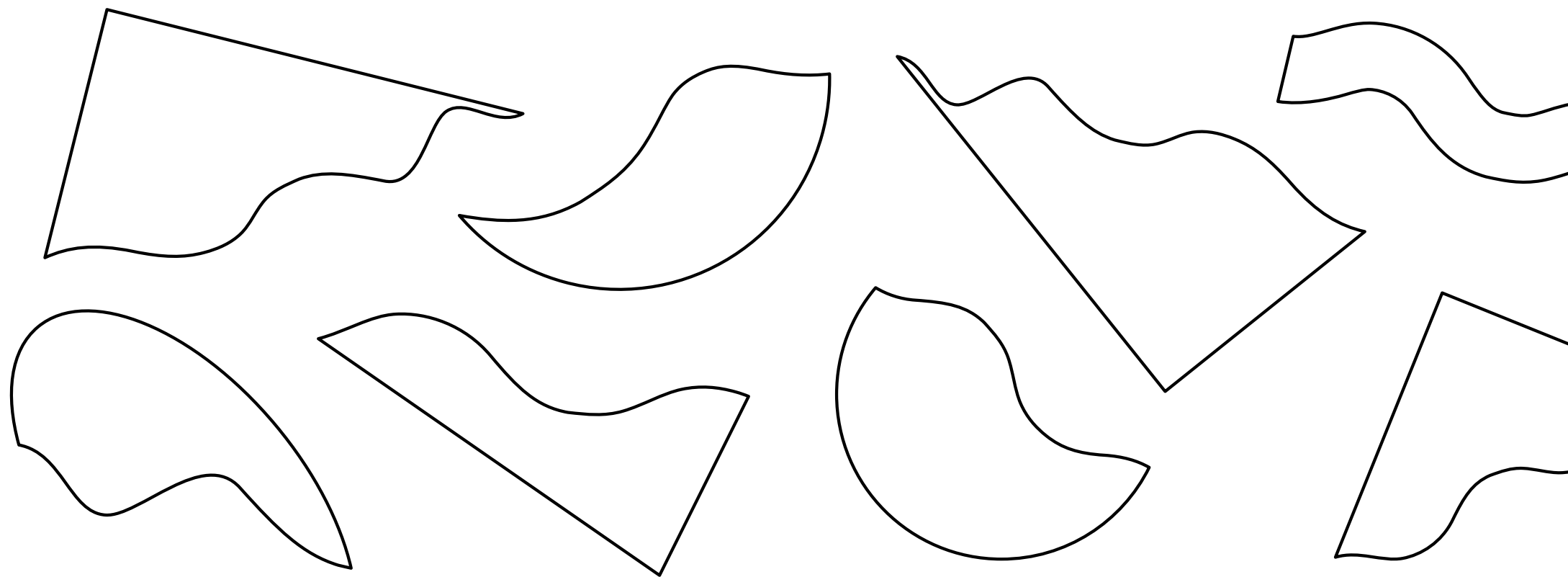


The Common Home Plan

OUR
COMMON
HOME



The Common Home Plan is the work of dozens of contributors and Common Weal is very grateful indeed for their time and commitment. Edited by Robin McAlpine, Craig Dalzell and Edmond Venabales.

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Preface

Our era is an era of crisis – economic crisis, social crisis, environmental crisis. From climate change to ever-widening inequality, people fear that we may be condemned to a future worse than our present. People look forward with fear; they long for a plan which persuades them the future can be better than our present.

This is that plan, the Common Home Plan. Despite the enormous complexity of these issues, and the gigantic scale of the problems to be solved, with ingenuity, technology, and the political will to implement substantial systemic changes, we can pull our society back from the brink. If Scotland takes responsibility for Our Common Home – if we generate electricity using clean, renewable sources; if we build our homes efficiently using non-polluting materials; if we shorten supply chains and create new, sustainable industries; if we replant our forests and reorganise our food production through a system of agroecology, then we can drastically reduce our carbon emissions, end the degradation of our soils, and live in clean, warm homes with abundant electricity.

This is a comprehensive Green New Deal for Scotland – a process of public planning, organised and implemented by public bodies and paid for out of the public purse. Just as the post-war governments across the West created whole new systems of welfare, healthcare, and infrastructure while also rebuilding Europe after the war, we will do the same for Scotland's energy, agriculture and housing – with the same benefits of employment, prosperity, and skills. This is a plan not just for our environment, but for our economy and society as well.

The time for targets is over. Let's get started.

Introduction

Purpose

We face a number of different environmental crises. Not only climate change, but soil degradation, deforestation, resource strain and mass extinction pose immediate threats to our ways of life. There is now widespread public awareness that something has to be done, but the limited time available means that we must move swiftly from merely being aware of the problem to committing to a comprehensive action plan to tackle these crises. Since this is going to involve a large amount of investment, and since the world also faces a series of social problems such as poverty and widespread issues of mental health, the investment in tackling the climate crises must also be planned in a way that solves the social problems too. This approach has become known as a 'Green New Deal'.

However, the growing support for Green New Deals around the world disguises a problem: there really aren't any comprehensive or detailed plans for people to get behind. There is no shortage of work which has been done, but it must be tailored to the individual places where it has to be implemented and it cannot simply be a plan for one aspect of the environmental crises (such as renewable energy or electric transport). Unless it is a properly coordinated and comprehensive plan it won't work.

Common Weal is a Scottish think and do tank which has done extensive work on many of the specific elements that are at the heart of a Green New Deal such as energy, heating, deconsumerisation and land. Having already produced many of the component parts of a Green New Deal over recent years, we set ourselves the task of pulling it together and filling in the gaps. That's what this report is.

But one of the factors that this report will highlight is that every Green New Deal will be different because they are, by definition, working with nature to provide what humans need and want but in a regenerative way which does not do harm in the process – and nature is different around the world. The way we will generate electricity in Scotland is not the same way it will be generated in Switzerland, or in Kenya, or Mexico. Many factors

such as density of population, patterns of energy usage, average temperatures, available land resources and travel distances will define how a Green New Deal is achieved. These will even be different across the UK where (for example) the viability of installing a District Heating Scheme in the densely-populated south of England will be different than in the much less densely populated areas of urban Scotland. So this plan is Scotland-specific.

But we wanted to signal clearly that this is a shared task, shared between nations and between the people of those nations. Scotland is Our Common Home, and so we as citizens share responsibility, just as the world is Our Common Home and so Scotland as a nation shares responsibility. So we called the project Our Common Home. What follows is the Common Home Plan, a comprehensive Green New Deal for Scotland.

Methodology

The Common Home Plan has been developed with the support and input of dozens of people who are experts in their various fields. It began by getting a group of people together to set out the challenges we face – and it quickly became clear that this cannot simply be shorthand to 'climate change' since the undoubtedly devastating impacts of an atmosphere which is heating up may not be the first of the environmental crises to impact severely on our way of life (and in fact may not even be the second or third to do so).

So from there the report sought to identify the full range of threats we face and then to set out the categories of action which are needed to tackle each of them. Up to this stage the work would look fairly similar to the preparatory work for any Green New Deal. The next stage was to translate these general categories of action into specific programmes of action for the specific conditions in Scotland. This involved an intensive process of assessing current performance, opportunity and potential, looking for current best practice, assessing those best practice options on the potential for their adaptation to Scotland

(and against each other), drawing conclusions about which approach would work best in the Scottish context and then working out how those solutions could be implemented and the inputs and costs required.

In many places options analysis was fairly easy – for example there was consensus on how to approach electricity and housing. In some areas there was broad consensus but some differences in emphasis – for example how much to emphasise active travel (walking and cycling) versus the electrification of vehicle transport. In these cases the report seeks to strike a balance which reflects the range of views. In a few areas there was a wider spectrum of views on what should be done – for example in food where there were differences of view on the extent of the role of reducing meat consumption, using new grow technologies and approaches to food imports. Even here there was substantial agreement (everyone agreed that food growing in Scotland must move to an 'agroecology' model) and where there were differences an attempt has been made to produce a model consistent with the rest of the Common Home Plan.

There is one more aspect to options analysis about which it is important to be clear: with a very small number of exceptions (which have been highlighted in the body of the report), no solution was selected which did not involve existing technology that can be implemented immediately. One of the great risks in tackling environmental crises is the idea that 'something will turn up' – that a new technology or process will solve each of the problems if only we wait long enough. This is no longer a feasible approach; a new technology (even if it has completed proof of concept in the laboratory) will take years to pilot, test, assess, scale up and roll out. That means any non-existing technology is unlikely to be available to come on stream within the timescales set out by the International Panel on Climate Change. Of course new technologies will appear, but the Common Home Plan is based almost entirely on current or old technology (while it has at all stages attempted to future proof infrastructure so that when new technologies do appear they can be quickly 'plugged in').

The methodologies for assessing and modelling these options varied substantially between options. This is inevitable; there simply hasn't been enough whole-system transformation of the sorts envisaged in the report to produce reliable information on costs and inputs on the scale required. The most common approach used in the report is to identify the best comparator for which there is data and then to derive a unit cost from which a picture for Scotland could be derived. For example, by looking at existing retrofitted District Heating Schemes it was possible to produce a reasonably reliable average cost for connecting a house which could then be multiplied by the number of houses to be connected. In some cases estimates already exist at a UK level (often contained in the work of the Westminster Climate Change Committee) and a pro-rata sum for Scotland has been produced. This does not necessarily mean a per capita pro-rata – for example, in a number of calculations in transport the ratio used was kilometres of road. There are a few examples in the report where more reliable data on Scotland is available (such as energy generation and usage).

In the original draft of the Common Home Plan all of these calculations and resultant numbers and relevant references were included. However, Common Weal is aware that many more people are interested in how we can create a Green New Deal for Scotland than will want to read the details of all the calculations involved. The decision was therefore made to remove these from the report and produce a Technical Report to accompany this Common Home Plan. All of the calculations and references can be found in that technical report.

There are two methodological issues in relation to transition. The first is that the Plan has been written in terms of 'what must be done and how it can be done'. In some occasions the component parts of what needs to be done exist in some form or other or do so at least partially. Scotland has many current national strategies for dealing with subjects such as waste, transport and climate change. Some of these are effective and form the basis of required action, provided they are supplemented, invested in and prioritised. Others aren't effective and simply don't comprise even the starting point for a solution.

There isn't the scope in this report to do a full assessment of the current public policy landscape and so the way component parts might be handled in a transition is not discussed. That is an implementation matter. As an example in some occasions where the report calls for a new organisation to be set up it may make most sense to adapt this from an existing organisation, but the Common Home Plan simply states the need for the organisation.

The second transition issue concerns powers and constitutional preference. Almost all the contributors to this report (though not all) believe that Scotland must become an independent country to be able to implement this. However some people who want to see action of this sort will hold a different option on the constitution. Likewise, some aspects of this report are difficult to achieve with full membership of the European Union (particularly agriculture) which suggests that membership of the European Single Market but not the full European Union should be considered. Again, people will have personal views on this. For these reasons the Common Home Plan simply sets out the tasks that are required and it is then for people to explain how they believe it can be done under the constitutional or international relations positions they favour – or to set out compelling alternative approaches.

Finally it is important to be clear about the limits of the methodology. There is simply too much which is currently unknown and the scale of the sums of money needed in some places is greatly out of line with the available knowledge. In some places this has been resolved simply by taking most conservative estimates (for example, the production of hydrogen has been priced at current capital cost levels despite the fact that these are certain to reduce rapidly in the future). In some places there has been no option but to use a degree of informed guesswork (for example, the cost of upgrading the thermal efficiency of all public buildings). This does not affect the core structural elements of the plan and assumptions have been made which are least likely to underestimate cost.

Problem and cause, prevention and solution

While the environmental threats to our future are numerous and can be grouped in different ways, there are broadly seven major world threats:

- **Climate change and carbon emissions.** This is the result of putting greenhouse gases into the atmosphere, particularly by burning hydrocarbons (oil, gas and coal) but also resulting from organic processes like the way land is managed.
- **Species extinction and biodiversity loss.** This is especially the result of the constant decline in habitat which has resulted from the way we do agriculture and from the use of biocides (particularly pesticides on crops) but also because of chemical pollution, extermination of predators and rising sea temperatures.
- **Pollution.** This includes chemical pollution but also particulate pollution such as microplastics or small particulate matter which is emitted from car exhausts and as their tyres wear down.
- **Water shortage.** This involves changing patterns of rain resulting from climate change as well as declining water tables, particularly where water is being used for agriculture at a rate faster than it is being replenished.
- **Resource drain.** Overconsumption and a linear economy (where we bury mineral and other resources in landfill after use rather than reusing them) mean that many of the essential minerals we need to sustain our way of life are running out with no identified replacement.
- **Deforestation.** This is almost entirely caused by clearing land for agriculture to meet the growing industrial demand for ingredients such as palm oil and soya.
- **Soil degradation.** This is the result of farming practices in which, each year, more nutrient content is taken from soil than replaced and because of land management practices such as the removal of trees. Soil either becomes infertile, dries out and is blown away or is washed away by floods.

These categories of threat are found everywhere but the precise nature of the threat is often regional in nature. For example, Scotland has some isolated water shortage problems but has nothing like the problem of collapsing water tables which is occurring in hot countries with large agricultural sectors while we have a loss of pollinators which will not be the same in regions without such intensive agriculture. However this doesn't change the fact that we have well-researched, consistent, broad approaches to tackling these seven threats. The following list summarises these solutions but is not comprehensive.

Carbon emissions and climate change

- Replace all non-renewable electricity generation.
- Replace all non-renewable heating sources.
- Adapt agricultural practices.
- Stop peat loss.
- Reforest.
- Move to zero-carbon transport.
- Improve energy efficiency and reduce energy usage.
- Move to zero-waste.
- Shorten supply chains.
- Adapt carbon intensive industries or reduce their volume.
- Change diets.

Species extinction and biodiversity loss

- Move to an agroecology system of agriculture.
- Rewild – allow some land to revert to an unmanaged state.
- Change diets and greatly reduce food waste.
- Tackle climate change.

Pollution

- Continually strengthen and police regulation on pollutants.
- Move to a zero waste economy.
- Adapt agricultural practices.
- Reduce and eventually end the use of plastic.

Water shortage

- Put in place effective water shortage planning.
- Improve household and industrial water use efficiency.
- Adapt agricultural practices.

Resource drain

- Deconsumerise – reduce the amount people consume in the first place.
- Use a hierarchy of borrow, reuse, repair, remanufacture and recycle.
- Move to a zero-waste economy and end landfill and incineration.
- Price-in the externalities of products.
- Shorten supply chains.

Deforestation

- Change diets and stop felling forestry for agriculture.
- Replant forests and establish new forestry.
- Move to a zero-waste economy and deconsumerise.

Soil degradation

- Move to a system of agroecology.
- Move to a zero-waste economy with composting.
- Change diets.

These are the generic sets of approaches to dealing with environmental crises and it is these which the Common Home Plan has tailored and adapted to Scotland.

Approach and delivery

In converting general approaches into Scotland-specific ones a number of guiding principles have been used and it

is helpful to understand these. The first is the question of how the world's crises are best met. Many people will be familiar with the argument that since the crises are global, the solution must be global. This has been a reason for inaction and there is little evidence that serious multilateral international progress is being made or is likely to be made soon.

There is something else about this argument which needs to be challenged: the impacts of human action are global, but the vast majority of those actions are local. Housing is a major factor, and this is a local issue not a global one. The same is true of energy generation, most transport, agricultural production, packaging regulation, consumption and retail and so on. In these areas the relevant policy-making body is national government and there is nothing preventing immediate action being taken. The failure to take action is a political issue, not a problem of technology; agreeing this internationally may be a good thing to do, but it is in no way sufficient to deal with the problem. It is hard to escape the conclusion that the call for multilateralism is an excuse to delay action for political reasons. By breaking down the various activities which need to change and analysing each one it quickly becomes clear very little of what a Green New Deal requires is contingent on international agreement.

The arguments against domestic action come down to 'but free markets will simply undermine any nation which does the right thing so unless we all do it at once virtuous nations will be punished'. This in itself is hard to stack up – most of Europe has much better housing standards than the UK and it hasn't resulted in economic failure. And there is a circularity to the argument; international trade agreements which allow 'dumping' of low-quality products onto markets, undercutting products manufactured responsibly, are the reason why some argue that international action is the only solution. So by identifying multilateralism as the problem in this context it is also presented as the solution. Yet there are no meaningful 'green trade' discussions. This has allowed responsibility to be passed around in a circle without it finally landing anywhere.

So the Common Home Plan seeks to take responsibility, to identify what can be done domestically and to argue that it

must be done. This does not mean there are no international issues to solve – free trade remains a problem for radically reducing the use of plastic and for supporting a proper organic food system. Some can't yet be solved – international travel is an issue since there is no solution to fast international transport which doesn't involve burning hydrocarbons. And obviously if large carbon-emitting nations don't do their part then everyone will be exposed to the impacts of climate change, pollution and resource loss. All these issues are considered throughout the Common Home Plan but we cannot allow them to become a reason for inaction.

The next guiding principle is that, just as the crises cannot be averted only through individual action, they can't be resolved through market forces alone. The next step on from the idea that individuals could solve this problem is to believe that if only we made tweaks to the global market system then that system could deliver the change needed. This is a very pervasive view and it underpins even some of the better thinking about how to mitigate problems such as climate change. This mindset believes that the key is setting the price for an activity or product and to put in place the right subsidy regime and then allow the market to respond and deliver the change. This is a deeply flawed mindset and the strategy will not be a success.

There are a number of reasons for this. First of all, there are simply more market drivers to encourage the key players (mostly big business and big finance) to do the wrong thing rather than the right thing. Fundamentally it is the pursuit of profit which has caused many of the problems in the first place and while profit will of course continue to have a role in a post-Green New Deal world, it will not drive the provision of power, transport, heating or land management. The economic theory known as Foundational Economics states much more clearly the fundamental elements of infrastructure and service provision without which modern life becomes impossible and shows that these are now and have always been better provided collectively rather than through a market system. This applies greatly to the tasks involved in the Common Home Plan.

