
DECARBONISATION NEEDS

The Waste sector in 2018 accounted for 4% of Scotland's greenhouse gas emissions, at 1.68MtCO₂e. The Government's target for 2030 is to bring this down to 0.7MtCO₂e (Figure 6.1). By 2045 the waste sector as a whole should see close to zero emissions, with some remaining emissions from existing landfill sites.

The Government's ambition is to embed a circular economy approach, designed to reduce, reuse, repair and recycle, as well as inshoring the production of goods consumed in Scotland. Specific targets include:

- A Deposit Return Scheme for drinks containers by 2022,
- Reduce food waste by 33%, and to recycle 70% of all waste, by 2025,
- Ending landfilling of biodegradable municipal waste by 2025.¹⁷⁴

Figure 6.1
WASTE SECTOR GREENHOUSE GAS EMISSIONS AND SCOTTISH GOVERNMENT TARGETS



Source: NAEI, Scottish Government

A circular economy approach means minimising the raw material inputs and new production, and maximising the reuse of materials and goods already in circulation. Examples range from bottle reuse schemes to dramatically expanding the amount of goods and machinery that are remanufactured or repaired instead of scrapped. This approach would significantly reduce the amount of waste managed: a Zero Waste Scotland study projects that a circular economy scenario sees a reduction in annual waste from 11 million tonnes in 2012 to 4 million tonnes in 2050, despite overall consumption going up.¹⁷⁵

Emissions from Scotland's waste exports (their management and their transport) are not counted within the government reporting or targets but should also be considered. About 20% of Scotland's non-organic recycled wastes are exported for recycling elsewhere, as is 33% of waste destined for incineration.¹⁷⁶

¹⁷⁴<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/11>

¹⁷⁵<https://www.zerowastescotland.org.uk/sites/default/files/ZWS%20Re-use%20mapping%20and%20sector%20analysis%20%28MPD001-009%29.pdf>

¹⁷⁶<https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/waste-data-for-scotland/>

GEOGRAPHICAL HUBS

Table 6.1 shows the spread of employment in waste collection, processing, remediation, and repair across Scotland. Moving towards a circular economy means expanding employment in repair and maintenance.

Waste collection employment dominates over processing, disposal and remediation, with a few exceptions, the biggest of them in the Highlands where there are 1500 jobs in waste treatment and disposal.

**Table 6.1
EMPLOYMENT IN WASTE, RESOURCE
MANAGEMENT, AND REPAIR ACROSS SCOTLAND**

Region	Repair	Waste collection	Waste management, treatment and disposal	Materials recovery	Total
Central Scotland	1,840	775	1,035	335	3,985
Glasgow	845	1,750	525	300	3,420
Highlands and Islands	430	320	1,685	140	2,575
Lothian	675	775	405	285	2,140
Mid Scotland and Fife	1,325	650	390	395	2,760
North East Scotland	3,970	1,200	225	265	5,660
South Scotland	435	675	560	335	2,005
West Scotland	1,500	220	605	320	2,645
Total	11,020	6,365	5,430	2,375	25,190

Source:
ONS Business Register and Employment Survey; Transition Economics analysis

Table 6.2
GEOGRAPHICAL HUBS FOR REPAIR AND RESOURCE WASTE MANAGEMENT

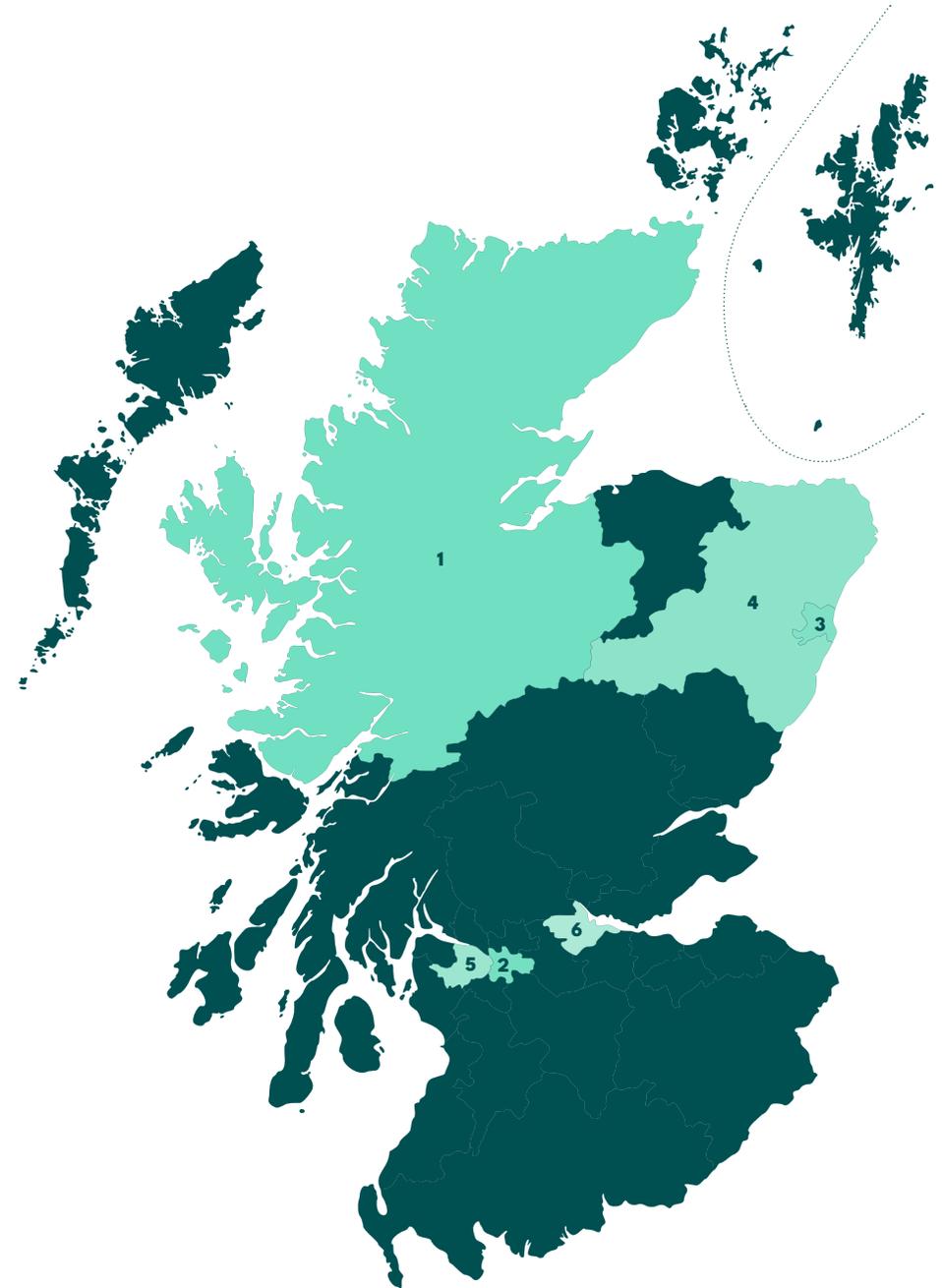
		Industry	Jobs	% of jobs in Scotland	Key workplace
1	HIGHLAND	Waste treatment & disposal	1500	31.5%	
		Treatment and disposal of hazardous waste	1000	65.6%	
2	GLASGOW CITY	Waste collection	1750	27.5%	
		Remediation activities & other waste management services	175	25.9%	
3	ABERDEEN CITY	Repair of machinery	1500	30.1%	
4	ABERDEENSHIRE	Repair of machinery	1000	20%	
		Repair of other equipment	400	57.6%	
5	RENFREWSHIRE	Remediation activities & other waste management services	150	22.2%	
		Repair of computers & communication equipment	1000	36.2%	
6	FALKIRK	Repair of fabricated metal products	400	39.2%	