Another reason the market approach will not work is that it simply isn't possible to price effectively all the market activities that are needed to avert environmental crises and this is why even free market advocates expect there to be a substantial subsidy regime. Put simply, there is no market pricing option which will come anywhere near close to building a District Heating System – even with subsidies. The same applies to most other green solutions – the market has had the opportunity to implement electric vehicle charging and simply hasn't responded, the market will not build large-scale hydrogen production unless the public sector underwrites it, and so on. In reality, the market-based approach is simply to say 'this is really a large public works project but corporations would like to profit from and control it'. It should be rejected on this basis alone as the inefficiency of existing private delivery of public infrastructure demonstrates (most notoriously the PFI scandals). This does not mean there are no market-based interventions which are needed, but those are about correcting negative market behaviours in areas outside the foundational economy (in particular 'pricing-in' externality costs, discussed in the Trade section below).

There is a final reason for the principle of not basing the transition on market approaches, which is that a Green New Deal is not the same as simply mitigating climate change. Rather, a Green New Deal is about tackling environmental threats but doing it in a way that also tackles social problems like poverty. If the scale of investment called for by the Common Home Plan was distributed through a market-pricing-and-subsidy regime, the outcome would be greater and greater inequality while the aim should be the opposite. To take an example, Scotland has the most concentrated pattern of land ownership in the developed world and if those land owners had been interested in developing an effective timber industry they could have done it long ago. But the Common Home Plan absolutely requires a large and effective timber industry in Scotland and must invest to deliver it. But if that investment went to existing land owners in the form of subsidies and then they were also able to own the resultant industry it would make an extremely wealthy and powerful people even more wealthy and more powerful, all using money from the taxpayer.

Another problem is who pays. One of the arguments that is used in favour of a market-led approach is that it appears to make the public investment needed look smaller. For example, a market-led approach would see electricity subsidies set to encourage renewable generation which would then be installed and owned by private businesses. The level of the subsidies would be less than the capital cost of the new generation infrastructure so would look cost effective. What this disguises is that the remainder of the costs and a substantial additional profit margin will simply be passed on to the consumer. Where electricity infrastructure could be built by the public sector very efficiently and paid for through low-cost borrowing paid back by progressive taxes, instead entirely non-progressive rises in electricity prices would impact negatively on people at the lower end of the income spectrum and increase fuel poverty.

For all of these reasons a market-led approach should be rejected entirely and instead a public planning-led approach should be used. This will work out cheaper, more efficient and much more equitable over the period of the Common Home Plan. This can be seen throughout the report where we count capital expenditure rather than notional market prices for the outputs of that capital expenditure.

The second guiding principle is that the time for setting targets was passed a long time ago. This has been another approach which has prevented progress, emphasising what it would be good to achieve but not how to achieve it. The Common Home Plan is undoubtedly driven by the science presented by the International Panel on Climate Change and while its descriptions of tipping points are compelling and indicate the urgency, they can only be tackled through action and that action will take the time it takes rather than be geared to desirable timescales. This means that some things can be achieved very quickly while others simply cannot. It may be desirable to have an entirely agroecology system of agriculture within a few years but it can't be achieved that quickly no matter how much we want it to be. Similarly there is no fast option for delivering carbon-free heating – the holes need to be dug, the pipes laid, the solar farms built and so on.

More than this, developing the Common Home Plan has involved an enormous amount of detailed analysis of bottlenecks in the transition and has addressed how to deal with those bottlenecks. But that does not mean it is even nearly possible to create a realistic or meaningful timetable for the work. To take the example of heating again, if a District Heating System is to be standard throughout Scotland every town, city and village will need a ring main installed. The complexity of doing this will be different in each location and until surveying and planning is done the depth of the complexity can't be known. And since each aspect of the work is dependent on preceding aspects of the work (you can't plan the sub-grids until you know where the ring main is) it makes a meaningful installation timetable unrealistic. This doesn't mean nothing can be stated about rate of progress; the report estimates how many houses can be fitted per year by a given workforce. But when it can start will depend on assembling that workforce and on how quickly planning and surveying can be completed.

However even a cursory glance at the work involved will make one thing clear; this isn't going to be completed in five years, or ten, or even 15. Estimating which tasks will take the longest time suggests that completing absolutely everything would not be possible in less than 25 years but that almost everything should be achievable in that time period. This is not intended to undermine any sense of urgency but quite the opposite – it is to show just how risky it will be to delay starting on this work. And nor is it to suggest that we can't make fast progress because while doing everything will take 25 years and while preparatory work will be needed before most things can be started in earnest, that does not mean the work will be phased evenly over the 25 years and, once properly started, some things can be completed much faster than this.

This raises another guiding principle – you don't do this kind of thing twice. The scale of investment is so large that it must deliver value not just for one generation or two, but for many future generations. There are a number of places in the report where it might be possible to propose an interim solution or a 'quick fix', but these in themselves would not be cheap and

they would soon need to be upgraded or replaced, meaning the cost and disruption would happen all over again. Throughout the report solutions have been selected to be stable, efficient, long-term and (as far as possible) future-proofed. There are aspects of the Plan where people may propose alternative approaches, such as starting to decarbonise heating by introducing a hydrogen-natural gas mix for domestic heating. That will work up until the point where the mix is 80 per cent natural gas and 20 per cent hydrogen, and achieving that would take perhaps ten years. But this is more or less as far as it can go because you can't increase the proportion of hydrogen much further than that, so in ten years we would need to start all over again.

So everything in the Common Home Plan is designed for the long term. This raises some other opportunities which may also be worth considering. For example, if trenches are to be dug to every house in Scotland and pipes are to be fitted, it might provide a once-in-many-generations opportunity to upgrade service infrastructure in other ways. Perhaps an 'integrated service grid' could be built, bringing all services (electricity, heating, data including phones and 5G, water and sewage/waste removal) into one coherent grid. This could greatly modernise Scotland's access to utility services and future-proof them by making them easy to access and upgrade. It is unlikely public works of this scale will be attempted again for many decades. However the Common Home Plan is already long and detailed so where an option fell into the category of 'potential but not essential' it has been left out.

Finally, another guiding principle is that the Common Home Plan must also be a once-in-many-generations fix for persistent social problems in Scotland, particularly poverty. However there is a caveat to this; Common Weal has a wide body of policy work on how to reduce poverty and make Scotland a more equitable, democratically-engaged nation. It would have been easy to include a lot of that material in this report, or to develop more (such as 'job guarantee schemes' which have been discussed as a potential part of other Green New Deals). But care has been taken here not to shoehorn in social policies which are complimentary but not central to the Common Home

Plan. This is in no way to suggest that the Common Home Plan alone is enough to tackle Scotland's social issues because it isn't. We can, however, make clear that this will carry the weight of tackling the biggest aspects of those problems.

Above all this will transition Scotland away from a linear, extractive economy to a circular, participatory economy. This will have two crucial impacts. First, it will act as a major intervention in the labour market creating many new jobs which are skilled and well paid while at the same time resulting in a transition away from lower-skilled, lower-paid work. This above all will provide a major response to poverty, and the economic stimulus effect of this spending will mean that a lack of people to fill well-paid jobs will be a bigger problem than finding good jobs for people. And second, it will move us away from an economy based on retail, which is an economy which transfers wealth from individuals to large corporations. It would result in an economy which is much more like the 'Local Wealth Building' model in which more wealth is retained and circulated round the domestic economy and much less of it is exported in the form of corporate profits. This in itself will have a powerful impact on reversing the growth of inequality. However, we still require a full raft of effective social, democratic and economic reforms to take place at the same time if we are to achieve anything like the maximum possible impact from the Common Home Plan investment.

Finally, a guiding principle is that, because this is a collective task and because it will serve many generations to come, the cost should be met through low-cost public borrowing paid back through progressive taxation. As this will serve multiple generations and need not be done twice, the cost should be shared across generations as well. So it is assumed that the costs of the plan should be spread over 50 years.

Cost and impact

It is important not to underestimate the level of investment that will be required to enact the Common Home Plan. But it is equally important not to underestimate the cost to be borne

by any nation transitioning away from an economy based on fossil fuels, constantly expanding consumption and intensive agriculture. There simply isn't an inexpensive way to do it, so the question is 'do it well' or 'do it badly'. And it is also important not to underestimate the consequences of not making the investment.

As has already been stated, climate change may only be the third or fourth in the queue of threats to our way of life. It is coming, inexorably and unavoidably, but before the worst of its impacts arrive we may already have faced food shortages resulting from the collapse of pollinators, or as a result of running out of the phosphates used in fertiliser, or because of the denudation of water resources in places from which we import our food. Another threat is that, rather than plan sensibly to move ourselves away from a reliance on rapidly-depleting resources, instead nations gear up to try and secure what is left for themselves. Resource-based global conflict or mass conflict caused by the mass migration of populations escaping severe climate impacts is a real threat.

The expression 'extinction' is used a lot in relation to the environmental crises, but at least for humans this may be rather inaccurate. Humankind survived an ice age and, in some form or other, is likely to survive the impact of these environmental crises. What is at direct threat is human civilisation as we have come to know it; it is absolutely not an overstatement to say that the structures of modern urban living are built on ecosystems that would need to fail in only comparatively isolated ways to put lifestyles as we currently know them at very severe risk. Those who worry about the cost of tackling the climate and other emergencies must be clear about the price to be paid if we don't.

So what is the scale of the investment needed? The following table summarises all the costs identified throughout the Common Home Plan. To avoid the risk of understating those costs they have been rounded up rather than down and where there was either a range of possible costs or the costs were being estimated the figure selected represented the higher end of the options.

Task	Cost (£bn)
Improving thermal efficiency of existing housing stock	40
Upgrading thermal efficiency of public buildings	5
Support for small and medium businesses in improving thermal performance of their buildings	3
District heating ring main	9
District heating ring main to house (including boiler replacement)	25
Thermal generation and heat store to heat ring main	17
Installation of new renewable energy capacity	21
Nationalisation of existing energy capacity	10
Upgrade electricity grid and install local battery storage	4
Build electrolysis plants and hydrogen storage	10
Invest in zero-carbon travel including charging and refuelling infrastructure	10
Invest in new food distribution systems, supply-chain shortening, novel food production and import substitution	1
Establish a National Resources Agency and invest in transition to a circular economy	1
Invest in a transformation of land practices	10
Workforce training, retraining and business transformation	1
Industrial strategy	2
Create a research and development hub for the entire project	1
Total	170

For many people a headline figure of £170bn will be sobering, possibly even alarming. But it is important to put this into perspective. First, as an order of scale, this is less than double Scotland's contribution to the cost of the 2009 bailout of the UK financial system. If the money for that level of investment could be found in a single year it makes clear that finding the same amount again plus a bit more over the course of 25 years is perfectly possible. Taking a slightly longer timeframe, these costs are small in comparison to the post-war reconstruction project and that work was paid for and completed in a period of less than 25 years. Not far from a third of this total is required to move to a zero-carbon system of electricity alone and no-one serious is challenging the need to make that move. We must accept the need, put the level of the cost into perspective and begin exploring the ways in which we pay for it.

The first thing to say about this is that it is being paid over 50 years. The Scottish Government implementing this Plan would issue bonds at various points during the course of the 25 years (bonds are an inexpensive way for governments to borrow money) and gradually repay them over the 50-year period. The staging of these bond issues will depend on when specific elements of investment are needed and so in reality some of the late-term spending might actually end up being paid off over a period longer than 50 years. But for ease of calculation let's assume that the whole sum was borrowed on day one and paid off. Current UK Bond Yields is 1.75 per cent. To be conservative, if a Scottish Bond Yield of 2.25 per cent was assumed then the interest costs of servicing those bonds would be about £1.85bn each year. As we will see, this is overtaken by additional revenue generated as a result of the investment. If the aim was to pay not only the interest but all the capital off during the 50 years the annual cost would be about £5bn. Because of the way inflation erodes prices the real-world debt costs will be constantly declining over this period.

However, that is only the beginning of the picture. While the up-front investment is £170bn, that investment creates a number of entirely new revenue streams which need to be factored in. As an example, this model would create an entirely

publicly-owned energy system in Scotland (for both electricity and heating). All the revenue from the sale of electricity and heating to customers in Scotland would become public income and since all the capital costs are included in the investment above it would all be available to spend. To give an estimate of this the average energy bill in Scotland is over £1000 a year and there are 2.5 million households in Scotland. That would create a revenue stream in the order of £2.5 billion every year, or half of the total annual repayment cost. There are other big opportunities of a similar nature. The revenue which would be derived from the scale of the investment in forestry will also be substantial and at least a proportion of this will be publicly owned. Another substantial revenue stream would be hydrogen; while most of the investment in hydrogen generation identified above would be required to meet domestic need, there will be a surplus and the investment made will enable the rapid establishment of a hydrogen export industry. If that industry is publicly-owned (given that the core investment is public) that would create a highly-valuable export industry which would produce a constant revenue stream as was the case in Norway which developed its oil industry largely in public ownership.

Even after the above direct income streams are taken into account there is likely to be some annual cost still to service (if the capital sum is paid off making the annual cost £5bn). But the sheer scale of investment into the Scottish economy resulting from the Common Home Plan would in itself create very large increases in tax revenue simply because of the number of people in good new jobs and the number of Scottish businesses that would see their income rise rapidly as they become part of a crucial supply chain.

Common Weal has done a very loose modelling of these impacts based on the Scottish Government's input/output tables (input/output tables are the basis for all economic impact modelling). The first thing to say about this is that it is very loose for a reason; economic impact modelling is based on the concept of keeping all the other elements of the economy static and then 'shocking' or changing one aspect of the economy, for example to investigate the results of more expenditure on

research and development. The problem with doing this for the Common Home Plan is that very little will remain static – the changes to the economy are just too great to model with any accuracy. Put simply, you can't use a model of the economy we had yesterday to make accurate predictions about an entirely different economy in the future.

However it is still possible to draw some conclusions. If the total level of expenditure involved in the Common Home Plan is fed into the current model and some basic assumptions are made about the split of the expenditure over different economy sectors the outcome is a cumulative increase over the 25 years of 965,000 'job years' and a total increase in direct public revenue of £48bn. This represents direct impacts of about 40,000 jobs a year and additional annual public income of close to £2bn. The jobs total is an underestimate since 40,000 is close to the number of direct new jobs identified as part of the spending and there will be more directly-created jobs than that number. And this is only the direct effects – the secondary effects are equally large. In total it is not unlikely that this investment would create 100,000 new well-paid jobs and increase public revenue by £4bn a year. At that point Scotland could pay off these costs with the additional revenue from tax and energy sales income alone – and still cut the cost of energy in more than half for customers. It should be noted that there are some other changes in the economy which will work in the other direction, particularly a decrease in the retail economy. But the numbers above include the jobs and revenue assumptions for the oil and gas sector in the model being set at zero and that still produces these large additional sums of income.

This is before any more creative approaches have been taken. A large amount could be raised by issuing public saving bonds rather than issuing bonds to international investors. It is also possible to 'write off' some of the debt or cover some of the costs through uses of non-standard techniques such as Quantitative Easing. This was used to create some of the bank bailout in 2009 and modern approaches to monetary theory are much more relaxed about writing off parts of long-term debt

than classical theories were (though this only applies to debts held in a domestic currency such as saving bonds).

The purpose of this modelling is not to make any claims about an accurate prediction of the impact of the investment required by the Common Home Plan but simply to show that the cost of the investment will be more than recovered from those impacts – over the 50 year period the Common Home Plan will more than pay for itself.

It remains only to emphasise that revenue is only one of the positive impacts of the plan. Our homes will be both warmer and cheaper to heat. Our food will be healthier and tastier. Our travel will be faster and more efficient. Our electricity will be plentiful and reliable. Our land will be both beautiful and productive. Our jobs will be better paid and more rewarding. Our quality of life will increase and our mental health improve. Our status as a global centre of learning and discovery will be reinforced. And our international reputation will be enormously enhanced. These are only some of the positive impacts that will take place. The challenges of a Green New Deal are often presented in terms of pain and sacrifice. This is entirely misleading. Rather, they offer the opportunity for greater happiness and contentedness, an end to poverty and a meaningful and observable increase in our wellbeing.

Buildings

New builds

All new buildings should be constructed with very high levels of operational thermal performance (they should be built to leak very little heat). To do this building standards must quickly be upgraded. Many people are familiar with the 'Passivhaus' standard: this is sometimes used as a shorthand for 'energy neutral' houses (which produce as much energy as they consume in heating). However, Passivhaus standards have been widely criticised for focussing too much on operational energy performance and not taking into account 'embedded carbon' – the environmental impact of the building materials and construction. A 'passivhaus' is required to be wrapped in a plastic membrane and have a mechanical ventilation system installed, and can contain many unhealthy and harmful materials such as steel, concrete and plastic. The Passivhaus standard is based on achieving a space heating performance of 15 kWh/m²/yr (each square meter of a house will require no more than 15 kWh of heat per year) and this should be the sort of thermal performance of all new-build houses and other buildings in Scotland. However, this be achieved in other ways, using almost exclusively healthy and organic materials most of which can be sourced in Scotland (see Construction below).

As soon as the Common Home Plan is agreed, all new houses must be ready for district heating – unless they are 'Energy Neutral' so require no net heating. All new housing developments must include the infrastructure for district heating, even if a primary ring main is not yet available in that area (see Heating). New-build houses which are off the future heating grid must be built with renewable heating systems installed.

One of the best ways to reduce the embedded carbon of a building is to ensure it has a long lifespan. Many of today's buildings are built to low quality standards and have a short planned lifecycle – they will be knocked down and the land redeveloped in the near future. This is incredibly harmful and no buildings should be designed with anything less than a 60-year projected lifecycle (and most should aim for 100 years and more). In addition, new-build activity should be

reduced altogether through a strategy of 'repair and renovate first' – existing buildings have already embedded the carbon of construction, so unless there are very specific reasons should always be renovated rather than demolished. Where demolition is unavoidable materials should be recycled.

Achieving this will require three major areas of action. One is regulation – all of the above requirements must be impelled by law. The second is developing domestic supply chains. This will require investment in forestry and wood processing facilities (see Land) and in recycling plants (see Resources). The third is training (see Learning) to support the construction industry in adapting and in learning new building techniques.

Existing housing stock

There are approximately 2.5 million households in Scotland at varying degrees of energy efficiency and with a wide range of technical issues to be addressed. Achieving maximal thermal performance is likely to be unachievable in many houses and in many where it might be technically achievable, getting the last ten per cent or so of efficiency may be so expensive as to be prohibitive. The 'PassivHaus' equivalent standard for existing homes is known as 'EnerPHit'. It assumes a thermal performance of 25 kWh/m²/yr, an 85 per cent reduction in current average heating requirement – and where this is achievable it is certainly desirable. Also, if zero-carbon heating infrastructure is in place (see Heating), the need to achieve that last ten per cent of efficiency is not so tightly constrained by the cost involved. A target of between 70 – 90 per cent efficiency should therefore be set, with most houses aiming to achieve the higher end of that scale.

In most cases this will involve little more than basic installations. One of the major problems is insufficient insulation in the loft and this should be the first priority. After that, 40 per cent of heat loss is through draughts and draught-proofing should be the second priority. Less heat is lost directly through walls (other than through draughts) but in some cases it may be worth installing cavity wall insulation. Replacing all single

glazing and repairing old window frames and some electrical replacements such as changing any non-LED lighting would also be effective in the vast majority of houses. Together, these strategies could meet the target energy efficiency.

By looking at similar installations, we know that a team of ten people can complete about 100 houses in a year. Central planning and project management must be added to total work-hours, but the efficiencies of scale of doing this at a national level means that completing a target 60,000 installations a year in the early years would be achieved with a workforce of approximately 6,000 people. Roughly ten per cent of these jobs would be at managerial and senior technical level, about 30 per cent at skilled trades level (particularly joiners and electricians) and the remainder semi-skilled (trained on installation of insulation and draught-proofing).

The input materials would primarily be insulation materials and various tapes and membranes for draught-proofing. The insulation materials should overwhelmingly be wood-based such as fibreboard or spray cellulose and given the scale and time commitment supply chains must be developed which allow the vast bulk of manufacturing to take place in Scotland since these are bulky materials to transport. Existing Scottish companies also have the capacity to produce tapes and membranes. It is difficult to assess the amount of glass and other materials required but the scale of purchase would give Scotland a strong hand during procurement.

The cost per building will vary greatly depending on current energy efficiency performance and the nature of the construction of the building. An average of about £15,000 per property is a fairly reliable guide estimate. The total cost for Scotland would therefore be around £35bn – £40bn.

This cannot be dealt with on a market-pricing basis and so must be centrally funded, planned and delivered, and it must be coordinated very closely with the installation of zero-carbon heating (see Heating). A National Housing Company must be set up to undertake this work. Supply of skilled labour will be a major issue in the early years, and extensive training of a new skilled workforce must also be a priority.

Public buildings

Public buildings vary from ancient and historic buildings to recent modern construction. There is a substantial limit to what can be done with ancient and historic buildings (even if regulations on modifications to listed buildings are adapted to more easily allow for energy efficiency upgrades), but the public sector should aim to have all modern buildings become net exporters of energy through investment in thermal performance, the installation of energy-generating capacity (particularly solar and biomass) and the replacement of low-efficiency energy-consuming devices with more efficient alternatives. It will take time to achieve this and it is very difficult to estimate the total cost because of the diversity in size and types of building. A requirement that all new public buildings conform to these standards must be developed, and public bodies must develop concrete plans with clear timescales for upgrading existing buildings. The cost of achieving this should not reduce the investment in public services and so should be supported from a central fund. Although the cost is hard to predict accurately, it's reasonable to assume that costs will not exceed ten billion.

Commercial buildings and private landlords

All citizens should have the right to have one primary household upgraded through public spending as above (with care taken that people who cohabit do not 'game the system' to get second homes upgraded). The required upgrade standards for a second home will be the same, but it will be for a householder to meet that cost. This will include landlords and other commercial renters. Generally, the same will be true of the private sector – they will be required, within a clear timescale, to meet the same standards and this will not be publicly funded. However, small businesses (and in some circumstances, some landlords) will need financial support to achieve this. Discussion with the private sector on establishing a regime fair to all should begin

immediately after the Common Home Plan is agreed.

The National Housing Company, which will be upgrading domestic homes (as above) should offer competitive prices to the private sector to undertake the work at the same time that domestic properties in the area are being completed, and the support for small businesses might come through discounting of this service.

The future of construction

Housing must be built to minimise its negative environmental effects and maximise its positive impacts. This will require that Scotland focuses on renewable, biodegradable construction materials which are wood-based where possible. This is increasingly possible through a range of new manufacturing processes that engineer wood for structural purposes which used to require steel. This is known as 'mass timber': construction materials made from multiple layers of timber joined to form panels and beams. There are a number of techniques for producing structural timber products:

- Glue Laminated Timber (Glulam) is made by bonding together layers of timber with structural adhesives under high pressure, to produce powerful beams and other components.
- Cross Laminated Timber (CLT) is manufactured from lower grade timber off-cuts made into thin strips which are layered with the grain running in opposite directions, then glued under high pressure to produce panels.
- Laminated Veneer Lumber (LVL) is similar, manufactured from thin, peeled veneers of wood, usually 3mm thick and glued with structural adhesive giving them high strength and rigidity.
- Dowel Laminated Timber (Dowel-Lam or Brettstapel) is fabricated from planks of softwood timber stacked and then connected under pressure with dowels, enabling lower grade timber to be formed into load-bearing panels.

- Nail Laminated Timber (NLT) is similar to Dowel-Lam but with nails rather than dowels connecting the timber planks.

There are very few construction applications in Scotland which cannot be built using wood as the primary or only structural material. Currently the highest building in the world to be manufactured solely from structural wood is 16 stories high and others are in planning which will be much taller than this. Certainly domestic housing can easily be built using only organic materials. There is a wide range of other materials and approaches which can be used to take non-renewable materials out of the construction process which has the triple impact of reducing non-degradable materials in the environment, improving the health effects of buildings (where residents will no longer be exposed to the chemicals which are used in current building practices) and move from a carbon-negative construction process (where construction materials emit carbon) to a carbon-positive one (where they lock-in carbon they have already absorbed).

Where that is not possible we should first use materials which are either recycled (concrete, metals and plastics can all be recovered and recycled) or have a low environmental impact in production. The use of environmentally damaging virgin materials like first-use plastic and concrete should only be permitted when biodegradable or recycled materials are not available and should be phased out wherever possible.

Achieving all of this will require changes to building regulations, the establishment and expansion of domestic supply chains of alternative materials (especially mass timber and timber-based insulation products) and may also require pricing mechanisms which disincentivise the use of non-renewable materials, particularly those that emit large amounts of carbon in their production (for further discussion of pricing mechanisms see Trade).

Regulation of electrical goods

All electrical goods installed in new build housing must be AAA rated for electrical efficiency. An ambitious timetable must be set for requiring that all electrical goods purchased in Scotland must also conform to AAA standard.

Making this happen

- Change building regulations to require all new-build houses to be energy-neutral and have a minimum 60-year lifespan
- Establish a policy of renovation rather than demolition
- Set up a National Housing Company to retrofit all existing houses to achieve 70 – 90 per cent thermal efficiency
- Change building regulations and invest in domestic supply chains to make almost all new construction materials in Scotland either organic or recycled
- Retrofit all public buildings to become energy positive
- Require all private businesses to achieve 70 – 90 per cent thermal efficiency but provide subsidies for small businesses
- Require all electrical goods to achieve AAA efficiency ratings

Heating

03

The challenge for heating is to make all heating zero-carbon and to make sure that heat loss is reduced as far as possible in both domestic and commercial buildings – while ensuring that heating bills for households remain affordable.

Heat generation options

Zero-carbon heating is difficult to achieve because of the nature of our existing heating infrastructure. Currently 90 per cent of Scotland's heating is natural gas, four per cent is electric and six per cent is renewable; this is the highest proportion of non-renewable heating in Europe. To understand the complexity of the problem it is important to appreciate the range of potential renewable heat generation options:

- Electricity can provide both space and water heating using existing infrastructure and modern electric radiators have become increasingly efficient.
- Solar thermal uses solar panels to extract heat from the sun and are around 70 per cent more efficient at extracting solar energy than solar photovoltaic (solar PV) panels which produce electricity.
- Geothermal and heat recovery are forms of heat generation which take often small amounts of heat out of the ground, bodies of water, geological formations of rock or geological features like redundant mine works – and then concentrate the heat to make it useable.
- Heat pumps are smaller-scaled forms of heat recovery similar to geothermal, with ground source heat pumps extracting heat from the ground (below the frost line) and air source heat pumps extracting heat from the air.
- Industrial heat recovery is where big energy users such as industrial plants which produce large amounts of heat waste are designed or retrofitted to allow that heat waste to be captured and used.
- Waste incineration produces heat (or combined heat and power where electricity is also produced) by incinerating household and commercial waste.
- Biomass refers mostly to wood fuels which are used to produce heat, although some other organic materials can also be used.
- Biofuels refers to a range of fuels which are made through biological processes such as methane derived from

- aerobic digestion of sewage and other compostable waste, or bioLPG made from organic matter.
- Hydrogen gas which contains a lot of heat energy (at least twice as much as natural gas) and can be burned with the only outputs being heat and water.

So, with such a wide range of options for heat generation, why is decarbonising heating so problematic? The answer is that each of these options has substantial problems and limitations. For many people moving to electric heating is the obvious solution because it mainly uses existing infrastructure – but this is not straightforward. First, for an efficient system it is likely that most houses would need to shift from a 'wet' heating system to an electric radiator system, meaning that all existing radiators and the pipework that serves them would need to be removed and replaced in every house (electric water heating with existing systems could be used but would need more electricity and so be more expensive to run). But the bigger problem is the impact on the electricity grid. Moving to all-electric heating would roughly double the load on the grid (see Heat Budgets) which would require significant upgrades to cope with this.

But the problem is exacerbated because the use of heating is not even across the day and coincides with other peak energy use periods. For example, currently there is a morning spike in electricity usage as people put on kettles, toasters and hairdryers in the morning. This would also be the time when central heating is switching on in many houses and when people are taking showers (direct electric water heating is very energy-intensive). Rather than the equivalent of switching on a kettle in each house, this could be equal to switching on six kettles. The grid does not like large spikes in energy use because it creates significant instability and can cause the grid to fail. So while the average load would double if moved to an electric heating system, the peak load might increase by a factor of five. Very significant investment would be needed in the grid to ensure it would be robust enough to remain stable in these circumstances. And while better-insulated houses would reduce this problem (see Heating Budget), much of the spike in heat load would come

from water heating for showers and this is not reduced through house efficiency measures.

There are two additional problems with electricity. The first is fairly obvious; we would need to invest heavily in new electricity generation to meet heating requirements. We will already need to increase the overall generation capacity in Scotland substantially just to decarbonise existing electricity and to meet the need of decarbonising transport. Installing enough additional generating capacity (mainly onshore and offshore wind – see Electricity) to meet this demand would simply add to the scale of the challenge. Finally, electricity is an expensive way to produce heat and, even using modern efficient systems, could lead to a threefold increase in household heating bills.

One of the standard responses to this is to propose that heat pumps be installed as part of the process to reduce load and demand. This is problematic; ground source heat pumps are indeed effective and efficient, but they require a substantial land area, are difficult to retrofit and are almost impossible to install in urban areas. They remain a valuable option for new build houses in rural areas or with a reasonable amount of garden space but don't provide a solution for existing buildings. Air source heat pumps are promoted by many, but serious caution is necessary because of their limited functionality. They are ungainly to fit and require a substantial amount of installation, but do not produce much if any useable heat at peak periods of the year (and are not particularly good at heating water unless large storage tanks are fitted). Put simply, there simply isn't enough heat in the air in Scotland for much of the year to extract in a useful manner and so they must be topped up by electricity, effectively making them an expensive all-electric heating solution for many months. They give the illusion that renewable heating at the household level is feasible and so imply a market solution is possible where each householder simply needs to fit a heat pump. This should be rejected as a widespread solution.

The next solution often proposed is to use hydrogen. Again, the attraction here is that it appears to be deployable using existing infrastructure because hydrogen can (in theory) be distributed via the existing gas grid and then used in existing

heating systems. But this is much more problematic than it seems. First, hydrogen has the smallest atomic size of any element and would simply leak from many parts of the existing gas grid (especially at joins and junctions but even straight through some of the pipes). It is highly flammable and has no natural scent so as well as being inefficient this could be dangerous. Hydrogen also reacts with metals in ways which make them brittle and prone to failure.

Then there are switch-over problems. While hydrogen can be used like natural gas, it requires a different type of boiler and so all household boilers would need to be replaced. But hydrogen cannot be 'phased in' so there needs to be a switchover point, which means all the new boilers would need to be dual fuel boilers enabling them to burn both natural gas and hydrogen, even though they may only use natural gas for a very short period of time. Since clean hydrogen is produced from electricity a hydrogen system would create the same problems of scaling-up electricity generation as an all-electric system, but current production processes are not at eventual efficiency so even more generation would be required. Finally (and crucially), hydrogen is currently very expensive and could increase household heating bills by a factor of seven or eight. Even as the technology progresses and prices come down, hydrogen will always be an expensive way to heat a house.

Which leaves the remaining renewable options. Biofuels will play an important part in rural off-grid heating but they require very large amounts of organic materials and so simply can't be produced on anything like the scale needed to replace natural gas. Similarly biomass will play an important part in heating but is bulky and difficult to transport; there are more important uses for timber crops and biomass boilers are bulky and not suitable for most homes (plus air pollution issues make widespread use of biomass undesirable in dense urban areas).

Waste incineration cannot be relied on as a fuel source for the very simple reason that we must take steps to eradicate waste altogether (see Resources); countries which invested in waste incineration in the 1990s and 2000s are already running

out of waste to burn and are reliant on importing waste from other countries, a clearly unsustainable option.

Which leaves options such as solar thermal, geothermal and industrial heat recovery. These are all very efficient, cheap and comparatively plentiful sources of renewable heat (or heat from waste heat recovery) but they all have one problem (which they share with waste incineration) – delivery. In these cases the heat generated needs a method of delivery to households. Solar thermal is the only option which can be fitted at an individual house level and only where there is south-facing roof space and the ability to install large heat storage tanks. Even then there is the problem of seasonal availability; solar thermal is obviously best at producing heat in the summer when it is least needed, so would need some form of inter seasonal heat store. Even then, it is unlikely that solar thermal could produce more than about half of the heating requirement for an individual house. The other two options are site-specific and so can only be used if there is a method of distributing the heat from its generation (either at industrial sites or geological features such as disused mines) to the households where it is used.

So there is simply no easy solution to decarbonising heating; all will involve expensive infrastructure investment and require substantial disruption. A heating system based on electricity and hydrogen would be unstable, expensive for the consumer and have substantial deployment costs. The Common Home Plan strongly argues that if this level of disruption and investment is to occur then it should aim to produce the best, longest-lasting, least expensive and most stable heating system possible.

A District Heating System is a distributed heating system based on a basket of different heating options. This is unlikely to be viable for remote households (current connection to the gas grid is a reasonable indicator) and these are considered separately below. There may be some existing houses which for technical reasons would not easily be connectable to a District Heating System, but the Common Home Plan proposes a clear hierarchy. The first option is District Heating (or a biofuel and biomass system for off-grid houses), then hydrogen for any houses where it is feasible, then electric for any remaining houses.

However there must be a substantial threshold of difficulty before any individual house is 'moved down' this hierarchy and some system of balancing or compensating these households for the high cost of their heating will be necessary.

Installing a District Heating System

District Heating Systems are methods of distributing heat through a heating grid. Installing a District Heating System involves creating a ring main carrying very hot water in highly-insulated pipes round the area being served, which is then fed by heat-generating plants at any point round its circumference. Sub-grids (perhaps the size of ten or 15 city blocks in scale) then distribute the hot water directly to homes. In the house the hot water pipe is connected to a heat exchanger (replacing the existing boiler) which extracts the heat needed from the grid and uses it to feed the existing household heating system. While the disruption of installing the grid is clearly substantial, the disruption within the house is minimal. It may also be worth installing house-level heat storage in the form of phase-shift heat stores ('heat batteries'). This is not a new technology – there are still-functioning systems 100 years old and Denmark already has more than 60 per cent of houses connected to district heating and is working to increase that to 75 per cent.

The scale of this task is clearly very substantial – trenches will need to be dug and pipes installed to every (urban) house in the country and a large ring main has to be installed in every town and city. However since all options for decarbonising heat are expensive and disruptive it is helpful to focus on the quality of the outcome. The oldest existing District Heating System has been functioning for over 100 years, and the heating infrastructure proposed in the Common Home Plan can be expected to last for centuries. It is the only future-proofed option, because if new heat-generating technologies emerge in the future they can simply be 'plugged in' to the ring main and so feed the existing system. Finally, a District Heating System provides by far the least expensive heating bills for households of any of the options and, depending on the mix of heat sources used, might even work out cheaper than natural gas.

It is often assumed that District Heating Schemes are entirely impractical for rural areas, but this isn't the case. Feasibility has been done on a District Heating System which distributes the heat over 140km and estimates that it will lose no more than ten per cent of its heat over that distance. And while the distances in rural areas are clearly greater, installation is much easier. Existing case studies suggest that many rural households can be put on a district heating grid at not much more cost per household than urban households (though many off-gas-grid homes may be infeasible to connect).

The cost of installation from a district heating ring-main to each house, including provision of a heat exchanger and some house-level heat store, is about £10,000 per household if done at scale, based on the cost of large-scale retrofitted installations which have taken place in other countries. This number is only slightly higher for rural areas, where despite longer distances there is greater ease of installation. But this number does not include the construction of the ring main or the cost of the heat-generating facilities which must be financed as well (see below). Following the model set out in Buildings above it is estimated that a team of ten people could fit about 120 houses a year, meaning that a total workforce of 5,000 would be required to install an initial 60,000 houses annually. Converting all of Scotland's housing stock would therefore cost approximately £26bn. To complete this in under 25 years the rate of house conversions must be quickly doubled. The main constraint will be available skilled labour force, so it will take some time to train and develop the numbers required.

The breakdown of the workforce would be similar to that required for housing retrofit – about ten per cent management and senior technical, about 30 per cent skilled trades (mainly plumbers and electricians) and about 60 per cent semi-skilled (laying pipework etc.). The materials required are primarily piping which can be sourced domestically if the supply chains to the North Sea oil industry are diversified, and heat exchangers and heat stores (both of which are currently manufactured in Scotland although production would need to be scaled up significantly).