Source:
ONS Business Register and Employment Survey; Transition Economics analysis

THE FUTURE OF WASTE

Under a circular economy approach, the decarbonised future of waste management involves designing out waste:

- Machinery, construction materials, vehicles, tools, and consumer goods will be made to last longer, and remanufactured, repaired, or repurposed when needed;
- Packaging will be avoided where possible, or reused, or as a last resort composted;
- All organic wastes will be composted and/or used to produce energy e.g. in anaerobic digestors;
- Of the remaining waste, the vast majority will be recycled.



OPPORTUNITIES FOR JOB CREATION

COVID-19 ECONOMIC RECOVERY

Our assessment recommends one shovel-ready waste infrastructure project requiring £80 million of public investment, with capacity to create 1,410 direct and supply chain jobs in its construction phase (Table 6.4).

Table 6.4
SHORT-TERM INFRASTRUCTURE PROJECTS FOR ECONOMIC RECOVERY: WASTE MANAGEMENT

Waste infrastructure projects	Score	Scotland jobs multiplier (direct & supply chain, jobs / £ million invested)	Public Investment (£ billion)	Avg jobs (direct & indirect) over 2-year stimulus period	Outcome
Build plastics recycling plants	16	14.10	0.08	1,410	A new plastics recycling plant to divert waste away from exports.

Source:
Transition Economics analysis

Table 6.5
LONG-TERM JOB CREATION OPPORTUNITIES IN
DECARBONISING WASTE AND RESOURCE MANAGEMENT

Project	Reuse packaging (expanded Deposit Return Scheme)	Workshops and tool libraries as a public service	Expand reverse logistics services	Rare metals recycling plants	Expand product-as-service and second hand retail.
Outcome	Glass and plastic packaging is returned and re-used.	Libraries and schools run loan schemes for infrequently used items (like DIY tools). These are remanufactured or repaired in-house.	Postal service or courier companies partner with manufacturers to collect and sort goods for remanufacturing.	Retain critical minerals in Scotland when EV batteries reach the end of their life through 2-4 cobalt & rare earth reprocessing plants, creating a domestic supply chain. ¹⁷⁷	People and organisations lease long-lasting goods (white goods, cars, furniture) or buy second-hand instead of buying new items. This significantly extends product life. ¹⁷⁸
Potential jobs created	Waste collection, sorting, and processing for re-use	Repair technicians (in public sector)	Postal service / logistics	Furnace operators, process operative, technicians	Manufacturing, repair, customer service, demand planning, asset management, postal service / logistics
Jobs maintained	Plastics and glass manufacturing (partial)	Local authorities' public services jobs	Postal service / logistics	N/A	Postal service / logistics, retail
Jobs at risk	Single-use plastics supply chain (if fails to adapt)	Tools sales	Waste sorting. Single-use plastic supply chain.	N/A	Waste sorting. Single-use packaging manufacturing.
Geographical hubs	Nationwide	Nationwide	Nationwide	Can be co-located with relevant industry e.g. Gigafactory	Nationwide, with concentration in logistics hubs (e.g. North Lanarkshire)
Investment scale (estimate)	Set-up: £240m. Operation: £740m/year (likely self-funding)	Set up: £10 million. Operation: £15 million annually.	Set-up: insufficient data. Operation: £85 million to £167 million (self-funding).	£500 million - £1 billion	Insufficient data.
Length of programme (estimate)	ongoing	ongoing	ongoing	10 years to build, then ongoing	ongoing
Job creation (estimate)	10,800	400 +	1,400 - 3,300	Construction: 700-1,400 Ongoing: 1,000 - 2,400	3,300 - 6,600

¹⁷⁷Certain metals are globally scarce and may present a risk to future Scottish manufacturing as they become difficult to source and increasingly expensive. These include cobalt, copper, lead, lithium. Many of these materials can be recovered and recycled from end-of-life products reducing the need for extraction of raw material and energy.

https://consultation.sepa.org.uk/communications/sector-approach-to-regulation-consultations-on-sco/supporting_documents/Metals%20Sector%20Plan.pdf

¹⁷⁸<https://www.zerowastescotland.org.uk/sites/default/files/ZWS%20Re-use%20mapping%20and%20sector%20analysis%20%28MPD001-009%29.pdf>

WORKFORCE IMPLICATIONS

WASTE COLLECTION, SORTING, AND INCINERATION

WASTE COLLECTION, SORTING, AND INCINERATION

According to HSE, across the UK annually “4.5% of workers in waste suffered from work-related ill health (new or long standing cases), which is statistically significantly higher than the rate for workers across all industries (3.1%)”. Fatal injury rates in the waste sector are 17 times higher than all-industry average.¹⁷⁹

In 2016 in the UK, 41% of the jobs in waste and recycling were lower paid occupations.¹⁸⁰

Research into conditions at waste sorting and waste recovery plants in the UK raises serious concerns: working hours of over eight hours a day, a noisy and smelly work environment, work in a confined space with a high speed moving belt, and paid at minimum wage. At a textile recycling plant, researchers found that workers (majority Eastern European migrant women) suffered from dust allergies and skin irritations.¹⁸¹

Councils tend to collect waste and not to process it. Processing is privatised, including waste to energy. Councils used to run the big landfill sites, but decided that the infrastructure to build recycling plants or waste to energy plants was too capital intensive to build themselves.

Stephen Smellie
UNISON

¹⁷⁹<https://www.hse.gov.uk/waste/statistics.htm>

¹⁸⁰<https://green-alliance.org.uk/resources/Employment%20and%20the%20circular%20economy.pdf> p11

¹⁸¹<https://journals.sagepub.com/doi/full/10.1177/0969776414554489>

WASTE TO ENERGY PLANTS

At waste-to-energy plants, trade union investigations in England have found a series of breaches of construction industry agreements across the UK. At sites in Merseyside¹⁸², Kent and South Yorkshire, GMB have found that “the companies have refused to allow the unions access to the workforce and do not pay the hourly bonus, industry sick pay, enhanced holiday pay, travel and accommodation allowances and other benefits”.¹⁸³

STUC affiliates express concern that the shift in waste management from local authority-run landfill sites to privately run recycling sites and waste-to-energy plants is leading to a decline in working conditions and representation.

None of the waste to energy plants are being built with the right labour standards. We're seeing social dumping, with no attempt to hire local labour.

Gary Smith
GMB

We've had many difficulties with Waste-to-Energy plants. These are construction projects, but employers don't adhere to industry construction agreements.

Jackson Cullinane
UNITE

LOGISTICS AND REVERSE LOGISTICS

Workers in private logistics companies frequently lack access to trade union representation as they are hired as self-employed contractors. Employers have been reported to use legal threats¹⁸⁴ and blacklisting¹⁸⁵ workers found to have participated in legal or strike action. Amazon's employment practices in Scotland have been repeatedly under fire for forcing warehouse staff to work overtime, penalising them for taking sick leave, and denying bathroom breaks.¹⁸⁶ An expanded logistics sector in private ownership and working on the gig economy model would present similar challenges; while an expansion of the postal service may be less likely to given the existing level of union organisation.

REPAIR, MAINTENANCE AND REMANUFACTURING

A significant expansion in remanufacturing - which in large part involves augmenting existing manufacturing operations - would be an opportunity to expand an existing relatively well-unionised workforce that is under threat of cuts (see Manufacturing chapter).

¹⁸²<https://resource.co/article/unions-allege-%E2%80%98deplorable%E2%80%99-treatment-migrant-workers-waste-facility-10423>

¹⁸³<https://resource.co/article/unions-protest-alleged-worker-exploitation-efw-developments-kent-and-yorkshire-11796>

¹⁸⁴<https://www.theguardian.com/business/2018/nov/22/gmb-union-drops-support-for-dpd-courier-walkout-after-legal-threat>

¹⁸⁵<https://www.ibblaw.co.uk/insights/blog/courier-company-accused-ignoring-employment-law>

¹⁸⁶<http://www.thetimes.co.uk/edition/news/amazon-workers-face-sack-for-sick-leave-and-missing-targets-mdv1w9qfh>

SKILLS

REPAIR SKILLS PROVISION

There are not enough repair and maintenance courses, particularly accredited courses, available in Scotland, according to research commissioned by Zero Waste Scotland in 2014. For instance, no courses at all were available in furniture upholstery repair, only one course in small electric appliance fault diagnosis and repairs, and no repair Quality Assurance courses for furniture, electronics, or textiles. No bicycle repair courses were accredited.¹⁸⁷ While this is not recent data, it highlights the scale of the challenge for recognising and resourcing repair skills. Additionally, the Zero Waste Scotland study focused on skills gaps based on interest in training from an existing workforce. If repair and maintenance are to be scaled up in a way that will significantly displace waste, skills provision will need to expand proportionately.

The Scottish Government's circular economy strategy recognises the need to invest in repair skills development. However, at present the strategy only targets training at third sector organisations to help them expand re-use activities, and does not yet support a scaling up of repair and maintenance for product-as-service companies.

SUPPLY CHAIN

The supply chain implications of **remanufacturing** are discussed in more detail in Manufacturing (Chapter 5).

ORGANIC WASTE PROCESSING

While in itself unlikely to create a significant number of jobs, building more anaerobic digesters to process Scotland's organic waste domestically would also support ongoing jobs in the buildings and heat sectors, by producing heat that can be used in district heat networks and biogas for the gas grid alongside hydrogen.

The primary barriers to using anaerobic digestion at a large scale are the availability of correctly sorted waste (or the sorting cost) and the need for technological development to maximise pipeline-quality gas output.¹⁸⁸

PACKAGING AND SINGLE-USE PLASTICS

Scotland's plastics manufacturers are already preparing for a ban on 'non-recyclable' single-use plastics.¹⁸⁹ However, the plastics and packaging manufacturing, as well as petrochemical manufacturers (such as Grangemouth), will likely see reduced demand with a shift towards the circular economy. There are no readily available data on the scale of single-use plastics and packaging manufactured in Scotland: analysing the makeup of this industry would be an important next step to plotting the transition pathway for it.

On the other hand, the continued need for compostable or reusable packaging creates an opportunity for bio-plastics made with timber pulp,¹⁹⁰ kelp¹⁹¹ or other organic materials.¹⁹²

¹⁸⁷<https://www.zerowastescotland.org.uk/sites/default/files/Scoping%20repair%20training%20for%20the%20re-use%20sector.pdf>

¹⁸⁸<https://www.energy.gov/sites/prod/files/2019/08/f66/BETO--Waste-to-Energy-Report-August--2019.pdf>

¹⁸⁹https://www.mcsuk.org/news/Scotland_ban

¹⁹⁰<http://www.forestryscotland.com/products-and-markets/emerging-markets>

¹⁹¹<http://www.marinebiopolymers.co.uk/>

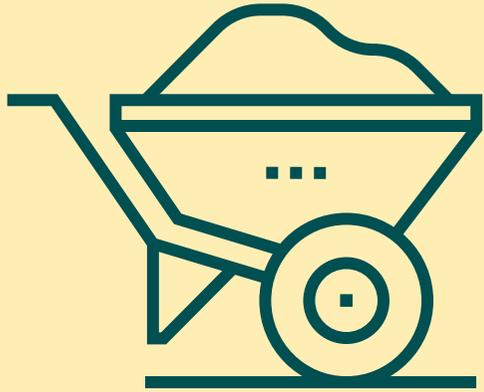
¹⁹²<https://bioplasticsnews.com/2020/01/05/scotland-ireland-chitin-bioplastic-hub/>

POLICY RECOMMENDATIONS TO CREATE FAIR WORK IN DECARBONISING THE WASTE SECTOR AND DESIGNING WASTE OUT OF THE ECONOMY

1. Designing out waste - and decarbonising unavoidable waste

To eliminate landfill use and minimise waste outgoings, as well as minimising the material inputs needed by Scotland's economy, and create 16,900-23,500 jobs in a circular resource management economy, Scotland needs:

Public Investment	1.1.1	Public investment of £80 million in the immediate future to expand Scotland's recycling capacity.
	1.1.2	Initial public investment of about £250 million to set up expanded packaging reuse schemes and public tool and instrument libraries.
	1.1.3	Public investment of £60 million in Research and Development to (a) support businesses in offering remanufactured products and products-as-services, (b) develop reverse logistics services in the postal service, and (c) develop efficient anaerobic digester technology.
Implementation	1.2.1	An additional plastics recycling plant built to minimise exporting plastic for recycling.
	1.2.2	Once well established, expand the Deposit Return Scheme to process a wider range of packaging (glass jars, multiple-use plastic containers, multiple-use plastic bags).
	1.2.3	Improved Local Authority collection services ensuring that food waste is captured for separate treatment, and to minimise the need for recyclables sorting.
	1.2.4	A public sector programme to offer 300 tools and instruments libraries across Scotland through the public and school library system.
	1.2.5	Scottish Enterprise to run a trial reverse logistics service with Royal Mail.
	1.2.6	Procurement standards introduced to favour remanufactured and repaired goods as appropriate to the sector and type of goods.
	1.2.7	Public support to businesses to expand remanufacturing and product-as-service offers, including through SNIB, R&D and public awareness campaigns.
Skills Delivery	1.3.1	Skills Development Scotland to coordinate developing accredited qualifications in repair and maintenance, and ensure their availability across Scotland.
Targets	1.4.1	Phased-in bans on exports of key resources for recycling or composting, including rare minerals in use in batteries, and food waste.
Supply Chain	1.5.1	Ensure compliance of waste processing contractors with Fair Work principles, both in Scotland and (where necessary) overseas.
Ownership	1.6.1	Waste sorting, recycling or incineration, as well as logistics services (postal service) run in the public sector would help secure fair work, while retaining efficiency.