Installation of ring main

The installation of the ring main is both comparatively routine and very complex. It is routine in that it is little more than a large, circular pipe buried in the ground around the circumference of a town or city. It is highly complex in that installation for any given location will require substantial surveying and planning. This means that in many built up locations it may well need to follow existing road networks which will be highly disruptive. In cities, completing a full ring main for the whole city will be complex; a series of large tanks with flow-and-return pipes might be placed at a number of points in the city and support their own sub-grids. However, this may be complicated by the location of heat generation, especially since some of this (such as geothermal or industrial heat recovery) is tied to specific geographies. The tanks feeding the sub-grids may themselves need to be linked to share heat generation. The phasing of the installation of ring mains will depend on the over all project management of the transition but will be done town or city at a time which means the phasing of the expenditure over 25 years will be uneven. The same general workforce will be involved in ring main installation as for installation of subgrids.

For these reasons, calculating a cost for the installation of the ring main component of a district heating system is particularly difficult. Typical prices for installing a district heating system have been examined and show a range of values depending on location and whether or not the system is large or small in scale (the economies of scale are particularly important because the average cost for heating can be as much as 20 times greater in a small-scale project than a large-scale one). Taking average installation costs of ring mains for each unit of heat distributed and multiplying that by the total heat load requirements identified in the next section, the Common Home Plan estimates that the national cost for the ring main component will be about £9 billion (though this is an overestimate because a proportion of that total load will be met by off-grid systems).

Developing a 'heat budget' for Scotland

As of 2017, Scotland uses about 86 Gigawatt hours (GWh) of heating power each year with a mix of about 90 per cent non-renewable, six per cent renewable and about four per cent electrical. We can move to an all-renewable heating system in a number of ways using a variety of mixes of the technologies outlined above. The following is an estimated heating mix designed to indicate the scale of the costs required; inevitably it will change as detailed planning takes place and the specific mix emerges.

The first change to the overall heating load is to reduce demand through a proper programme to improve the thermal efficiency of buildings as set out above in Buildings. This would reduce heating demand by about 40 per cent. The next most efficient step for decarbonising heating is to use solar thermal generation which is comparatively easy to install, uses relatively inexpensive components and produces inexpensive heat. It's biggest limitation is that it is seasonal – it generates most heat in the summer when the demand for heating is at its lowest – and so inter-seasonal heat storage is needed. This is also a basic technology to deploy and involves digging a reservoir, lining it, filling it with gravel and water and then putting an insulating cap over the top. Over the course of the summer heat exchangers take spare heat from the solar thermal panels and use it to heat the water in the reservoir and then over the winter the heat exchangers take the heat back out of the water and use it for the District Heating System.

If about half of the remaining heat demand after insulation is met by solar thermal then it would need to provide about 17 GWh per year worth of heat. This would require between 27 and 31 square kilometres of solar thermal panels across Scotland. There is approximately 25 km² of useable, south facing roof space in Scotland so the entire solar thermal capacity could in theory be deployed without the need for much additional land for large solar thermal arrays. However, the installation of large arrays will be substantially cheaper and more efficient and are therefore desirable. This would also free up roof space for solar photovoltaics (PVs) for generating electricity.

Geothermal will be a significant part of the mix but numbers are uncertain. Geothermal sources can be split into three broad categories; hot dry rock geothermal (drilling into rock formations or 'fracking' them), warm aquifer geothermal (drilling to find large bodies of underground water) and the use of heat recovery from other geological features like abandoned mines. So little data is available on the potential for the first two in Scotland that the Common Home Plan does not include any contribution from these. The use of former mines is much better studied with the total potential for heat extraction being around 2,500 terawatt hours (TWh). If this was extracted at a rate of about 10 per cent of the maximum a year it would produce about 1.2 gigawatts of heat and be reliable for at least 40 years (the effect of the warmth of the earth 'recharging' these is not sufficiently measured so it is not easy to be precise about how long these resources would be viable).

Biomass and biomass with Combined Heat and Power is a good option for Scotland and production of biomass heating will increase. As an illustration, to achieve a five-fold increase in biomass heating capacity would require a maximum of 96,000 hectares of additional productive forest in Scotland (see Land). Other biofuel such as biogas will also be employed but it is less easy to make accurate assessments of how much of the heating load this can provide. The heat budget below has taken a conservative approach and has not allocated a lot of capacity to biomass and biofuels purely because there isn't enough assessment of where and how this is likely to be used, so the numbers in the table below are likely to be an underestimate.

This 'heat budget' makes the assumption that use of electric heating at the house level would decrease and so assumes only about half of its current contribution. However, the total amount of electricity increases in this model since at least some electrical top-up of heating grids may be necessary, particularly as the new energy mix is taking shape. As an example, a dedicated wind turbine (or a small number of them) could be co-located with solar thermal arrays and used to directly heat the inter seasonal heat stores. This is particularly attractive since this heat comes at a different time of the year to solar thermal.

Scotland has some energy-from-waste plants and it clearly makes no sense to decommission these while we still produce waste, but given the goal of moving towards zero waste it is assumed that the total volume of energy produced in this way stays static. However this is likely to be an underestimate of eventual 'heat from waste' because the heat budget does not include any contribution from industrial heat waste recovery and this could become a substantial source of energy (there simply isn't enough information available to make reliable predictions about its scale). While the Common Home Plan does not assume domestic heat pumps will be a major source of heating it is certainly desirable to increase their use where possible. If the current contribution of heat pumps was tripled it would produce slightly over 1,000 gigawatts hours of heat a year.

Hydrogen as a multipurpose energy-storage solution has enormous potential, especially when combined with non-schedulable renewable energy generation (see Electricity) – but as explained, moving to a hydrogen heating system is difficult and expensive. For this reason it is assumed that hydrogen is mainly used in large-scale generation facilities, particularly for top-up. This is needed because at periods of very high usage (generally during a cold spell) the demand on a heating grid may outstrip the supply of the basket of heating sources and so require topping up. This is the best potential use of hydrogen, with large-scale hydrogen heating plants attached to the ring-main amounting for about three per cent of the total heating budget. Even if this proportion was to become higher it would not increase the capital cost since it will simply involve running the 'top-up' plants for a longer period.

Source	GWh/year	% of current heat load
Total current usage	85947	
Replacement 'heating budget'		
Insulation and efficiency savings	34000	40
Solar thermal	20500	24
Geothermal (mines)	10500	12
Biomass	6500	8
Biomass (CHP)	1500	2
Electrical	8000	9
Energy from waste	449	1
Heat pumps	1122	1
Hydrogen	3163	3

Estimating the cost of installation (which is additional to the cost of the ring main and the local heating grids) is not straightforward. It requires calculating the total amount of energy used, the rate at which it is used and the peak demand for heating in Scotland (which varies from 2GW in July to 10GW in January). Severe cold snaps can see days or weeks of higher heat demand with the peak recorded demand so far being 22 GW. The following table contains a summary of the assumptions made and shows a cost range from about £8 billion to about £17 billion (though the higher costs come from smaller-scale installation so economies of scale mean that total costs should come out at the lower end of the prediction range).

Type	Cost for 1GW (£bn) – Lower Range	Cost for 1GW (£bn) – Upper Range	GW capacity required	Lower Cost (£bn)	Upper Cost (£bn)
Solar thermal	£0.57	£0.94	4.500	£2.57	£4.23
Geothermal	£0.93	£2.00	2.752	£2.56	£5.50
Biomass	£0.35	£0.65	4.094	£1.43	£2.66
Biomass CHP	£0.35	£0.65	0.823	£0.29	£0.54
Electrical	£1.10	£4.00	0.535	£0.59	£2.14
Energy From Waste	£1.20	£3.60	0.353	£0.42	£1.27
Heat Pumps	£0.56	£1.43	0.294	£0.16	£0.42
Hydrogen	£0.78	£1.30	0.149	£0.12	£0.19
Total Cost				£8.14	£16.95

Off-grid households

In urban areas 92 per cent of households have access to the gas grid but in rural areas this drops to 64 per cent. While some of these (especially unconnected urban properties) may be addressed through the roll-out of district heating, and even though district heating is feasible in many rural areas, for many households it will simply be impractical to connect them to a District Heating System (gas grid connectivity being a reasonable indicator). For urban areas (where storage and space are issues) a hierarchy has been proposed above with hydrogen and then electricity as the next options in order of preference. However, in rural areas where space is less of a premium there are other options.

BioLPG is not yet being produced on a sufficient scale to play a major role in urban heating but it is cheap to produce and can work in existing boilers so is a very good option for rural housing – for many homes this will simply be a case of switching fuels. Bio-fuels can also replace kerosene for households which use oil boilers. Other options include domestic biomass boilers or a mixture of technologies including ground source heat pumps and solar thermal. There are some locations where electric heating may be viable, for example island communities which generate excess electricity they are unable to export. In all cases there must be price-levelling mechanisms. In urban areas only eight per cent of those classified 'income poor' are also classified as 'fuel poor' but in rural areas this ratio is reversed – only eight per cent of those classified as 'income poor' in rural areas are not also classified as 'fuel poor'. For some off-grid homes the cost of installing replacements will be higher than the average for district heating installation, but this will be offset by other urban properties which are below the average so should not require funding beyond that set out above.

Heat Supply Act

The UK energy system loses around £9.5 billion per year on wasted energy – equivalent to more than half the average UK annual electricity bill, or the power generated by 37 nuclear plants or by wind turbines covering 40 per cent of Scotland. But, unlike solid waste, we can't see it piling up in our bins and landfill sites so it's easy to forget that dumping it straight into the atmosphere or into water bodies is one of the most wasteful things we do in our society. Yet Denmark, which leads the world in using waste heat to supply district heating networks, has had a Heat Supply Act since 1979.

Put simply, a Heat Supply Act (HSA) would require all developers of large waste heat sources to recover and recycle that heat to feed local homes and businesses and, where available and feasible, it would require all new housing and commercial developments to connect to those sources

through district heating. The first years of a HSA would see these requirements placed on all new buildings and any public and commercial buildings undergoing significant renovation or extension. Where developers cannot connect to an existing source of demand they would be expected to identify any local areas earmarked for developing new housing or commercial buildings, and install sufficient infrastructure to create a supply node on a future heat network. Similarly, minor changes to the planning permission process for new housing and commercial buildings would be introduced to favour those close to existing sources of waste heat, and co-located with new sources. After five years the Act would be extended to require all existing producers of waste heat to do the same within a ten year compliance period.

However, as well as saving energy and reducing greenhouse gas emissions, a Heat Supply Act would enable the development of new heat networks and encourage co-location of housing with public, commercial and industrial buildings, reducing both transport emissions from employees' commuting and the time they take getting to and from work. Such an Act would even help tackle Scotland's democratic deficit and problems such as fuel poverty by increasing access to services by encouraging the location of public buildings close to homes and workplaces.

Making this happen

- Set up an Energy Development Agency to plan the shift to renewable heating.
- Set up a National Energy Company to install a national district heating system and renewable heat generation infrastructure.
- Task the National Energy Company with developing a full decarbonisation plan for off-gas-grid houses.
- Invest in training the workforce to deliver this.
- Establish a Heat Supply Act to compel this transition to take place.

Electricity

The challenge for electricity is to replace all non-renewable energy with a system that uses Scotland's vast amounts of renewable energy; wind (onshore and offshore), hydro, wave, tidal, subsea current, solar, biomass and geothermal. Since decarbonising transport will require a transition to electric and hydrogen vehicles the electricity capacity for achieving this must also be installed.

Assessing Scotland's electricity need

In March 2019 Scotland's renewable generation reached a total of 11.3 GW and a further 12.9 GW is planned and under construction. In addition to renewables Scotland has two nuclear plants which generate 2.2 GW when operational and gas-fired power stations for responding to intermittency and peak demands. Scotland generated 26.7 TWh of renewable electricity in 2018, along with at least 10 TWh from nuclear energy and around five TWh from gas and oil. We exported a net 13.5 TWh of electricity.

However, only about a fifth of the energy Scotland consumes comes from renewable sources. The rest came from fossil fuels, particularly oil for transport and gas for heating. Planning the future generation requirements will therefore involve replacing current non-renewable electricity generation, meeting the needs of the electrification of transport and the production of hydrogen for transport and from some contribution to heating (mostly hydrogen for peak period top-ups as proposed above). However because the Common Home Plan advocates a system of district heating the assumptions some have made about the need to electrify heating do not apply since this will be met by other energy sources (as explained in the Heating section).

Renewable energy is largely 'non-schedulable'. This means that although it is still possible to plan the provision of renewable energy because of the accuracy with which future wind patterns can now be predicted, it cannot be turned on and off at peak times during the day. This means that schedulable generation such as gas and nuclear cannot be replaced megawatt by megawatt unless storage is included. At the moment large-scale battery storage technology is capable of evening out the load across parts of the grid to meet demand peaks across the course of the day, but it does not have the storage capacity required to offset non-schedulable renewable energy. Pump-store hydro is efficient but most potential sites in Scotland have already been developed. The production of hydrogen through electrolysis (running electricity through water to create hydrogen and oxygen) can utilise over-supply of renewable electricity (for

example, overnight) and this can be stored in broadly the same way as natural gas. It can then be used to replace natural gas in existing gas-fired power stations, in order to meet peak demand. Hydrogen will also be required as part of the transport fuel mix and as heating top-up in district heating networks.

The general assumption is that intermittent renewables require a 25 per cent over-supply to ensure stability of supply, so meeting Scotland's annual usage of 111 TWh would require installed capacity of around 139 TWh. Some of this extra capacity will be supplied by batteries and stored hydrogen and storage efficiency will need to be factored into the future planning of energy supply once more knowledge has been gained.

This suggests that, over the 25-year period of the Common Home Plan an additional 112 TWh of generation will need to be deployed, equivalent to 47 GW, or roughly four times existing renewable capacity, or about twice the total amount of renewable generation currently installed or planned. The phasing of this will need to be planned carefully around events such as the scheduled switch-off of Scotland's remaining nuclear capacity in 2030 and timed to match the phasing-in of electric and hydrogen vehicles. However, as the lead-in time for large scale generation is around 10 years, more must be rapidly commissioned.

Energy Sources

A mix of renewable types and storage is required to ensure security of supply – solar supplies power largely during the day in summer, wind tends to be stronger in winter, tidal is predictable but at present not fully commercially developed. The following gives a summary of the predicted cost of different kinds of electricity generation:

Generation type	Estimated price per MWh in 2025
Onshore Wind	£30.00
Offshore Wind	£69.00
Solar PV	£47.00
Nuclear	£98.00
Gas with CCS	£79.00

Nuclear power is so expensive and so dangerous that there is simply no justification for considering it as part of Scotland's energy mix and Carbon Capture and Storage (CCS) is unproven at scale or over the long term (with fears the CO₂ may simply leak) and simply prolongs the unnecessary use of hydrocarbons, which also contribute to local air pollution. Scotland has enormous marine energy potential but the technologies for capturing this are not yet mature enough for us to be confident about their widespread deployment so should not be planned in to an initial energy mix. While there will be a place for solar PV it is much less efficient than solar thermal and so the latter should be prioritised (but there is significant scope for solar electric farms where there is land but low local heating demand). Scotland will therefore emphasise wind generation, particularly on-shore wind, which should mean Scotland's energy costs are very much at the low end of the spectrum.

Smaller scale generation can be integrated into this overall mix in a number of ways. Individuals can be incentivised to install capacity themselves (potentially with subsidy) and then be paid a unit price for the electricity being generated (the current model). But there are alternatives; for example, all house builders could be required to install generation capacity into new housing as part of planning permission, with the homeowner not 'owning' the electricity generated. Existing buildings might have renewable generation fitted as part of the process of upgrading thermal

performance and installation of district heating (see Buildings and Heat above). Landowners could be paid to allow turbines on their land where they are being deployed in smaller numbers. It would be for the Scottish Energy Development Agency (see below) to create strategies, financial models and regulatory regimes to best ensure the rapid development of dispersed and small-scale generation.

Installation cost

Scotland's energy system should be unified and properly integrated to enable effective planning so a publicly-owned National Energy Company should be set up to carry out the work of installing all of the necessary new generation capacity. To maintain a fully publicly-owned and integrated system the National Energy Company should also develop a strategy for buying back existing generation capacity and also the National Grid in Scotland. Taking existing capacity into public ownership will require 'fair compensation' to be paid. This is a complicated issue simply because different facilities will have different lifespans and will have already generated different amounts of profit. It has been estimated that the cost of nationalisation at a UK level would be about £100bn so a figure of approximately £10bn is assumed for Scotland.

The cost of installing the necessary extra electricity generation capacity will depend on the energy mix chosen which will in turn depend on decisions about where we wish to install that capacity. Onshore wind is the least expensive way to generate renewable electricity in Scotland but large wind farm developments can be controversial and so decisions need to be made about how much we wish to deploy. Offshore wind is more expensive to install and maintain but is less controversial politically and there is greater capacity for expansion. Solar PV will be competing with solar thermal for space and solar thermal is about 70 per cent more efficient at generating energy. The Common Home Plan does not include assumptions for any of Scotland's domestic demand to be generated from new

marine sources (wave or tidal) because these technologies are not yet commercially deployed at a large enough scale to be confident of viability in the necessary timescale, and because there is more than enough scope to generate domestic power needs from other sources. However marine energy generation will improve continually and its viability will increase. Scotland should plan to develop wave and tidal and subsea current energy as an export business. If there are sufficient technological improvements in electrolysis from salt water it may be that an off-shore hydrogen industry could be developed in Scotland (also discussed in Trade below).

The following table gives an indication of the costs of installation. It makes a fairly arbitrary assumption about the balance of new generation capacity between the three primary technologies but does not include any calculations for smaller-scale generation technologies such as combined heat and power from biomass. This is not intended to reflect the final balance of new generation since this is heavily dependent on assessing specific generation sites and opportunities but should give a realistic assessment of the likely final cost balance.