7

AGRICULTURE AND LAND-USE

SUMMARY

WHERE WE ARE NOW

Agriculture accounts for 18% of Scotland's emissions largely due to livestock.

Decarbonising livestock farming fully is not technically possible.

Forestry has significant negative emissions, removing the equivalent of 19% of other sectors' emissions.

CURRENT EMPLOYMENT

67,000 Agriculture

4,400 Forestry & logging

2,400 Aquaculture

SKILLS SHORTAGES

- Organic agriculture and horticulture
- Forest management and planting
- Peatland restoration

INNOVATION OPPORTUNITIES

- Vertical agriculture
- Seaweed farming

FUTURE JOB CREATION POTENTIAL

DIRECT & SUPPLY CHAIN

Up to 43,000 jobs over 12+ years in nature restoration and sustainable farming, with the right policies.

PROJECT	JOB CREATION ESTIMATES
Expand local organic farming	4,500 - 20,500
Expanding forests	6,900 - 16,700
Rewilding	2,000
Restoring peatlands	700 - 1,140
Reduce deer population	2,800

Achieving this level of job creation will depend on significant government action to make agriculture more sustainable and expand Scotland's forests.

Potential forestry employment is distributed fairly evenly across Scotland, with agriculture particularly in Tayside, Grampian, Fife, Lothian and Scottish Borders.

TOP 5 RECOMMENDATIONS

- 1 Invest £8.6-11.8 billion into expanding forest cover and £500-700 million into peatland restoration by 2035, and £100 million/year into rewilding and reducing deer populations.
- 2 Forestry and Land Scotland to lead a reforestation programme on both public and private lands aiming for 38% of tree cover by 2040.
- 3 Scotland's Farm Advisory Service to provide support and funding to land managers to switch to organic agriculture, agroforestry, and encourage innovation in hydroponics and aquaculture.
- 4 Local authorities set targets to increase local food production within and near urban and semi-urban centres, by identifying sites, supporting new co-operative small-holdings and facilitating veg box schemes and markets.
- 5 Increased resources to monitor and enforce labour standards in Scottish agriculture, to eliminate slavery and end worker abuse.

CONTEXT

DECARBONISATION NEEDS

Agriculture and associated land use is a major source of greenhouse gas emissions in Scotland, behind the transport sector,¹⁹³ with emissions of nearly 7.5 MtCO₂e in 2018, or 18% of Scotland's total emissions. The Committee on Climate Change has warned the Scottish Government that the lack of emission reductions in sectors like agriculture puts the Scottish climate change targets at risk.¹⁹⁴ On the other hand, the Land Use, Land Use Change and Forestry sector is considered to sequester carbon, primarily through carbon stored in continued or new forest growth. In 2018 this amounted to 5.4 MtCO₂e greenhouse gas emissions sequestered

AGRICULTURE

75% of Scottish agricultural GHG emissions are related to livestock production. This is not surprising given the significance of grassland and rough grazing in Scottish agriculture, which together account for almost 80% of agricultural land¹⁹⁵ and are far more carbon-intensive than other forms of agriculture.

Organic food production is commonly considered to be less carbon intensive than traditional intensive agriculture,¹⁹⁶ although there is some debate in current scientific literature about whether a whole-system switch to organic methods would result in better climate outcomes or not (due to the greater land area needed).¹⁹⁷ Organic production accounts for only a small percentage (2.1%) of agriculture in Scotland, compared to almost 3% in the UK as a whole. There has also been a year-on-year decline in the percentage of Scotland's land certified as organic.¹⁹⁸

The Scottish Government's Climate Change Plan sets the following targets for agriculture:

- By 2032 the agriculture sector as a whole will be competently using available low emission technologies, including maximising efficiencies, minimising inputs and maximising outputs, precision farming, optimal slurry and manure usage and storage;

- Increased innovation in feedstuffs and fertilisers;
- Significant changes in use of appropriate land to accommodate a large increase in afforestation and peatland restoration/management, along with further integration of woodland and hedges on farms and crofts.¹⁹⁹

There are a number of more ambitious proposals being promoted by a variety of stakeholders to take agriculture closer to net-zero targets: eliminating nitrogen fertilisers; agroforestry; shifting diets to drastically reduce production of carbon-intensive foods, particularly beef, dairy and lamb; building up highly concentrated food growing systems such as “vertical farming” or hydroponics.²⁰⁰

FORESTRY AND LAND USE

This amount of carbon sequestered by Scottish forests could be significantly increased. Scotland has much less woodland cover than other countries in Europe at 18.7% in 2019, compared to a European average of 40%.²⁰¹ The Scottish Government's Forestry Strategy aims to expand woodland to cover 21% of Scotland by 2032, with 14,000 hectares of afforestation in 2022/2023,²⁰² while the more recent Climate Change Plan aiming for an annual 18,000 hectares of afforestation by 2024/2025.²⁰³ However, with increasing calls to double and even quadruple²⁰⁴ forest cover within the next 10-20 years to draw down and store carbon and deliver on negative emissions, Scotland's afforestation targets are under pressure to become more ambitious.

Aside from a sustained and ambitious tree-planting effort, this requires reducing Scotland's deer population. A Scottish Government commissioned working group report estimates that Scotland's deer population could stand at around 1 million, and significantly hampers afforestation efforts. The report recommends enforcing culls in order to keep average deer density to under 10 per square kilometre.²⁰⁵

Further, Scotland will need to sequester more carbon by restoring peatlands. While healthy peatland landscapes store carbon from the atmosphere as peat, “degraded” (e.g. dry) peatlands can emit carbon back into the atmosphere. The Scottish Government's Climate 2018 Change Plan sets, and the 2020 Climate Change Plan reiterates, targets to restore 50,000 hectares of degraded peatland by 2020, increasing to 250,000 hectares by 2030.²⁰⁶ The full extent of peatland to be restored is estimated at 600,000.²⁰⁷ Scientists have expressed concern that the impacts of a warming climate will further negatively impact Scotland's peatlands, meaning that there is likely more work to be done to protect them into the future.²⁰⁸

¹⁹³Scottish greenhouse Gas Emissions 2016 <https://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2016/>

¹⁹⁴<https://www.climatechange.org.uk/policy/challenges/land-use/>

¹⁹⁵<https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf>

¹⁹⁶<https://www.nature.com/articles/s41893-020-0489-6>

¹⁹⁷<https://www.nature.com/articles/s41467-019-12622-7>

¹⁹⁸<https://www.gov.scot/publications/review-environmental-socio-economic-barriers-benefits-organic-agriculture-scotland-summary-report>

¹⁹⁹<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/13>

²⁰⁰Interviews with STUC affiliates; <https://commonweal.scot/policy-library/common-home-plan/>; <https://foe.scot/more-action-needed-on-climate-threat-of-methane/>; <https://www.thetimes.co.uk/article/meat-eating-must-halve-by-2050-to-hit-uk-climate-change-target-2j16hdjwif>; https://www.heraldsotland.com/business_hq/17526260.vertical-farming-way-counter-climate-change-threat/

²⁰¹<https://greenscotnews.com/news/reforestation-rate-is-woefully-inadequate>

²⁰²<https://www.gov.scot/publications/scotlands-forestry-strategy-20192029/pages/3/>

²⁰³<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/12/>

²⁰⁴https://commonweal.scot/sites/default/files/2019-11/CommonHomePlan_Digital.pdf

²⁰⁵<http://www.gov.scot/publications/management-wild-deer-scotland/>

²⁰⁶<https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018>

²⁰⁷<https://www.nature.com/sites/default/files/Publication%202015%20-%20Scotland%27s%20National%20Peatland%20Plan%20-%20July%202015.pdf>

²⁰⁸<https://link.springer.com/article/10.1007/s10113-019-01550-3>

GEOGRAPHICAL HUBS

Scottish agriculture employs approximately 67,000 people. Forestry, logging and associated services account for 4,400 jobs, aquaculture for 2,400 jobs, and other services, industries and wholesalers, around 6,000 jobs.

Agricultural and forestry employment is harder to estimate accurately than other sectors due to the prevalence of seasonal, precarious work. In addition, agricultural statistics are collected separately and by different government agencies.

Table 7.1 presents regional employment in forestry, logging, relevant services, manufacturing, and aquaculture across Scotland as it is reflected in the Business and Employment Register Survey. The Highlands and Islands are a hub for both forestry and logging (1,000 jobs) and aquaculture (2,000 jobs). Mid Scotland and Fife and South Scotland concentrate agricultural services jobs and forestry and logging jobs.

Table 7.1
LAND USE, FORESTRY, AQUACULTURE & AGRICULTURAL SERVICES EMPLOYMENT BY REGION

Area	Services (agriculture)	Hunting, trapping and services	Forestry	Logging	Services (forestry)	Aquaculture	Agrochemicals manufacturing	Wholesales	Total
Central Scotland	205	10	145	30	15	40	400	175	1,020
Glasgow	10	0	5	10	5	10	0	0	40
Highlands and Islands	410	95	930	50	175	1,995	0	190	3,845
Lothian	135	50	220	5	150	55	0	30	645
Mid Scotland and Fife	995	200	670	45	50	160	0	280	2,400
North East Scotland	660	75	435	65	100	40	10	530	1,915
South Scotland	725	60	950	135	225	70	0	605	2,770
West Scotland	80	0	45	0	20	30	0	95	270
Total	3,220	490	3,400	340	740	2,400	410	1,905	12,905

Source:
ONS Business and Employment Register Survey,
Transition Economics analysis

The Scottish Agricultural Census identifies Grampian, Highland, and Tayside as areas with the highest total agricultural employment, at 11,000, 10,100, and 8,500 workers respectively (including working occupiers). Table 7.2 shows the spread of agricultural employment by region in Scotland (note that due to differences in sources, regions used here do not match regions used elsewhere in this report).

Table 7.2
AGRICULTURAL EMPLOYMENT BY REGION (2017 DATA)

Region	Working occupiers	Full-time employees	Part-time employees	Casual and seasonal employees	Total workforce incl occupiers
North West	13,881	1,529	1,751	889	18,050
North East (Grampian)	6,528	2,183	1,177	1,152	11,040
South East	6,715	5,001	1,934	4,800	18,450
South West	10,611	4,703	2,738	1,408	19,460
Total	37,735	13,416	7,600	8249	67,000