Type	2017 Cost for 1GW (£m)	Total GW to be installed	Total cost (£bn)
Onshore Wind	£1,196.00	6.4	7.4
Solar PV	£1,124.00	6	5.6
Offshore Wind	£3,433.00	2.5	8.5
Total			21.5

The electricity grid

Scotland's electricity network is managed by two private businesses which together supply energy to firms which sell electricity. The supply of energy to consumers is becoming more

complicated with the growth of renewables and future challenges such as dynamic price changes, retrieving power from electric cars, and other developments. These make 'keeping the lights on' and maintaining voltages much more complicated, as evidenced by the power outages which have already affected the UK National Grid. This emphasises the need to invest substantially in upgrading the grid to meet the targeted capacity. This will require substantial investment not just in wires and batteries but in new technology such as the 'Internet of Things', 5G and smart grids. That investment will be in the order of £4bn. The National Grid in Scotland is privately owned and the workers and management of the grid are essential to ensure the transition to a low carbon future happens. However, the complexity of future energy planning cannot be achieved without widespread coordination and there is no reliable means of market pricing which can achieve the scale of transition required. The Common Home Plan therefore assumes that the National Grid must be nationalised, the costs of which are included in the table above.

Hydrogen

Hydrogen is extremely energy-dense and is made by running an electric current through water, producing hydrogen and oxygen (a process known as electrolysis). The cost of producing hydrogen from electrolysis is determined by the cost of the electricity required. It is assumed that as a mature industry hydrogen production will cost under half that of diesel (relative to the energy produced). Most hydrogen has traditionally been produced chemically (from ammonia or natural gas) rather than by electrolysis but this generates a lot of CO₂. It means large-scale electrolysis has not been deployed and so the efficiency gains achieved through continuous improvements in engineering have not yet been achieved. The efficiency rate of electrolysis is expected to level at about 74 per cent in the next decade, meaning only about 26 per cent of the electrical energy is lost in the process. But when considering the efficiency it is also important to bear in mind that electrolysis can utilise

all 'wrong time' electricity generation which, in a country which will be overwhelmingly reliant on renewable generation, means reducing electricity wastage to zero. At an entire system level the efficiency will thus be much higher.

There will be three primary uses for hydrogen; transport, electricity storage and heat redundancy. Transport technologies are developing rapidly so it is hard to know which ones will win out, but it is very likely that smaller vehicles will be battery-electric powered and larger vehicles will use hydrogen fuel cells (discussed further in Transport). Current models suggest we need about 100 Hydrogen Refuelling Stations (HRS) at a cost of £620 million if we want to decarbonise large vehicle transport – should hydrogen be used in other vehicles the number of HRSs could double. On average each HRS will be expected to consume about 80,000MWh per year or 219 MW every 24 hours. This suggests Scotland needs 1.8GW of electrolyzers.

The second key use for hydrogen will be electricity storage, both to capture 'wrong time' electricity and to ensure the grid can meet peak demand periods each day (plus some hydrogen for heating system top-up). Hydrogen from electrolyzers can be used to fuel Combined Cycle Gas Turbines which are used by the National Grid at times of peak demand or low wind to top up electrical supply. They can use hydrogen (combined with steam to achieve the right combustion balance) to produce electricity in exactly the same way as current gas turbine generation, with the latest claiming a 63 per cent efficiency. This means that the combined process of electricity-to-hydrogen (74 per cent efficiency) and hydrogen-to-electricity has an efficiency of 46.6 per cent – which still makes it cheaper than nuclear energy. Based on the assumptions made in the electricity, heating and transport sections of the Common Home Plan, the following table assesses the total amount of hydrogen Scotland will need.

	Energy required from hydrogen (GWh)	Hydrogen required (tonnes)
Electricity	8000	242200
Transport	15000	454500
Heat	3000	90900

The world's largest currently-operating hydrogen-from-electrolysis plant is the Rhineland Refyne plant. It produces 1,300 tonnes per year and so at that scale Scotland would need over 600 plants. It is still a demonstration-scale project and industrial production plants will be at least ten times this size when rolled out. However this remains the current best estimate of cost and so the Common Home Plan has allocated the equivalent of 600 plants at a construction cost of £20m each at a total cost of £10bn.

Supply chains

Scotland has been sluggish in capturing the spin-off economic benefits of the renewable energy revolution and has failed to develop the widespread domestic manufacture of renewable technologies currently being deployed. This is primarily because of the privatised nature of the UK's energy markets but also reflects a lack of political will to negotiate during planning processes. Scotland still has some remaining heavy industry which could form the basis of new supply chains. Current supply chains to the North Sea oil industry can diversify to supply energy-generating components. Securing supply chains in Scotland is not only a matter of domestic economic benefit; transporting enormous wind turbines from manufacturing plants in China and Indonesia on carbon-emitting transport to reduce carbon emissions is clearly illogical.

In addition, if Scotland is to pursue this plan it would make it a pioneer in the large-scale development of hydrogen-from-hydrolysis plants and the widespread deployment of hydrogen in the electricity, heating and transport systems. It would be a national tragedy if Scotland did not capture the economic benefits of these new industries, including employment and technological innovation. However, the only means of ensuring supply-chain capture is for collective public bodies to integrate the development of supply chains with all generation capacity into a larger coordinated plan, commissioning the necessary technologies and materials. This in turn will require an effective national industrial strategy.

Oil and gas

The Common Home Plan argues that Scotland must take responsibility for its environmental impact beyond our own borders as well as the impact of domestic activity. This is explored below (see Trade, and also sections on Transport, Food and Waste) and very much applies to Scotland's oil and gas sector. Scotland has good reason to feel aggrieved about the level of domestic economic development which resulted from the exploitation of Scotland's oil resources, but these must be treated as historical issues and the national approach to the future management of resources must be based on the principles set out in this report. That leads to one main conclusion – we must stop extracting oil and gas from Scottish waters. The carbon emissions and other pollutants resulting from oil and gas extraction cannot be justified. By the end of the 25 years of the Common Home Plan Scotland will no longer be using oil or gas for any of its energy requirements (the only remaining use of oil-based fuels would be in air travel). There are other uses for petrochemicals such as the production of plastics and pharmaceuticals, but since virgin plastic use must be rapidly decreased it is unlikely that oil fields would be financially viable on this basis. For that reason, Scotland must have ceased extracting oil and gas by the end of the 25 years.

Not many of the main oil-extracting companies are Scottish and tax revenue from oil and gas is currently low and not expected to rise significantly in the near future. There are, however, many jobs that depend on the North Sea oil industry and in the supply chains which service it, and the industry has been central to the economy of Aberdeen and, to a lesser extent, the rest of the North East. However, this is already an industry in decline and the number of jobs being created by the Common Home Plan will far exceed the number lost from the oil industry. Nor are these jobs lower quality – many are high-skilled technical and engineering positions. The remaining impact of the closure of the oil industry in Scotland must be addressed through a proper economic diversification strategy. This should be based around the needs of the Common Home Plan. Much of the energy-related infrastructure needed to achieve the Plan should be developed in the North East to help replace the loss of oil-related economic activity, and the overall diversification strategy should seek to redirect the outputs of supply chain companies – the role of a number of these in delivering district heating systems has already been considered.

Cost summary for electricity

To achieve the above in an effective and coordinated way Scotland requires a National Energy Company which would progressively take over energy supply to customers and would develop and own all future large-scale energy generating facilities. Nationalising existing large-scale generation capacity will eventually achieve a negative net cost; these facilities generate more than they cost and so any compulsory purchase would pay for itself over the 25-year course of the Common Home Plan. However a sum for the upfront cost has been included and this will enable Scotland to either pay off the costs faster or to choose to reduce electricity prices. The coordination job would be undertaken by a Scottish Energy Development Agency which will plan all new capacity and have responsibility for ensuring an energy system which 'keeps the lights on' while meeting all the needs of the decarbonisation agenda.

	Cost (£bn)
Development of electrolysis plants	10
Installation of essential new capacity	21
Upgrading the grid including local battery storage	4
Nationalising grid and existing large-scale energy generation	10
Total	45

Making this happen

- Set up an Energy Development Agency to plan the move to a zero-carbon energy system.
- Set up a National Energy Company to build and own the generation and energy storage capacity needed.
- Invest in electrolysis plants to generate hydrogen for energy storage.
- Nationalise and upgrade the National Grid, including local storage and 'smart grid' technologies.
- Gradually take existing generation capacity into public ownership.
- Develop domestic supply chains for infrastructure manufacture by developing an industrial strategy.
- End the extraction of oil and gas in Scotland.

Transport

05

The challenge is to reduce the environmental impact of all transport in Scotland. Transport emits more carbon (37 per cent of all Scotland's CO₂ emissions) than any other sector so decarbonisation is a special priority.

The future of transport

Of the areas covered in this report, transport has one of the most uncertain futures. Competing technologies are developing simultaneously and it is unclear which will win out or in what situation different technologies will perform best.

However, it is nearly certain that a high proportion of road and marine vehicles are likely to be battery-electric powered, with others using hydrogen fuel cells and some a combination of both, as these are proven technologies which are already economically competitive. Air travel is much more problematic, with technologies capable of replacing fossil fuels no further than proof of concept or early prototype stages. The reality is that, with the exception of short domestic flights, air travel in the medium-term future is a case of 'work around' rather than 'final fix'.

But one of the biggest unknowns is the development of autonomous or driverless vehicles. An enormous amount of international investment is being made in driverless technology and some driverless vehicles have already been deployed. However, the potential impacts of driverless are so great that it is hard to know how it will develop. For example, 'on call' vehicles (summoned on your mobile phone) if deployed effectively would likely displace a large volume of car ownership, resulting in turn in major changes in urban planning assumptions (on-street parking and the assumption of parking capacity in housing developments may decline or even disappear). How this is deployed might vary from a utopian vision of extremely efficient and high-quality publicly-owned driverless infrastructure making travel much faster, or a dystopian chaotic privatised version in which competing firms clog up the roads with vehicles which force passengers to sit through invasive advertising during their journeys. The future of public transport is also uncertain; a highly-efficient autonomous vehicle fleet would almost certainly displace at least some of the travel currently done by trains and buses.

It is easy to plan now for the transition to human-driver electric vehicles; indeed, it is urgent that we begin in earnest. But it is not necessarily the case that this actually prepares Scotland

for the next generation of transport – for example, human drivers will need charging points which are on primary travel routes (effectively where there are current petrol stations), but that would not be the case for driverless where some of the charging will best be done away from main travel arteries.

For these reasons, the key will be to plan a properly integrated transport system designed for the public good. A National Transport Company should be established and it should be tasked immediately with rolling out comprehensive charging infrastructure and to develop with urgency a national transport transition plan.

Reduce the need for travel

One of the drivers for the environmental impact of transport is simply the increased volume of short journeys we all now make. There are many reasons for this – we work further from home, seldom plan new housing in a way that is integrated with work, shopping or access to services, emphasise large supermarkets and out-of-town shopping complexes, prioritise the interests of cars over the interests of pedestrians or cyclists and fail to invest in public transport. These are all effectively planning failures – we plan our urban areas in ways which favour property developers and large corporate retailers but which require us to make more short journeys that we can't make on foot or by bike.

It is assumed that this is a popular approach, and yet 'the commute' is not generally viewed positively and if we think about the popularity of a shopping street such as Buchanan Street in Glasgow we can see how much people appreciate pedestrianisation. Many people who have less access to transport (particularly older people) come to feel isolated when we plan communities with the assumption of lots of short journeys that they find it hard to make. It also reduces the time we spend out and active in our own communities which in turn makes it hard to develop positive community cohesion and to make us feel connected.

There are many options. We should look again at new work technologies such as remote working and while these can be isolating if we only work from home, we could require large new developments to have remote working hubs included where people could work remotely but be surrounded by other people even if they're not working for the same employers. We could require the integration of food shops with new developments so people buy more of their staples more locally. And we should certainly reverse the impacts of service centralisation so that people can get access to key public services as locally as possible. For example, childcare works best when it is close to home and designed to fit with work patterns and schools will always be better situated in places where the pupils can walk there from home.

A National Transport Company should integrate the ability to make more journeys by foot or by bike with its overall transition plan. We cannot assume that the challenge of transport is purely a technical problem of changing petrol engines for electric ones.

Electrification

The priority must be to urgently commit to ensuring a robust charging infrastructure is in place with annual targets. For motorways and large parking facilities, rapid chargers should be installed. This work needs to be completed quickly and so must be enforced and paid for collectively to ensure full coverage of service stations. The cost of completing this should be less than £100m. All new homes with parking bays must install charging points and this should be included in building standards regulations. The total number of vehicles in Scotland is around three million. It is assumed that this will increase as the population rises, but it is equally possible that the number will decrease if we achieve much more efficient vehicle sharing as autonomous vehicles develop. Many of these vehicles are currently parked on the street overnight and so if charging infrastructure designed for private car ownership and maximum convenience is to be prioritised, this would mean installing

street-side charging in every residential street where cars are currently parked. This is an enormous task; the chargers themselves would cost nearly £1bn, the complexity of installing them would increase that cost very substantially and the disruption involved would be substantial. That would be fine if it we could be confident this is where charging infrastructure will be needed in future, but if other transport approaches develop it could become an expensive white elephant. This complex decision must be made as part of the transition plan developed by the National Transport Company. Whatever decisions are made, infrastructure investment must begin quickly.

HGVs, most forklift trucks and large agricultural vehicles will gradually move to being fuelled by hydrogen. With abundant renewable energy and water resources, Scotland should make that hydrogen through electrolysis delivering carbon-free long-range transport (see Electricity above). A European standard for ensuring standard refuelling has not yet been issued; however, it is likely this will happen soon and most new trucks should use hydrogen fuel cells within ten years of the Common Home Plan being implemented. Scotland will require 20 to 30 large truck depots providing hydrogen refuelling. A National Transport Company should identify suitable locations for these in Scotland and build them. These will also fuel smaller long-range vehicles. Assuming 30 depots in Scotland, a cost of £600m is estimated. Some buses will run on electric and others on hydrogen. Local authorities taking control of bus services should plan accordingly for appropriate charging and hydrogen production infrastructure. The existing hydrogen bus manufacture industry in Scotland should diversify and establish a fuel cell truck manufacturing division.

Although the majority of train journeys in Scotland use electric trains, only around 25 per cent of the track is electrified. The remainder of the journeys use diesel locomotives or heritage rail steam. Although electrification is the best option, it is impractical to convert all lines (many of which are single track) to electrification even within the timescale of the Common Home Plan. However it is expected that the first hydrogen-fuelled trains will be operating in the UK within the next few years so all newly

commissioned trains procured to run on non-electrified lines should be hydrogen-powered and the potential for retrofitting existing trains should be explored (there is potential for much of this work to be done in Scotland). Diesel-fuelled ferries should gradually be replaced with hydrogen or biofuels – Scotland already has a pioneering role in building these. Small boats and ships should be converted to electric or biofuel.

Air travel is by far the most difficult aspect of transport to decarbonise with no viable alternative to fossil fuels having made it past the basic concept stage for large planes or long journeys. Shorter journeys on smaller planes (for example, internal flights to the Scottish islands) will soon be possible on electrically-powered aircraft and a strategy for replacing fossil-fuel planes for these journeys must be developed. In the medium term this may also provide a solution for longer flights to the rest of the UK and the closer part of the continent, but there is little sign of technological solutions beyond that and given the international nature of air travel it will be more difficult to compel any of this to happen.

There are options around disincentivising or even rationing flights to seek to reduce numbers – for example by giving people an 'air miles' budget and then taxing any flights beyond that budget at a rate which would discourage travel. There are problems with this; the vast majority of flights are taken by a small minority of people and they are mostly business-related. Business flights are particularly non-price-sensitive (costs have to rise a lot before businesses stop taking these flights) so this may not have a large effect. Greater and more advanced use of teleconferencing can be used and, in combination with price measures, may have some effect. However travel has important economic and cultural benefits and care must be taken not to reduce Scotland's international connectivity.

This may involve more creative work-arounds. For example, travel by ferry can be very pleasant and hydrogen ferries have very few negative environmental consequences. The primary objection is time – the travel time is clearly much higher. Perhaps a solution to this would be to encourage leisure travel by ferry by giving people who choose ferry extra leave days

to compensate for the longer travel time. Even more radically, perhaps all citizens would be given the right to at least one publicly-funded ferry journey each year which would give people a strong incentive not to fly.

Assessing investment

It is estimated that a total of 15 TWh of electrolysis-produced hydrogen will be required for road transport in Scotland based on major roads and the likelihood of more fuel cell vehicles in Scottish rural and island areas. The cost of this has been covered in Electricity above. The minimum investment requirement for creating the initial infrastructure to support decarbonising transport is in the order of £3 billion (this will create the basic charging infrastructure). However, this is not a realistic assessment of the likely infrastructure costs over 25 years. We therefore assume that at least £10 billion is assigned for infrastructure alone (this sum does not include any public contribution to vehicle adaptation). The current assumption is that the cost of replacing or upgrading the vehicle fleet will simply be absorbed during natural replacement. That will certainly be true to a substantial degree, but that approach may not deal with all issues (there will clearly be a cost to adapting vehicles which are not being replaced, such as trains and boats) and is unlikely to deal with them fast enough. Common Weal is not aware that estimates have been made of adaptation or replacement costs. As an indication, the electrification of existing private cars (assuming current average car prices) would cost approximately £50 billion alone. The total cost over 25 years of completely decarbonising transport is unlikely to be less than £100 billion. The strategy developed will determine how much of this is funded collectively and how much is funded privately based on strict regulatory change which pushes the costs directly to vehicle owners.

Making this happen

- Create a National Transport Company to plan the essential transitional work outlined above.
- Begin installing the core charging and refuelling infrastructure.
- Invest to replace or retrofit existing public transport to be zero-carbon.
- Commission more hydrogen ferries to replace the existing fleet.
- Develop a strategy for how to deal with the problem of air transport.

There are three challenges for our food system. First is access – we need to make sure that everyone in Scotland can afford to eat and enjoy a healthy diet, produced sustainably. Some environmentally sustainable food-growing approaches may have implications for productivity and yields of which we need to take account. Second is security – we need to ensure that we will have reliable food availability in the future. Both domestic and global food production is vulnerable to a changing climate, soil degradation, food price spikes and shocks to supply chains resulting from conflict, trade policies or disease outbreaks. Third is reducing then ending the negative environmental impacts of food from production, processing and transportation (including refrigeration), water use, and waste. The acute decline in the population of terrestrial and marine species is a direct consequence of a wasteful and destructive food system. The collapse of insect populations as a result of the use of pesticides is of particular concern given their keystone role in so many ecosystems.

There is a fundamental difficulty with producing a plan for creating a 'regenerative' food system (one where the natural assets which produce the food are not degraded in the process) which is that it simply hasn't been done on a sufficient scale anywhere in the world to be able to secure reliable data for modelling the transition. For example, there are many small and medium-scale farms that have moved to an 'agroecology' model of production which achieves sustainability, but there are no big 'industrialised' farms which have done this. It means that it is currently impossible to provide accurate and consistent answers to questions such as 'what is the food productivity of a hectare of land farmed regeneratively rather than industrially?'. Evidence suggests this need not be reduced, but it may be more labour-intensive.

So while we know the methodologies which can be used to make farming regenerative, we don't know enough about what they cost to implement, what the impact on food prices would be or what the impact on productivity would be. But, while we don't yet know exactly where a better food system will end up, we know enough to get started. The broad approach to where we use land is going to be some form of 'agroecology' and there are a lot of established practices with which this will be constructed (see below). Uncertainty is more to do with the route than the destination, but this still requires much learning during the process of implementation.

There are some additional options which can play a part. For example, various forms of artificial light-assisted growing facilities can be sited anywhere (land quality and soil fertility don't matter) and could displace some out-of-season and other imported foods in Scotland (domestically produced tomatoes in the winter months, for example). Commercial-scale indoor growing relying on or assisted by artificial light is already taking place, but again, it is not yet at a scale which provides sufficient data to enable accurate modelling of what this might look like deployed at scale in Scotland. For these reasons, and as with large-scale hydrogen-through-electrolysis plants (see Electricity above), Scotland should take on a 'pioneer' role

in adapting our food system. We must 'learn as we go', both implementing changes continuously but constantly monitoring their impact and effects. This will require a large, well-funded National Food Agency with responsibility for planning, implementation and analysis.

Changing diets

There are many reasons why Scotland should want to change its diet, with the health impacts of how we currently eat being high among them. But there is a need to alter the form in which we consume calories if we wish to achieve the goals of the Common Home Plan. As is now widely known, different food groups require different amounts of resources to produce them, with meat in general and beef in particular being an inefficient means of providing calories for human consumption. It is now widely recognised that our eating patterns should change for environmental reasons as well as health ones. We need to eat less meat but meat of a higher quality, and we need to vary the content of our diet more. For example, legumes (beans, peas, lentils and so on) are excellent crops for the environment because they are 'nitrogen setters' – where most plants take nitrogen out of the soil as they grow, legumes put it back in. We need to move away from highly processed foods which rely on unsustainable ingredients such as palm oil. And our diet must enable us to shorten supply chains; transporting food long distances around the globe is generally inherently harmful.

Changing diets will require three things. First, there needs to be public information to help people understand what a sustainable diet looks like, and to provide people with the necessary cooking skills (see Learning). Secondly, the system of food distribution and its regulation must work in concert to make a diverse range of foods grown and processed in a sustainable way easier to source and to make unsustainably-grown and highly-processed foods more and more difficult to source. This can begin with prohibitions of bulk discount offers for highly processed foods, the gradual raising of food standards,

working with (and implementing duties on) food distributors such as supermarkets to support shorter supply chains and sell fewer highly-processed foods and to encourage the development of new distribution routes, such as enabling greater direct selling from supplier to consumer through cooperatives. Thirdly, we need a proper debate about how to 'price in' the externalities of food production so that the cost more accurately reflects their relationship with the environment. Current free trade policies make this controversial (see Trade) and the balance between the desire to eat less environmentally harmful food and those who wish to prioritise free trade will need to be negotiated. We may also wish to impose taxes on certain foods to encourage behaviour change, just as we currently do with tobacco and alcohol.

The outcome of this will be that food quality will improve – but it is likely that food costs will as well. Under the Common Home Plan this will be countered by rapidly-decreasing costs for heating and transport. But the impacts of food cost rises can be addressed in a number of ways; for example, income raised through pricing mechanisms might be used to create a 'food budget' where citizens are provided a monthly payment (or have a food debit card loaded with credit) to help smooth out any rises in food costs and to assure access to good food for all. Alternatively, this could form the basis of a Universal Basic Income. Another step worth taking would be to introduce a 'legal right to food' into Scots law which would create a legal protection against poverty resulting in poor or insufficient diets.

While some investment in education and training will be necessary and some public investment in the food distribution system may be needed (for example, to support the development of public cooperative sales platforms for producers or to assist retailers during transitions), the costs should not be large in comparison to the other elements of the Common Home Plan and so are assumed to be rolled into the costs of a National Food Agency and an education programme.

Moving to an agroecology system

Agroecology is a term for what can be considered 'regenerative agriculture' – a system of farming in which the essential elements of the agricultural process (soil, water, pollinators) are managed so they regenerate themselves. This means ensuring that growing in soil does not degrade that soil, reduce its fertility or cause it to be depleted. It means farming without threatening populations of pollinators or the wider system of biodiversity they rely on. Agroecology also treats the land in ways which enable it to sequester the maximum amount of carbon from the atmosphere, for example by using approaches which cause minimum disruption to the complex root systems which develop in soil and store a lot of carbon but which are disturbed by intensive farming, releasing carbon into the atmosphere.

There are many methods of agroecology and this is still a developing practice, at least when applied to large-scale or whole-system agriculture. For the reasons explained above, it isn't feasible for the Common Home Plan to prescribe a precise model for a national system of agroecology nor the specific method for getting there. But there is more than enough knowledge about the underlying approaches which result in regenerative agriculture to enable us to make progress. For example, crop diversity is essential – different crops take different nutrients out of the soil and put different nutrients back in. Mixed planting strategies and crop rotation are well understood and indeed traditional approaches which are highly effective. For example, interspersing or rotating crops which deplete soil nitrogen with ones which fix nitrogen into the soil greatly improves the long-term health of the soil. Other important synergies need to be designed into the agricultural system – annual food crops, perennial food crops, livestock, woodland, aquatic animals, watercourses and floodplains, hedgerows and 'rewilding' are all aspects of land management which support each other when their management is planned and coordinated but which can undermine each other when they are not.

Efficiencies in agriculture are assumed to be of scale, but this disguises other inefficiencies. For example, a large

proportion of artificial fertiliser is washed away before it properly reaches the soil, harming the wider environment without actually enriching the soil. Meanwhile we produce masses of compostable waste which goes into landfill or is processed as sewage and so is never returned to the soil, so we lose a form of highly efficient fertiliser. Indeed purely achieving the synergies of planning can in themselves increase productivity and efficiency – mixing woodland and pasture and mixed planting can increase yields simply through better stewardship of the resources. This all fits in with concepts of 'resilience' and the 'circular economy' (see Resources below) and is aided through more equitable land distribution – it is easier to plan effectively with smaller farm units which can be more closely managed.

Soil is not only developed and enriched by what happens above ground and much of the carbon which is captured by good land management is captured by root systems. When roots grow they do so by absorbing atmospheric carbon; when those roots then decompose into the soil (in the case of annual crops) they deposit the carbon into the soil. The larger the root systems become, the more carbon they capture; the more those root systems are disturbed, the more of that carbon they are likely to release back into the atmosphere. One way to maximise the carbon-capturing performance of agriculture is to use 'no dig' techniques. There are various forms of this but basically it involves growing subsequent years' crops in new compost on top of land rather than ploughing up and planting into the land. This regenerates soil while also capturing carbon. Another example is to use different grazing methods. Animals tend to be grazed in large areas in which foliage is therefore kept short and this is especially the case with hill-farmed sheep. But the shorter the foliage above the ground, the lesser the root system that develops below the ground. So if grazing animals are moved around smaller grazing areas where foliage has been allowed to grow longer in each, the animals will get the same amount of nutrition but the root systems will have been able to grow much more extensively.

However, the issue of reducing the use of biocides (weedkillers and pesticides) is complicated and there is no 'easy'

option to enable a substantial reduction on the amounts which are sprayed into the atmosphere (and which have led to a 75 per cent collapse in insect populations across Europe). Integrated Pest Management involves a range of techniques which reduce the need for biocides – but they can be time-intensive. Crop rotation helps as crops grown in the same space year after year encourage the establishment of pests which target those crops. A higher threshold of action is required, meaning that some loss to pests is accepted (but this will have an impact on yields). Monitoring pests closely and intervening early (or at the right time) can help. Non-chemical options can be considered such as introducing natural predators to pests or hand weeding (though again, there is a time and productivity cost to this). Only after this has all been attempted would chemical pesticides be used and those would need to be more carefully selected and applied to minimise damage. It should not be underestimated how much of a change this would be, nor the range of implications. Preventing high-quality food grown in this way from being undercut in price by poorly-produced imports would be part of the debate over 'pricing-in'.

The farming community is a crucial pillar of rural life and many farmers are farming land that has been farmed by their families for many generations. It is imperative that farming practices change, but it is equally important that farmers are partners in that change and that it is not imposed on them in ways which will cause ill feeling and resistance. This means creating incentives and providing support. Incentives must come from redirecting subsidy payments away from the current 'bulk target' model towards rewarding farmers for good stewardship practices which continue to be highly productive and the level of those subsidies may be increased during a transition period to help where structural investment is needed. Support requires that farmers are provided training to help them adopt new practices. However, we should recognise that there must also be some element of 'stick' as well as carrot – there must eventually be penalties for farms which do not adopt best practices, and those penalties must become prohibitive.

The responsibility for supporting this transition could be either the National Food Agency or a National Land Agency (see Land below). This should be resourced to enable all of Scotland's agricultural system to have moved to a regenerative model by the end of the 25 year period of the Common Home Plan. It is very difficult to know the level of investment this will require, but it will be substantial. The Common Home Plan has allocated £1 billion extra investment in food systems over the 25 years, but this depends on how existing subsidies are used and is likely to be an underestimate.

New technologies

Artificial growing technologies have moved forward enormously in recent years, particularly with the rapid improvements in the efficiency of LED lighting. While this is often shorthand to 'vertical farming', in fact the verticality is primarily a response to providing food for places with limited land but dense populations. Indoor growing is really artificial light combined with a controlled nutrient feeding routine. Best known is 'hydroponics' in which plants are not grown in soil at all but in a neutral grow medium (which can be reused) and where the roots are 'flushed' regularly with water enriched with nutrients. This enables close control of conditions to mimic the natural growing environment of the crops. There are variations; aquaponics grows crops in water which also contains fish, and the natural waste the fish produce fertilises the crops, providing both a vegetable crop and fish which can be harvested for food. Alternatively it is perfectly possible to grow directly in soil but do it indoors where the light can be controlled. In theory all crops can be grown this way. Growing salad and fruit crops (particularly tomatoes, cucumbers, peppers, courgettes and so on) is already done commercially using artificial light. Large scale tests of growing grains such as wheat have been carried out and from staple crops to entire indoor orchards the scope for this kind of controlled growing is enormous.

There are a number of advantages; the intensity of the nutrition means that crops can be grown in a density two to five times greater than growing in soil and because there is full control over the heat and light regime. Repeat cropping throughout the year becomes possible in Scotland, enabling three or four harvests instead of one or two. In fact, the intensity of growing actually increases the cropping rate with many crops being ready for harvest up to 25 per cent quicker. And of course the growing can be stacked – even in a single story warehouse three or four layers of crops can be grown. This means that even a single story growing environment can produce 30 or 40 times as much as the same area of current agriculture. The environment is controlled so the external weather or season have no impact on crops – they are predictable, reliable and non-seasonal, so Scotland could produce food like tomatoes or peppers all year round. Indeed in theory there are no crops Scotland couldn't grow all year round if it chose to invest in growing infrastructure. Efficiency, food security and sovereignty and availability aren't the only benefits. It would greatly reduce the global environmental footprint of agriculture and in particular it would help relieve the environmental pressures on the parts of the world we currently source our food (not least unsustainable water management) while removing the carbon emissions and other negatives caused by transporting food around the globe. And indoor growing effectively means that you are growing in 'clean room' conditions – there is no need for any form of biocides (weedkillers or pesticides) and the likelihood of plants facing infection is greatly reduced. And food quality would rise rapidly – the current practice of picking fruit and veg while underripe, transporting it internationally and then ripening them artificially would end and with it the substantial loss in food quality involved.

Common Weal has done some broad-brush calculations to indicate the scope; to produce a weight of food equal to a quarter of that consumed by the Scottish population and assuming currently-identifiable performance measures it would require about 1 TWh of electricity a year (less than ten per cent of the energy we use for transport) and, including the capital

costs and assuming a 30-year lifespan for the facilities, would cost about £1.75 per person per day. Efficiency and performance will continue to increase as the technology is deployed more widely and so costs will come down. There is no reason why, with ambition, Scotland could not begin to grow large volumes of the food we consume in almost entirely non-polluting and reliable indoor facilities.

There are other new and novel forms of food production. Aquaculture technologies enable fish to be produced in indoor and controlled environments and there are rapid developments in 'artificial foods' such as lab-grown meat and dairy. These are at varying stages of development and so while aquaculture is a viable technology to deploy now, laboratory foods are not. There are also other developments which will introduce new options into the food system, such as the farming of insects for meat. While this may be an important factor in places where there are shortages of calories for the local population, it is less clear that a 'calorie-rich' country like Scotland will rely as heavily on these kinds of developments, but that may change. There are also new technological developments in existing farming, such as 'virtual fences' where GPS-linked collars can keep grazing animals in a given space by giving an audible warning followed by a small electric shock if animals stray beyond the boundaries of the virtually fenced area. This enables a much more varied strategy for grazing, and some of these can have very beneficial effects in terms of carbon sequestration. All of these developments and more will improve in viability and, over time, many of these new approaches must be integrated into the food system.

Reducing food waste

Scotland wastes 1.35 million tonnes of food every year and this is a massive resource drain which must be tackled. There is no one simple way to achieve this; it must be tackled by the accumulation of lots of small behaviour changes. This process has already begun but it must be accelerated. As with the move

to agroecology, initially the focus should be on working with and supporting individuals and businesses to change behaviours but increasingly this must be a regulated matter with penalties for failure to achieve behaviour change. The food system is large and complex and made up of many different kinds of activities, from primary food production through processing to retailing and the hospitality sector and including 'public kitchens' (catering in schools, hospitals, prisons and so on) and the preparation of food in the home. The Common Home Plan is not the place to outline every behaviour change required, but the following is a summary of the areas of change:

- Individual. There must be education, training and support to help people adopt better practices in buying, storing, preparing and reusing foods – and recognising when food is genuinely no longer useable. Achieving these kinds of changes among the entire adult population is difficult so it is important that the school curriculum integrates food practice education to ensure future generations are aware of good practice throughout their lives (see Learning below). There is a wide range of practices which can help inform individuals but investment in these must be made if behaviour-change is to be supported.
- Catering industry. Business audits must be offered to all businesses to analyse how they are managing food to minimise waste and then be trained and supported to implement the findings. This will include good housekeeping, from getting shopping lists right to how to manage food storage to optimal use of raw ingredients. It will include advice on menu planning, purchasing and ordering and how to improve operational efficiency, handling and preparation. 'Doggy bags' must be de-stigmatised. Colleges and others must adapt to enhance the knowledge of those training as the next generation of the hospitality industry.
- Manufacturing sector. Here audits will also be the key; identifying areas of waste, implementing improvements and explaining ways manufacturing businesses can turn their waste stream into an income stream.

- Retail sector. There are a number of practices which can reduce waste in the retail sector, many of which relate to the impacts of stock management and sales forecasting (for example, supermarkets over-stock shelves because customers respond negatively to empty shelves, but there are other ways to overcome this problem by redesigning displays so overstocking and the resulting waste do not happen). Other practices include better collaborative partnerships with producers to streamline supply chain wastage, ending multi-buy promotions and 'upselling' items such as 'wonky' fruit and veg.
- Surplus food redistribution. Some waste is inevitable but this does not mean it is unusable. Food which fails to sell for cosmetic reasons (perhaps because it is wonky or approaching a sell-by date despite still being entirely edible) is perfectly useable in the catering and processing industries. Other foods can be distributed to good causes, charities or social enterprises – though it is to be hoped that the impact and nature of the economic stimulus resulting from the Common Home Plan will end the need for food banks. A 'matching role' for the National Food Agency can help maximise the utilisation of food.

Of course, no matter how efficient the system there is always going to be food waste – but this should also be seen as a resource. There are a range of technologies which can turn food and other organic waste (from garden waste to sewage) into energy and compost. Various forms of accelerated digestion and composting produce biogases which can be used in a district heating system or bioLPGs for off-grid heating and result in a highly fertile compost which can be used in land management.

Making this happen is primarily a process of behaviour change and will require major investment in the capacity of a National Resources Agency to support people and businesses through the transition. This must be very seriously funded. Investment in waste treatment plants will also be necessary (see more in Resources below).

Food distribution and supply chains

We need to face up to the environmental harm of long supply chains, obviously including the impacts of transportation but also factors such as increased processing to introduce preservatives and excessive amounts of non-recyclable packaging to aid transport. We also need to face the reality of the impact of international food markets where they undercut the market for food produced in an environmentally sustainable way by dumping cheap, harmfully produced food into markets. The desire to maintain free trade is all well and good, but the real impact of our exposure to a global food system which may not be changing its practices must be debated and addressed – we cannot simply turn a blind eye to the damage food production is causing the world just because it is produced overseas and the harm is 'out of sight'. A number of means of increasing food security and shortening supply chains have already been discussed. The following is a summary of them:

- More food must be grown in indoor controlled environments, displacing some imports of foods currently impractical to grow or which are out of season in Scotland. These can be developed publicly, commercially or cooperatively.
- Food retailers must be both supported and regulated to develop better relationships with domestic producers, especially small and local producers.
- Cooperative sales platforms and similar initiatives can be developed to connect producers directly with customers.
- Land reform can enable much greater availability of allotments and other methods for those who wish to grow their own food.
- Economic development agencies can take an active role in working with a National Food Agency to stimulate and support new food producers and processors.
- The domestic food industry can be very substantially supported during its further development by strategic use of public procurement, ensuring guaranteed order books

which enable planning and scaling up – much more of the food bought by 'public kitchens' like schools and hospitals must be sourced domestically.