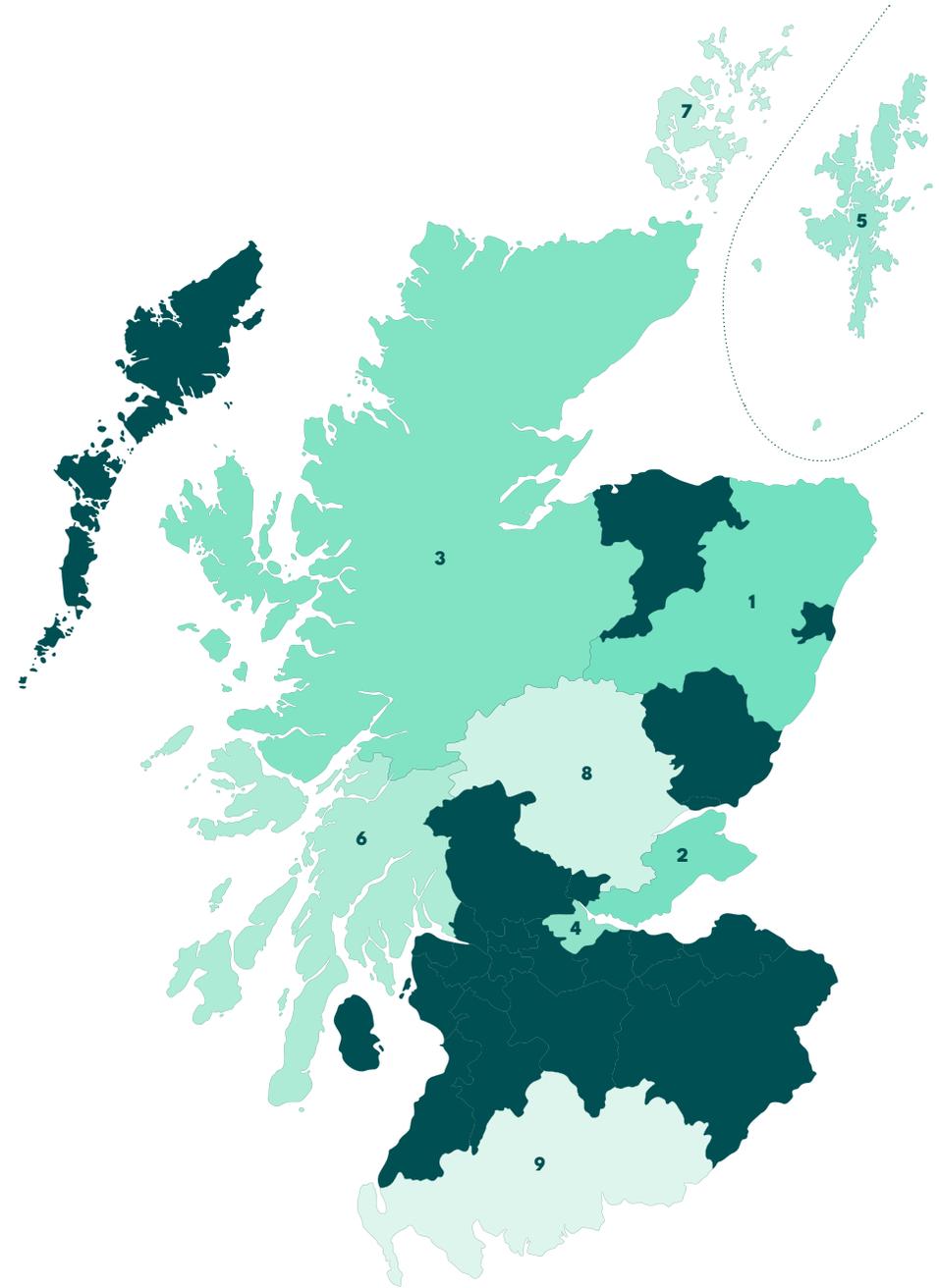
Source:
Scottish Agricultural Census

The Business and Employment Register survey identifies the following hubs (Table 7.3). Scotland's only agrochemical manufacturer is Syngenta, at Grangemouth in Falkirk, where the sector employs 400 workers.

Table 7.3
GEOGRAPHICAL HUBS FOR AGRICULTURE SERVICES, AQUACULTURE, FORESTRY AND LOGGING AND SERVICES

		Industry	Jobs	% of jobs in Scotland	Key workplace
1	ABERDEENSHIRE	Fishing	2250	48.2%	
2	FIFE	Support activities to agriculture and post-harvest crop activities	600	20.2%	
3	HIGHLAND	Marine aquaculture	500	29%	
4	FALKIRK	Manufacture of pesticides and other agrochemical products	400	97.6%	
5	SHETLAND ISLANDS	Marine aquaculture	400	23.2%	
6	ARGYL & BUTE	Marine aquaculture	350	20.3%	
7	ORKNEY ISLANDS	Freshwater aquaculture	300	44.4%	
8	PERTH & KINROSS	Hunting, trapping and related service activities	150	30.6%	
9	DUMFRIES & GALLOWAY	Logging	75	22.1%	

Source:
ONS Business Register and Employment Survey; Transition Economics analysis



THE FUTURE OF LAND-USE, AGRICULTURE AND FORESTRY

Scotland's land-use will need to change dramatically to enable the country to decarbonise and reach net-zero - in ways that also boost health, leisure and jobs:

- Farming to achieve net-zero emissions by 2040²⁰⁹ or earlier.
- A significant shift towards zero-emissions farming techniques (from Organic farming to hydroponics) and agroforestry.
- Greater local food production - including by growing food indoors.
- Increased use of Organic fertilisers.
- Reduced livestock farming for meat, primarily the rough grazing of sheep (which will also become increasingly non-competitive with the rise of plant-based meat alternatives).
- Increase in non-recreational deer hunting & venison production, alongside reducing the deer population.
- Widespread reforestation (for timber production) and rewilding (for wildlife, leisure, and flood reduction) of Scotland's landscapes, contributing to carbon sequestration
- Restoration of much of Scotland's peatland ensuring peatland acts as a carbon sink and not an emitter.

²⁰⁹Target of the National Farmers Union <https://www.nfuonline.com/news/media-centre/press-releases/nfu-reiterates-its-net-zero-aims-for-agriculture>

OPPORTUNITIES FOR JOB CREATION

COVID-19 ECONOMIC RECOVERY

Our assessment recommended three shovel-ready agriculture projects costing £2.13 billion that can create an immediate term boost of 16 thousand direct and supply-chain jobs for two years (Table 7.4).

Table 7.4
SHORT-TERM INFRASTRUCTURE PROJECTS FOR ECONOMIC RECOVERY: AGRICULTURE AND LAND-USE

Energy	Score	Scotland jobs multiplier (direct & supply chain, jobs / £ million invested)	Public Investment (£ billion)	Avg jobs (direct & indirect) over 2-year stimulus period	Outcome
Reforestation schemes	17	20.29	1.80	14,612	Expanding existing forest cover by 13%.
Environmental restoration (incl flood defences)	15	11.32	0.20	905	Doubling planned flood defence reinforcements.
Support farmers to switch to Organic Agriculture	16	13.64	0.13	703	3,400 farms receive grants and support to switch to Organic.
Total			2.13	16,220	

Source:
Transition Economics analysis

LONGER TERM DECARBONISATION JOB CREATION OPPORTUNITIES

Meeting Scotland's climate targets calls for the following longer-term measures for land-use (Table 7.5):

**Table 7.5
LONGER TERM JOB CREATION OPPORTUNITIES IN DECARBONISING LAND-USE**

Project	Expanding local organic farming and agroforestry	Expanding forestry for timber production	Rewilding	Restoring Scotland's peatlands	Grow deer hunting and venison production
Outcome	A more climate-friendly farming system provides more local, healthier food and stable jobs, and phases out high-emissions practices.	38% of Scotland is covered in woodlands.	Community-ed rewilding projects across Scotland's rural areas.	Restoring 600,000 hectares of Scotland's peatlands.	Expanded local deer stalking and control over deer numbers, boosting local incomes and meat production.
Potential jobs created	Growers, farm workers	Forest machine and chainsaw operators, sawmill operatives, engineers, hauliers, fencers, tree planters	Environmental officers, ecologists, tourism workers	Conservation Officers, Drainage engineers, Labourers	Deer stalkers, deer managers
Jobs maintained	Farm workers				Abattoir workers
Jobs at risk	Petrochemical fertiliser supply chain		Rough grazing sheep farmers	Rough grazing sheep farmers	
Geographical hubs	Tayside, followed by Grampian, Fife, Lothian and Scottish Borders.	Everywhere ²⁰	Everywhere	Highlands & Islands ²¹	Everywhere
Investment scale (estimate)	Further research needed (organic conversion and improving job quality on their own could result in higher food prices - additional measures needed to balance this out). Organic conversion subsidies to cover all farmland would cost £800 million.	£6.8 - £9.9 billion	£100 million / year	£530 - £685 million	£56 million per year
Length of programme (estimate)	10 years	12-20 years	ongoing	15-20 years	15 years
Job creation (estimate)	4,500 - 20,500	6,900 - 16,700	2,000	700 - 1,140	2,800

²⁰<https://www.climatexchange.org.uk/media/4201/analysis-of-land-suitability-for-woodland-expansion-in-scotland-july-2020.pdf>

²¹http://map.environment.gov.scot/Soil_maps/?layer=10

WORKFORCE IMPLICATIONS

JOB QUALITY AND REPRESENTATION

FORESTRY

Until 1980, forestry (and tree planting) was dominated by the public sector. Since then, the Scottish Forestry has instead primarily paid private landowners grants per hectare rather than buy the land and plant it themselves.²¹² Tree-planting efforts declined as a result.