- Pricing mechanisms must be considered to capture something like the true costs of the negative environmental externalities their transport has caused. These would improve the competitiveness of the domestic food industry.
- New forms of distribution must be designed to maximise the connectivity of producers and consumers, for example if overnight automated delivery systems develop alongside driverless cars.

This is a controversial area because of the interactions of free trade ideologies and international institutions. It also affects far more than just food and so this is considered in much more detail in Trade, below.

Making it happen

- Set up a National Food Agency to plan a transition to a sustainable and regenerative food system.
- Task the National Food and National Land Agencies to work together to support a transition to an agroecological system for Scotland's food production.
- Set up a National Resources Agency to pursue a package of measures designed to greatly reduce food waste.
- Invest in new forms of technology which will enable new forms of food growing.
- Develop an industrial strategy to encourage the development of new food processing businesses
- in Scotland and to shorten supply chains.
- Develop new regulatory frameworks for all parts of the food industry and redesign farming subsidy regimes to reward good environmental practices.
- Use pricing mechanisms to embed environmental externalities in the cost of food.

- Pursue import substitution to reduce the environmental impact of unnecessary imports.
- Institute a legal Right to Food to ensure that changes to the food system do not harm the access to healthy nutrition of anyone in Scotland and compensate for any resulting increases in food prices by exploring options such as a food budget or Universal Basic Income.

Land

The challenge for Scotland's land is to make sure it is both productive and well-stewarded so that it can serve our generation but is also kept in a healthy state for the generations to follow. It is also necessary for us to use our land to capture carbon from the atmosphere and to enable the recovery of animal populations.

Scotland's use of land

It is important to be aware that Scotland's land, even its 'wilderness' land, is in no sense 'natural' but rather the result of centuries of intensive management by humans and some long-term neglect (our birch woods). If Scotland's land was left to 'naturalise' it would once again be almost entirely covered in forest. The question is not 'how do we protect our land as it is?' but 'how do we manage our land so it becomes as it should be?'.

The following table indicates the current estimated uses of land in Scotland. These statistics are derived from different sources with different methodologies used, so the percentages do not add up to 100 percent. Some land may also have multiple purposes, such as rough grazing in and around wind farms.

Land Use	Hectares	Proportion of Scotland's land
Forestry	1,080,000	13%
Grouse shooting	1,500,000 (estimate)	18%
Biomass crops	19,000	0.24%
Wind farms (onshore)	517,000	6.5%
Agriculture (crops)	513999	6.42%
Agriculture (meat, poultry and dairy except rough grazing)	243137	3.04%
Agriculture (rough grazing)	3369775	42.12%
Agriculture (animal feed crops)	1288557	16.11%
Agriculture (small farms and mixed holdings)	291821	3.65%
Horticulture	24684	0.31%

Land Use	Hectares	Proportion of Scotland's land
Housing and urban	1,300,000	16.00%
Brownfield and derelict land	11500	0.14%

Well-managed land is a carbon sink – it can absorb carbon from the environment and store it in the land, reversing the impacts of climate change. Badly managed land will be the opposite – a net producer of carbon. Over a 40-year period one hectare of forestry can sequester 200 tonnes of carbon. The two most poorly-managed uses for land in Scotland in terms of biodiversity, carbon capture and soil quality are rough grazing and grouse moors (with land managed for deer stalking also low in biodiversity). In both cases long-term heavy grazing by sheep has more-or-less stripped plant life away from the land, preventing deep root systems from capturing and storing carbon in the land and allowing natural composting of dead plant matter from regenerating the soil. An area equivalent to Scotland's grouse moors alone could, if reforested and rewilded, capture up to about seven million tonnes of carbon a year. This means that every six years it would remove an entire year's worth of Scotland's peak greenhouse gas emissions. Land is also essential to producing the supply-chain crops needed for many other parts of a Green New Deal, for generating heat and power, and to provide the construction materials which must dominate construction in Scotland in the future. But we need a national land management strategy and proper investment if we are to achieve these things.

Ownership, planning and land management

Scotland has the most concentrated pattern of land ownership in the developed world, with only 450 landowners owning half of the private land in the country. This prevents new land-based industries from starting up and so stifles innovation. Much of

this private land is held either as a tradable asset (Scottish land values have risen at a rate well above the stock market) or as estates for grouse shooting and deer stalking (or both). The intensive management of grouse moors is terrible for biodiversity (the persecution of birds of prey is widespread) and carbon sequestering and its productivity is poor – virtually any other use for this land is more productive. Managing land for deer stalking encourages managers to maximise the population of deer (sometimes artificially through direct feeding) to reduce the length of time clients have to walk or drive to their prey and to increase the valuation of the estate. This is extremely damaging as deer graze any new growth in woodland wiping out natural regeneration and causing the long-term death of forests. And since deer are non-territorial animals and migrate as populations increase this problem is spread to all the neighbouring land.

A legacy of intensive hill farming is similar; like deer, sheep are close grazers and they prevent most plant life from regenerating, which is why so much of upland Scotland is dominated by land stripped bare of shrubs, trees and many kinds of foliage and as a result does not provide a suitable habitat for many types of wildlife (nor can it act as a carbon sink). Scotland has almost the lowest level of forest cover in Europe – and most of this is in the form of industrial plantations which are low in biodiversity. This is particularly incongruous because there is probably no other country in Europe more suited to an expansion of forestry – we have a much wider range of growing conditions than the Nordic countries and much more available growing space than almost any other European country.

Meanwhile Scotland produces less than 20 per cent of the construction materials it uses, importing the rest, and while we have a comparatively large timber processing sector in relation to our current forestry, it is small in relation to our potential. If the Common Home Plan is to be achieved then much more of the materials we build with and use must be sourced locally and sustainably and land is needed for energy generation, biodiversity recovery, carbon sequestration and more. The current approach to land is simply failing to deliver what Scotland needs.

There are three aspects to this: ownership, planning and land management. Even if existing landowners could be persuaded or coerced into doing the right thing, it would simply increase inequality as a tiny number of families would dominate more and more of the economy. The underlying philosophy of the Common Home Plan is that this transition should benefit everyone in Scotland, not a small number at the expense of the rest. We need to diversify land ownership. It would be ideal if Scotland had an ownership pattern similar to the Nordic countries where a large number of people each own a fairly small amount of land and so it is used much more effectively and innovatively (though some of the very small holdings can also be inefficient). However, achieving that in Scotland will take time, and the tasks at hand are urgent. A Scottish land ownership strategy is required.

To achieve a diverse ownership pattern in the long term it will be necessary to take an interventionist approach in the short term. There are a number of market-based actions which can help – for example, introducing land taxes would incentivise the productive use of land or its sale. This would have a substantial impact on bringing down the price of land. In combination with 'right to buy' options for local communities this could start to develop broad and locally-owned or community-owned land ownership patterns. To improve land management practices there will be increasing regulatory requirements on estates to ensure they are following high-quality land management practices and delivering positive outcomes; those which want to do this well should be supported which will leave those who don't significantly incentivised to break up and sell land holdings. Banning private land sales and requiring land sales to be publicly advertised (with a cap on ownership size and enforced lotting up of the land for sale) would also begin to change ownership patterns. It is also worth stressing that some of Scotland's land owners are in it for the long term and are doing an excellent and diligent job of managing the land they own. Those owners should not be affected by these changes.

But despite these and other steps, if we are to achieve large-scale redevelopment of land in Scotland for the public good and in the timescales needed to respond to the climate

emergency there is little option but the use of compulsory purchases (where the public would take ownership of the land after paying compensation) and compulsory sales orders (where owners would be compelled to sell tracts of land on the open market). Some of this land could be broken up into Nordic-sized forestry plots (in the order of 25 hectares) or crofts for smallholders and put up for sale, either for land-based industries or potentially for investors who want to put some long-term savings into the reliably-profitable forestry industry (though there is a strong case for a cap on the volume of land that one person could buy in such a sale to ensure diversity of ownership). It may take time for a market for land of this sort to develop in Scotland and a rolling programme of land sales could be managed as interest – and the market – developed. But the process of developing this land must begin immediately and ambitious targets must be set not only for how much of Scotland's land is reforested but how quickly this is going to happen. A target of 50 per cent of Scotland's land area being reforested may well be one of the best contributions Scotland can make to tackling global climate change. However, if timescales for climate change are to be taken seriously, public planting must begin immediately, prior to adjustments in land ownership..

Planning is also essential. When the current planning regime was brought in after the Second World War successful lobbying meant that 'agricultural' land (including forestry) was exempt – which is most of Scotland's rural land. We therefore have a situation where the use of land and space in urban areas is closely regulated in the public interests but outside the urban areas there is a free-for-all where landowners are able to do largely as they please with land (other than building on it). This has been one of the main factors driving poor land management – there has been little incentive to do it well. Land is a crucial national resource which must be managed in the national interest. A planning and zoning regime must be introduced, designating areas for specific purposes and requiring the land use in these areas to be developed on the basis of these specific purposes. This has been done twice in Scotland, both times after world wars where so much timber was used to wage

the war that the capacity to fight another war in the future relied on planting tree crops. A similar mindset is required – to take on the environmental and social challenges Scotland faces we urgently need a national effort to plan our future. An assessment must be made about what Scotland needs from its land in the next 50 to 100 years, and we need to act to meet those needs. It is important that this is done with the support of the communities which live on this land. This will require legislation and a planning authority.

Finally, land management is crucial. Scotland itself will be a patchwork of agriculture, timber crops (for construction, manufacturing, biomass and more), wind and solar farms, rewilded land and restored peat bogs for carbon capture, the processing industries that are needed to sustain the land-based industries and land for homes to enable people who work in land-based industries to establish a life. This will be peppered with eco-tourism, a hutting movement, relocation of energy-intensive industries which are best based close to energy sources (i.e. co-located with wind farms) and other signs of a vibrant rural economy. But each of these in themselves must be well-managed – Scotland needs planting between wind turbines to encourage biodiversity and carbon capture, the integration of woodland development into agricultural practices, the management of deer and sheep populations, the reintroduction of species which have faced population loss, the mixed planting of timber crops, the need to keep open migration routes for animals and much more. This does not happen by itself; currently land is often intensively managed to keep it barren, from now on it must be intensively managed to bring it back to life.

Achieving this will require a National Land Agency. This will have two primary functions (and could be two organisations); to oversee the land planning and to actively restore and manage the land. It would implement a proper reporting mechanism from private landowners, impose requirements on them and monitor performance, gather data and provide a centre of learning. But it will require investment. If land is to be bought for collective development it will require fair compensation to existing owners – although the level at which this is set will be contested (the

United Nations has confirmed that 'fair compensation' does not mean 'market value'). Over the course of the 25 years of the Common Home Plan the cost of land purchases might be largely offset if it is subsequently broken up and sold in public offers, but it is very likely that some will remain in public ownership and certainly there will be an upfront cost for the public.

The proper management of land will involve three main elements; investment, supply chain and workforce. There needs to be a supply chain to enable reforestation, which mainly means large nurseries to produce saplings for planting (the market will respond to this challenge and existing tree nurseries can scale up quickly). And there needs to be substantial training to increase the supply of a workforce with the skills needed for land management. Current direct employment in forestry in Scotland (not including secondary and processing jobs) is summarised in the following table:

Activity	Direct employment (FTEs)
Forestry Commission (including Forest Research)	1224
Forest/woodland owner/lessee	995
Land agents, consultancy, advice, legal	121
Forest management (incl. ground prep., fencing, planting, nurseries etc.)	1701
Harvesting, sales of wood and timber	1268
Misc. self-employment (planting, managing, harvesting)	1000
Total	6309

This includes areas of current forestry which currently may not be particularly well managed and if the total forestry area is to be roughly quadrupled then in total an additional workforce in the order of 20,000 more people will be required in planting and management.

The costs of establishing and managing forest inevitably vary according to conditions and use. The following table gives an estimate of the range of costs:

Type of woodland	Lifetime management cost (per HA)	Of which planting and establishment costs (per HA)	And annual management cost (per HA)
Farm woodland managed for mixed objectives	£13,900	£7,700	£124
Broadleaved woodland managed for biodiversity	£9,900	£4,000	£118
Broadleaved woodland managed for timber	£13,400	£7,100	£126
Upland conifer, managed for timber	£6,900	£3,400	£70
Lowland conifer managed for timber	£9,700	£5,200	£90

To move towards 50 per cent of Scotland dedicated to forestry, approximately two and a half million additional hectares must be planted and managed (though some of this can be unmanaged wild land which is covered in trees). A crude average of the above costs would suggest that this would cost (over the full lifespan of the forests) about £25 billion, not including the purchase of the land.

However there are a number of factors which make this an overestimate. First, there is simply much more land in Scotland which would be at the lower end of this cost spectrum because of the nature of the land (i.e. there is a more limited scope for the more expensive options). This cannot be achieved in a very short timeframe because of constraints on available land, supply chain and workforce. The lifetime of a forest in the above table is assumed to be more than 50 years and those could themselves only be planted over 50 years, meaning those costs would be spread over the best part of a century (though with substantial

front-loading of costs). Over that lifespan the cost of planting forests should decrease substantially as proper deer management reduces the cost of deer fencing (once deer numbers are proportionate to woodland cover natural regeneration will mean that in many places woodland will begin to 'plant itself'). And of course many of these costs would be borne by individual land owners and most will generate profits (in timber and other crops) over their lifetimes. However, to make the rapid and substantial progress needed it will need a substantial injection of investment over the 25 year period. Dedicating something in the order of £10 billion over the 25 years of the Common Home Plan may be a reasonable assumption. This would be used for compulsory purchase of land, development of workforce, replanting and ongoing land management.

Agriculture

The approach to better land management in agriculture has been discussed above (see Food) and the costs and implications of moving to a system of agroecology are covered in that section.

Forestry

The environmental benefits of forestry are largely covered above, the need for timber to displace unsustainable construction materials has been discussed (see Buildings), the merits of integrating woodland into agricultural land has been considered (see Food) and the need to think about a much greater use of wood in product design and manufacture is covered below (see Resources). But what does a good forestry environment look like and how is it achieved?

Scotland has an unusually wide range of forestry types with growing conditions in the north in the same category as the Nordic countries, the south being in the category of continental Europe and the west being an oceanic zone. Very little of Scotland is above the treeline (the altitude at which

trees do not grow) and most of our land is suitable for forestry. Land is categorised according to its uses on a nine-point scale, with Category 1 being prime arable land and Category 7 being land with poor quality soil, with agricultural use limited to rough grazing (the top two categories are of no value to any kind of forestry). While it makes little sense to plant woodland in land in the highest categories for agricultural use (other than as a mixed management approach), most of the other land categories are capable of sustaining some kind of tree planting (though the least fertile soil is not going to provide commercially viable forestry and so would be developed for carbon capture and biodiversity). This means that Scotland is able to sustain a particularly diverse forestry industry with a wide suitability of tree types. However, climate change is causing changes to growing environments and there may be changes in the species which fare best in Scotland.

Next to land ownership and management, the biggest barrier to forest development in Scotland is deer management. It is hard to overstate how damaging a dense deer population is to forestry. The combination of Scotland's abundance of open land but comparative shortage of forestry in combination with the herd-maximising practices of shooting estates means that ratios of deer populations to available woodland habitat is badly out of balance. This leads to over-foraging which prevents the forest floor from regenerating and regrowing and makes establishing new forestry particularly expensive because of the need for extensive deer fencing. This is not good for the deer either; unsustainable populations in the summer lead to the deaths of many deer in the winter months when deer take shelter in woodland (and die quickly if they are fenced out of woodland) and there is simply insufficient habitat to feed them. All of this results in a cost for forestry in Scotland which is much higher than that in Norway where deer fencing just isn't needed because the volume of forest keeps the deer density at a balanced level.

This means we need a serious deer management regime. This will involve population control through stalking (especially

with a switch to highly controlled non-recreational deer hunting which is the norm throughout Europe in comparison with the elite recreational model found in Scotland), but that in turn can provide an organic and ethical source of food. Venison should play a much larger role in the Scottish diet and supporting supply chains, combining wild venison with farmed venison to ensure continuity of supply for supermarkets and promoting the meat to the public would all help. The re-introduction of predator species might also be considered – lynx are good for controlling the population of roe deer and wolves keep deer populations moving which reduces the overgrazing impact on any given area. Once greater volumes of woodland are established, Scotland will again be able to sustain larger deer populations with lower densities in the woodland.

The volume of sheep farming in Scotland is declining, partly because of the poor economics of hill farming but largely because a new generation of farmers are less interested in hill farming. Sheep are just as damaging for forestry as deer. Close grazing prevents deeper and wider root systems from developing and these larger root systems decompose into the soil, capturing carbon. Excluding sheep from areas which are to be developed will be necessary.

This creates the conditions for forests to re-establish across Scotland, but planning these is important. The post-war practice of extremely dense plantations of single crop trees (Sitka Spruce from Canada was discovered to be the most successful fast-crop tree for Scotland) did not represent good land management. These plantations are of low value for wildlife and long-term soil health because of the density of the planting and the lack of diversity. Good modern commercial forestry takes a different approach and is made up of mixtures of planting, each in smaller blocks (though far too much remains stuck in the old model of dense single crop planting). Faster growth conifer blocks are staged for successive cropping (to avoid the massive clear-felling of large areas in one go) and interspersed with other planting.

While best practice planting remains limited in scale, this must be the vision for the future – to include broadleaf planting

for long term timber production (roughly, conifers are what most people know as softwood trees and broadleaf indicates hardwood), mixed native woodland planting for potential cropping and biodiversity, gaps between planting to enable wildlife, careful management around watercourses to protect river habitats and so on. This approach produces a sustainable, profitable and indeed beautiful approach to how forestry sits in Scotland's land. There are of course other approaches to sustainable forest management such as 'continuous cover' where rather than felling entire areas of trees when cropping, trees are taken out selectively over a larger area and new trees planted (or allowed to regenerate) in their place. Unfortunately, not enough modern forestry adopts these good practices.