The Forestry sector primarily subcontracts its workforce, particularly those in the harvesting sector. A 2017 skills survey showed 74% of the workforce recorded are not on company payrolls but are contracted/self-employed subcontractors.²¹³ This limits trade union presence.

Tree planting and fencing (as opposed to timber harvest) are particularly arduous. Workers walking long distances in difficult weather are paid insecure wages at a piece rate. Partly because of this, a high proportion of planting and fencing activities are undertaken by migrant workers.²¹⁴ Expanding the workforce to meet Scotland's reforestation targets will require a significant improvement in pay and conditions.

²¹²<https://www.carbonbrief.org/in-depth-qa-how-will-tree-planting-help-the-uk-meet-its-climate-goals>

²¹³<http://www.forestryscotland.com/media/357797/scottish%20trees%20and%20timber%20sector%20survey%20-%20feb%202017.pdf>

²¹⁴<http://www.forestryscotland.com/media/357797/scottish%20trees%20and%20timber%20sector%20survey%20-%20feb%202017.pdf>

AGRICULTURE

Many jobs in farming are physically hard, seasonal, low-paid and precarious, with few of the employment benefits that people working in other sectors take for granted.²¹⁵ This is partly due to the physical nature of the work, as well as the industry structure and government policies being formed in the interests of supermarkets and farm employers, rather than farm workers.²¹⁶

Agriculture has the highest rate of fatalities of any industry in the UK. We need to ban pesticide use on farms. They're causing ailments and fatalities for farm workers.

Jackson Cullinane
UNITE

Agricultural workers are some of the most skilled and among the worst paid.

Jackson Cullinane
UNITE

Accurate figures do not exist on how many people work in agri-food. The lack of enforcement of employment law in the gang master sector leads to high rates of exploitative practices.²¹⁷ Casual and seasonal employees make up 8,250 out of 67,000 people employed in Scottish agriculture. However, the employers' association National Farmers' Union believe that agricultural statistics may be underestimating significantly.²¹⁸ Without better measurement and resources, it won't be possible to enforce labour standards to eliminate slavery and end worker abuse in the Scottish food system.

The pressure by supermarkets for greater production volumes, product quality, and low margins (for growers) has led to a substantial intensification of horticultural production, and forced down labour standards and pay. To meet these increased demands, growers have increasingly sought workers described as "reliable, flexible and compliant", which are perceived as being traits "more likely to be found in foreign workers".²¹⁹

Bulgarian and Romanian workers remain fundamental to the sector, accounting for an estimated 60% of Scotland's seasonal migrant workforce in 2017, with a further 18% from Poland. A significant majority are engaged in the East Coast soft fruit sector during the summer months, with peak labour use in the June to August period.²²⁰ With the fall in the pound and the comparative reduction in wages for migrant workers, recruitment from Central and Eastern Europe has become harder. Employers are now demanding workers from outside the EU be let into the UK, amidst estimates of 10% to 20% worker shortages.²²¹

Evidence from across Europe and in the UK indicates that smaller farm holdings are more labour-intensive than larger ones. Increasing farm diversity and peri-urban food systems has the potential to increase the number of jobs.²²²

²¹⁵https://www.sustainweb.org/foodandfarmingpolicy/farm_pay_and_working_conditions/

²¹⁶Interview with union official, February 2019.

²¹⁷<https://www.theguardian.com/uk-news/2016/may/11/gangsters-on-our-doorstep>

²¹⁸<https://www.nfonline.com/assets/97783>

²¹⁹<https://www.gov.scot/publications/farm-workers-scottish-agriculture-case-studies-international-seasonal-migrant-labour/pages/8>

²²⁰<https://sefari.scot/research/the-fruits-of-their-labour-seasonal-farm-workers-in-scottish-agriculture>

²²¹<https://www.nfus.org.uk/news/news/nfu-scotlands-seasonal-workers-survey-identifies-labour-shortage-fears>

²²²https://www.sustainweb.org/foodandfarmingpolicy/farm_pay_and_working_conditions/

SKILLS ISSUES

Across all land-use sectors, the Committee on Climate Change has identified a need amongst land managers for support, skills and training to aid transition to alternative land uses.²²³

FORESTRY

The level of afforestation required to meet Scotland's existing targets and to achieve a net zero society will require a significant expansion of Scotland's skills - to plant enough trees, manage forests and harvest timber.

Forestry involves a specialist skillset, very different from farming. A transition towards more forestry will require training and support for land-workers to manage, conserve and/or harvest trees, as well as well-developed local supply chains that help them to sell timber and wood.²²⁴ Upland farmers may benefit from the presence of regional forestry advisers, to support afforestation schemes and management plans while adding to the local and regional skills base.²²⁵

Already, the Scottish forestry and timber industry faces a potential labour crisis with an ageing workforce operating in most of the industry sectors - most operators are over 50.²²⁶ In the short-term, the sector has aimed to recruit workers particularly from the oil industry (engineers with transferable skills) and the agricultural sector (machine operators with transferable skills).

There has been limited intake into the forestry sector in recent years, and there is limited structured training. Few companies have a formal training department with specialists and resources to support the development of staff. In-house training undertaken within the industry is mostly completed informally on the job.²²⁷

Across forestry and timber sectors, future shortages are expected primarily at the operator level: Forest machine operators, Chainsaw operators, Sawmill operatives, Engineers, Hauliers, Planting contractors.²²⁸ These shortages are expected already if operations continue at the current level. The necessary significant expansion in the timber industry and accelerated planting of new forest will face further shortages.

SUPPLY CHAIN ISSUES

NURSERIES

Significant nursery capacity and seed availability are required to plant tens of millions of trees each year. Neither Scotland nor the UK has these at the moment, which means importing more saplings. This raises risks to tree health, which creates risks for land managers.²³² There will be a need to expand nursery capacity for tree saplings in Scotland as much as possible, to meet demand. Increasing local vegetable production in Scotland will also require more plant nurseries, to deliver annual seedlings.

NEW FARMING TECHNOLOGY AND FERTILIZER

There are opportunities to develop new Scottish supply chains for and areas of sustainable agriculture, e.g. seaweed farming for food, animal feed, Organic fertiliser, and other uses.²³³ Conversely, farm waste can be turned into compost, energy and gas using anaerobic digestors, contributing to energy decarbonisation opportunities.

REWILDING AND PEATLAND RESTORATION

Both rewilding and peatland restoration will require a significant expansion of skills in Scotland from a very limited base. There are currently few existing training opportunities or qualifications in peatland restoration.²²⁹ More opportunities exist for rewilding, including work experience based 'learning by doing' traineeships²³⁰ and a number of conservation degrees. Nonetheless, both areas will need significantly increased training schemes, to be able to meet labour demand.

AGRICULTURE

In Scotland the horticulture and potato sectors currently use seasonal labour to undertake key planting, harvesting, grading and processing tasks on farms - tasks with no real mechanical alternative. The "best" workers develop skills over multiple seasons, with returnees becoming keystone workers - helping manage and run the farm businesses.

With regards to skills required in decarbonising agriculture, a review commissioned by the Committee on Climate Change highlights the need to provide advice and skills provision to land managers in order to ensure take-up of options to switch to agroforestry and other necessary changes in practice.²³¹

²²³<https://www.theccc.org.uk/wp-content/uploads/2018/11/Land-use-Reducing-emissions-and-preparing-for-climate-change-CCC-2018-1.pdf>

²²⁴<https://policyexchange.org.uk/wp-content/uploads/2019/12/BIGGER-BETTER-FORESTS.pdf>

²²⁵<https://policyexchange.org.uk/wp-content/uploads/2019/12/BIGGER-BETTER-FORESTS.pdf>

²²⁶<http://www.forestryscotland.com/media/357797/scottish%20trees%20and%20timber%20sector%20survey%20-%20feb%202017.pdf>

²²⁷<http://www.forestryscotland.com/media/357797/scottish%20trees%20and%20timber%20sector%20survey%20-%20feb%202017.pdf>

²²⁸<http://www.forestryscotland.com/media/357797/scottish%20trees%20and%20timber%20sector%20survey%20-%20feb%202017.pdf>

²²⁹<https://www.iucn-uk-peatlandprogramme.org/resources/peatland-learning-training>

²³⁰<https://www.planitplus.net/Apprenticeships/ViewVacancyCA/456/7>

²³¹<https://www.theccc.org.uk/wp-content/uploads/2020/01/Vivid-Economics-and-ADAS-2020-Policy-framework-for-deep-emissions-reductions-and-carbon-removals-in-agriculture-and-land-use-in-the-UK.pdf>

²³²<https://policyexchange.org.uk/wp-content/uploads/2019/12/BIGGER-BETTER-FORESTS.pdf>

²³³<https://www.argyll-bute.gov.uk/news/2019/dec/report-provides-template-seaweed-farming-argyll-and-bute>

POLICY RECOMMENDATIONS

1. Decarbonising Scotland's land

To create 17,000 - 43,000 jobs in the transformation of Scotland's land from a significant source of emissions into a net sink.

Public Investment	1.1.1	Invest £130 million into expanding organic farming in the coming two years, and at least an extra £800 million by 2030 to further expand local organic farming and agroforestry.
	1.1.3	Invest £200 million into peatland restoration in the coming two years, and a further £300-£500 million by 2035.
	1.1.4	Invest £1.8 billion into expanding forest cover in the coming two years, and an extra £6.8-10 billion by 2035 - towards both forestry and natural growth.
	1.1.5	Invest £50 million per year into rewilding programmes, and a further £50 million annually to reduce the deer population.
	1.1.6	Invest £90 million into R&D in silviculture, to improve forest health, resilience, productivity and wood quality, and into ecology, agriculture and sustainable food systems.
	Implementation	1.2.1
1.2.2		Scotland's Farm Advisory Service to offer grants, skills and consultancy to farmers to switch to Organic and/or agroforestry methods. Provide rural land-owners (particularly small farmers) loans to adjust their land-use, providing support with high up-front costs and long-term pay-backs of investing in alternative uses. ²³⁴
1.2.3		Local authorities set targets to increase local food production within and near urban and semi-urban centres, by identifying sites, supporting new co-operative small-holdings and facilitating veg box schemes and markets.
1.2.4		Increased resources to monitor and enforce labour standards in Scottish agriculture, to eliminate slavery and end worker abuse, through both the Scottish Government and the UK-wide Gangmasters and Labour Abuse Authority.
1.2.5		Forestry and Land Scotland to lead a national reforestation programme on both public and private lands, alongside legislation compelling large land-owners to reforest, rewild or restore peatlands on 30% of owned land.
1.2.6		Introduce statutory regulation to reduce local deer densities, and broaden participation in deer stalking to the local communities. ²³⁶
1.2.7		Scottish Enterprise to support innovative farming technologies including seaweed farming and vertical farming.

Skills Delivery	1.3.1	Climate Skills Scotland to work with colleges to deliver training in conservation techniques, sustainable management of peatlands, agroforestry and organic farming, forestry and silviculture, and rewilding.
	1.3.2	Provide advice and training to land managers to aid transition to zero- or negative-carbon land uses. ²³⁶
Targets	1.4.1	Establish a target of 2.96 million hectares covered in trees - 38% of Scotland - before 2040. ²³⁷
	1.4.2	Expand Scotland's existing peatland restoration targets from 250,000 hectare by 2030 to 600,000 hectares by 2035.
Supply Chain	1.5.1	Support for nurseries and tree health by offering a tax rebate on saplings and seedlings sourced and grown in Scotland.
Ownership	1.6.1	Given the large public investment into reforesting Scotland, there should be a significant increase in community and public ownership of forests. Large landowners who do not reforest or restore 30% of owned land, hand land over either to local community associations or to Forestry and Land Scotland.
	1.6.2	Public sector tree-planting and reforesting should be led by Forestry and Land Scotland.

²³⁴<https://www.theccc.org.uk/wp-content/uploads/2018/11/Land-use-Reducing-emissions-and-preparing-for-climate-change-CCC-2018-1.pdf>

²³⁵https://www.scotlink.org/wp-content/uploads/2020/01/LINK_DeerReport_Aug2019_v21b.pdf

²³⁶<https://www.theccc.org.uk/wp-content/uploads/2018/11/Land-use-Reducing-emissions-and-preparing-for-climate-change-CCC-2018-1.pdf>

²³⁷<https://www.climatechange.org.uk/media/4201/analysis-of-land-suitability-for-woodland-expansion-in-scotland-july-2020.pdf>

END NOTES

The STUC is Scotland's trade union centre. Its purpose is to coordinate, develop and articulate the views and policies of the trade union movement in Scotland; reflecting the aspirations of trade unionists as workers and citizens.

The STUC represents over 560,000 working people and their families throughout Scotland. It speaks for trade union members in and out of work, in the community and in the workplace. Our affiliated organisations have interests in all sectors of the economy and our representative structures are constructed to take account of the specific views of women members, young members, Black members, LGBT+ members, and members with a disability, as well as retired and unemployed workers.

This report was written by Mika Minio-Paluello and Anna Markova of Transition Economics, and commissioned by the Scottish Trade Union Congress (STUC). It does not represent the views of the STUC General Council, nor specific affiliate trade unions.

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April 2021