As pointed out above, Scotland's land is not 'natural' or 'wild' but the result of human action. Likewise, if we want a substantial increase in healthy forestry in Scotland we have two options: manage the forestry or wait a very long time. The lifecycle of a forest is measured in hundreds if not thousands of years and an unmanaged forest goes through a number of stages (each of which can last centuries) before they reach any kind of fully-developed and fully-established state. Even a well-managed new plantation will take a hundred years to become properly established for broadleaf and 50 for conifers (though the commercial cropping can begin in a few decades for fast-growth spruce and pine and a few years where coppicing for biomass and other use is deployed). To achieve this we need to make the investment in land management and workforce training which is outlined above.

Processing and supply chains

The better use of Scotland's land needs a wider infrastructure to support it. Timber needs processing, food production needs distribution and will benefit from localised processing, wind farms benefit from the co-location of energy-intensive businesses, biomass needs a biomass boiler infrastructure – all of this in turn can stimulate the manufacturing industry. If the supply of

new materials from a land strategy is not met with the economic capability to absorb those materials then the benefits are greatly reduced (exporting is of course desirable economically but for the purposes of the Common Home Plan the focus is on the immediate environmental and social impacts, so the emphasis is on replacing existing non-renewable materials). There is great benefit to rural economies if value can be added locally before the product is transported onwards to national centres for further processing. This will reduce raw material miles. In the case of wood products, for example, round logs could be cut into boards and seasoned before being transported by road and rail to centres for further processing. Or even better, specialist light engineering firms could be scattered throughout the forest to manufacture their products (as is the case in Finland).

This will require a national industrial strategy, a coordinated plan for shaping and influencing the economy. Common Weal has published a number of reports outlining the elements that make up an industrial strategy. It requires an 'entrepreneurial state' mindset which sees government as an active player in the economy and not a 'referee' standing back and watching things unfold. The Scottish National Investment Bank should underpin an industrial strategy, public procurement must be used to help sustain developing industry sectors to help provide guaranteed order books, economic development must emphasise economic connectivity and supply chain development and integration, diversification strategies must be put in place, genuine public-good private-public partnerships should be developed but government should also intervene directly where it needs to – among many other practices.

In developing an industry sector to support forestry there are cases where existing industries and businesses can be scaled up, others where diversification can bring existing businesses into new areas. With international partnerships, specialised businesses may be encouraged to develop a manufacturing or processing presence in Scotland. But there will be occasions where the business base simply does not exist and so must be established from the ground up. This in turn might involve negotiation with potential start-up businesses or overseas businesses, but it might also mean establishing publicly-owned companies.

Scotland must rapidly develop advanced timber processing facilities capable of making modern cross-laminated structural materials which can displace steel and concrete in construction. It needs the capacity to manufacture wood-based insulation materials (and this is required quickly) since current materials are either environmentally harmful or require international transport (Scotland imports its cellulose insulation from the continent, which has a significant carbon footprint). It should develop more capacity to make paper-based packaging materials and should develop partnerships with universities to begin making new and advanced materials from biomass (including 'bioware' and bioplastics). Biomass is an important component in heating off-grid houses (those not being connected to a district heating system) and in topping up heating in rural District Heating Systems. For this we should be manufacturing sufficient wood pellet fuel, most of which is still imported into Scotland. And we should be expanding the Scottish advanced materials research and manufacturing capacity to innovate new ways of replacing plastics and other non-renewable materials with wood products. The investment needed in the rural and forestry aspect of an industrial strategy can only be assessed properly once a more detailed plan is in place, but will certainly come into the hundreds of millions of pounds over the 25-year course of the Common Home Plan.

Seas

It is easy to forget that over 80 per cent of Scotland's landmass is underwater. Unlike Scotland's land, most of our seas are not enclosed or owned. The sea, the marine life inside it, and the seabed are publicly owned assets and the use of them is licensed and at public discretion. Throughout history, Scotland's seas have been of huge cultural and economic importance – neolithic settlements in the Forth were constructed out of oyster shells, and villages like Plockton were planned to exploit the historically huge herring runs. The harbour towns and villages fringing our coastline were built on fish and this relied on an

abundant resource. Sadly, Scotland's Marine Atlas indicates the natural health and ecological resilience of our seas have been in decline for decades.

At the peak of the herring boom in 1913 there were 10,000 boats fishing for herring in Scotland alone. At this time, Scotland's seas were also much healthier – seagrass distribution in the early 20th century was somewhere between 50 and 75 per cent greater than it is currently. Seabed habitats that provide essential spawning and nursery functions for fish, such as maerl beds, flame shell reefs, and sponge fields were intact. Historical accounts of the lost wealth of Scotland's seas read like fiction in the modern era of depleted stocks and denuded resources. As anyone who visits Scottish ports will know, the ghosts of a once-vast industry remain and are testament to fisheries that supplied huge amounts of seafood, employment and economic activity across Scotland.

Our seas are now in a degraded situation, both in environmental and economic terms. Following an extended period of overfishing the quota system was introduced, effectively establishing fishing rights as tradeable assets, which have become concentrated in fewer and fewer hands. There are currently around 2,500 fishing boats operating in Scotland. The vast majority of these are small scale creel boats, using pots to catch species such as crab, lobster and langoustine. Whilst creeling makes up the majority of vessel numbers the creel industry is diverse and its management under-resourced. The bigger fisheries, specifically the trawl and dredge industries, dominate the lobbying landscape but perform poorly against both environmental and economic targets. They are highly concentrated, with much of the quota or capacity controlled by a handful of businesses. It has led to the inequitable situation where fishermen are forced to lease quotas.

Whilst societal and technological changes mean we will never go back to the time when sail boats towed nets for inshore turbot with minimal environmental impact, the situation we find ourselves in is unsustainable. Following consolidation of the industry's control of quota fish stocks, those within the fleet excluded have resorted to catching species lower down the

food chain. Scotland is now fishing these harder for the same or lower returns. As catch per unit effort decreases, fishing boats are having to reach in to the 'marginal' areas of our seas, leading to an increase in reports of boats illegally entering Marine Protected Areas. Some industry bodies have even successfully lobbied to open MPAs to trawling and dredging. This further undermines the carrying capacity of the sea, by destroying seabed habitats which provide spawning and nursery grounds for fish. This is only making things harder for the businesses and is ultimately a dead-end.

A proper Green New Deal for our sea would find easy support because increasing productivity of our seas by recovering natural processes is in the interests of both the fishing industry and the environment. The key challenge, and the reason we have found ourselves in this situation, is that the seas are a common resource and without effective governance to fairly distribute access to that commons, there is a race to the bottom. The allocation of fishing rights in Scotland is far too centralised and must be diversified so more businesses can get a chance. But crucially we must change how we allocate these quotas; they must become based on economic, social and environmental sustainability criteria and not on the basis of influence and lobbying. There must be a clear preferential for businesses which can demonstrate that they are able to fish in a sustainable way which does the minimum harm to sea life, and the social and economic impact on coastal communities should also be a factor.

But if we are to diversify our seas we must also decentralise the fish processing industries. At the moment it is difficult to sustain fishing businesses in many traditional fishing industries because what is caught cannot be processed locally and so is transported longer distances. There are clear economic and social impacts on these communities but there are also many ways in which this is environmentally harmful. An industrial strategy for Scotland must support and encourage the rebirth of fishing communities by supporting the development of the infrastructure which will enable that rebirth.

Another substantial part of Scotland's aquaculture is fish farming, mainly of salmon to supply the luxury food export market. These are currently mostly 'open containment' where the fish are kept in large cages but in open coastal waters. This brings a number of environmental issues with pollutants from the fish farms and disease derived from dense populations (particularly sea lice) able to reach wild fish stocks. There should be a moratorium on the expansion of this industry and a proper strategy put in place so that Scotland can maintain a thriving aquaculture industry which does not harm wild fish. Another factor in farmed salmon which must be addressed is feed supply. Almost all the feed used in domestic salmon fish farming is imported from the other side of the world (in the form of various small fish). No matter how well Scotland's seas are stewarded, it will continue to harm the world's oceans if we are contributing to the collapse of fish stocks in other parts of the world which are less well stewarded (the small fish would have become the natural food source for larger fish in the seas where they are caught). This is simply exporting harm to other, often developing countries. There are many proposed alternatives to this (such as farming insects domestically to create a new feed supply chain). Those operating fish farms must come forward with proposals for achieving this with a clear timetable.

One option for farmed aquaculture is 'closed containment' – onshore fish farms which are not directly linked to the sea and so where the pollutants and any potential diseases do not affect wild stocks. The technologies and practices in this area of aquaculture have developed rapidly and many kinds of fish species can be farmed in this way. However if greater closed-containment fish farming is to be developed there should be close consideration given to the impact on fishing communities – these facilities should not all be built on industrial estates in the central belt and the public planning process should seek to make sure that coastal communities gain the benefit of developments of this sort.

This points to another opportunity to improve how we manage our seas – species diversification. Scotland is overly-reliant on salmon in its aquaculture and we should diversify the species we specialise in. This is good for the economy but also good for sea management and fish stocks. There are

already moves to restore oyster reefs since this will greatly assist seabed recovery. But moves like this will, in time, also open up opportunities for Scotland to develop new markets.

Finally, while marine-generated energy has already been considered (see Electricity above and Trade below) it is worth noting that, just as rural communities close to large wind farms are expected to gain some community benefit, so the impact of large marine energy development in coastal communities should bring community benefit to them as well and this must be planned into the development of this energy source.

Water

Water shortages are not an obvious problem faced in Scotland given the level of rainfall, but while this is broadly true for much of the country, there are specific geographical areas which are already facing water shortages after extended periods of dry weather. This is due to a combination of geographical features, increasing local demand and the volume and quality of local water storage and distribution. Responding to this is site-specific and Scottish Water has an existing water shortage plan which should be implemented. Some investment in greater storage capacity may also be needed. However, this does not mean that Scotland shouldn't manage its water much better and certainly avoid water wastage. This will be given further discussion below (see Resources).

Making this happen

- Set up a National Land Agency to oversee the management of Scotland's land.
- Set a target of 50 per cent reforestation and task the National Land Agency to deliver it.
- A process of National Land Planning should be introduced to zone rural land in Scotland for specific defined purposes.

- A greatly-strengthened system of regulation and reporting on land management must be put in place.
- A large-scale workforce training programme must be implemented to train roughly 20,000 additional land managers.
- A land ownership strategy must be developed quickly and a programme of land reform put in place, including direct action to diversify land ownership in Scotland
- A rural industrial strategy must be developed and implemented
- Scotland must move to an agroecology system for farming as outlined in the Food section.
- The quota system for fishing should be changed so they are assessed on environmental performance
- Scotland's water shortage plan must be fully implemented.
- Investment in the order of £10 billion must be anticipated over the 25 years of the Common Home Plan.

Resources

The Circular Economy

The overall aim of a 'circular economy' is to keep material resources and products circulating in our economy at the highest value possible, minimising the need to extract new resources from our environment and preventing the creation of waste. However we currently live in a mainly 'linear economy' where we extract resources and make materials and products, use those materials and products and then discard them as waste. 'Waste' is a concept created by humans and it does not occur in nature. Indeed, waste is really just a way of describing failures in resource use and we need to eliminate it to achieve a sustainable net zero society.

Our consumption of products and materials in a linear economy drives our carbon emissions, with huge amounts of embedded carbon contained in the products we buy. This is added to by the emissions created from treating these products as waste when we discard them: methane emitted from landfill sites or CO₂ from incinerating the waste. Despite countries signing up to climate commitments the OECD projects global materials use to more than double from 79 Gt (giga tonnes) in 2011 to 167 Gt in 2060. So action on our energy use is not enough; we need a circular economy to achieve zero carbon. Scotland is already one of the world leaders on the transformation path to a circular economy and the existing national strategy is still the correct holistic approach – we just need to implement it faster and further. Responsible consumption has to be the main focus as well as sustainable production approaches. Companies and consumers need to make the leap and we need low carbon industrial manufacturing, with more based in Scotland rather than abroad.

Multiple drivers are challenging our throw-away society. Images from the BBC's Blue Planet series and social media are having an impact on consumers. Now is the time for a ramp-up of efforts and to make a lasting difference. The practical measures required to achieve a more circular economy are already well known. They include:

- New fiscal measures, such as taxes and pricing mechanisms.
- New regulations, such as bans for the most damaging products/materials/activities.
- Changes to public procurement to ensure low carbon and the circular economy are at the heart of public spending and to help support these industries as they develop.
- The introduction of 'producer responsibility' schemes and laws where producers are made responsible for their products and their environmental impact throughout their lifetime.
- Developing new business models and investing in resource use innovation.
- Consumer awareness campaigns to change lifestyles and expectations.

All of these changes will benefit our economy. Research studies have already shown that rather than create new costs, this transition to a circular economy will generate billions of pounds in savings and new opportunities for business.

Reducing consumption

The first and most challenging task in managing resources sustainably is to reduce consumption in the first place (deconsumerisation). This is challenging because western economies (and the politics which manage western economies) are almost wholly geared around expectations of constantly rising levels of consumption. There is no consumption that does not require resource inputs and making all of those sustainable is not possible given the overall volume of that consumption. And yet the steps towards it are straightforward. This is discussed in more depth below (see Us) but achieving a reduction in consumption is a prerequisite for achieving sustainable and circular resource management. This must not be seen as a 'cost' or a sacrifice but be embraced as a positive choice which will improve the quality of our lives and our health.

Materials

The key to a circular economy is the materials we use – and the materials we don't use. The resources we use have to be sustainably sourced and in a form that allows them to be used again, thereby preventing them from becoming waste. This can only be achieved if we also look at the materials we don't use – first because we are not consuming them in the first place, reducing the volume of disposable consumption to manageable levels. With those that remain we want to achieve a lifecycle of materials in human society which mimics the lifecycle of materials in nature – a limited range of common materials used for most things with natural materials that go back into the soil at the end of their useful life and non-organic, technical materials that we keep in circulation in our economy for as long as possible before loss (such as metals and glass). This 'biomimicry' concept applies to everything and so all materials should have to pass a test on their sustainable sourcing and recyclability. This test should be part of all Producer Responsibility Schemes as they are introduced for different types of product (see below) and monitored by a National Consumers Agency (see Us below).

A lot of attention has been focused on the use of plastics in our economy and the negative impacts on nature and the potential impact on the human food chain. Humankind needs to phase out the use of these materials altogether as there is fundamentally no environmentally acceptable way to return these into the biosystem at the eventual end of their life, even if they are reused and recycled many times before that happens. And it must be noted that their day-to-day use will create 'microplastics' (like 'plastic dust' which comes simply from friction on the surface of the plastic when it is touched and moved). Microplastics are already causing serious environmental harm, particularly as they can now be found in the digestive tracts of most animals species, even those found in some of the remotest depths of the ocean. We must treat the recycling of plastic as the first response to failure – but it is still a failure. Instead there should be a 'reject and reuse' approach.

However to phase-out the use of plastics is a huge

task and some alternatives can be less recyclable and more environmentally damaging – a world of billions of people requiring more extraction of resources from the natural environment to replace plastic could increase biodiversity loss globally. In the interim period, rather than replacing plastics completely we need to look more holistically at the issue. First we must simply prohibit or make unattractively expensive many plastic goods altogether, and this very much includes packaging. We must shorten supply chains (see Trade below) so that we end the use of many forms of plastic packaging which have the sole purpose of protecting goods during long-distance transport. Any plastic we can replace immediately we must replace (see below). Even after this, for a period of time there will be applications of plastic we are not yet able to replace. For those we must change the culture of our consumption from using disposable products to reusable products which will further reduce plastic consumption and its negative impacts; this has been sufficiently demonstrated by the change in patterns of use of plastic carrier bags after a 5p surcharge was made mandatory. Another example being adopted in Europe is introducing reusable coffee cups (with a deposit) that can be handed back to a coffee shop the next time you buy a coffee. You get your deposit back and the coffee shop washes the cup for the next customer. So the key here is to get away from our disposable society and make the move to reusable products the new norm.

Allowing only the most recyclable types of plastic (PET, HDPE and PP) in our packaging and products and ensuring these are properly collected at the end of their lifetime will also minimise the negative impacts where a reusable model is not yet available, and it will ensure any reusable plastic products can ultimately be recycled. Again this can be achieved through regulation within Producer Responsibility Schemes ranging from packaging materials to vehicles and electronic goods. And for the most damaging products these should simply be banned, as the European Union is doing in its Single Use Plastics Directive.

Scotland has the potential to develop much, much greater use of one particular material: wood. Scotland is currently one of the least-forested countries in Europe, but also has one of

the highest potentials for forestry (see Land above). Wood processing is now an advanced manufacturing industry in some countries with advanced cross-lamination providing a wide range of applications (there is more information on cross lamination in Buildings above). Cross lamination can produce a range of goods from obvious ones like furniture, tableware and stationery to more surprising ones such as casings for electrical appliances and high-performance sports bicycles. Many of the goods we currently assume must be made of plastic can be made from wood. Above, the role of wood in replacing the vast majority of current non-renewable materials has been discussed – even structural roles which previously could only be fulfilled by steel. If we include other forestry crops such as bamboo (which can easily be grown in Scotland) the range of goods in which plastics can be replaced increases. And of course there is a wide range of paper and cardboard products which can replace non-renewable packaging materials.

Even more advanced processing of wood is being developed. One example is the use of wood in additive manufacture (commonly known as '3D printing'). Here fine wood dust is combined with binding agents (which themselves need to be organic), then built up in layers into what can be very complex and intricate component shapes. This could be used to replace plastics in a range of component manufacture. Another example is that the cellulose in wood can form the basis of bioplastics (materials which feel and behave like plastics but which are naturally-derived and fully compostable) and raw organic matter can be fermented with particular bacteria strains to form bioplastics which can be used for anything from injection moulding to thin, transparent 'cling-film'-like materials. It should be noted however that the production of plastics in this manner can put significant strain on biodiversity and soil health if it is treated not as renewable but unlimited – more mass planting of new crops to produce new bioplastics is not the way forward.

Looking at the products people use every day it becomes increasingly clear that replacing non-renewable materials like plastic is perfectly achievable; Scotland needs a combination of support for the development of these manufacturing industries

and regulations to compel a shift in the direction of their much greater use.

Producer Responsibility

The concept of 'producer responsibility' which can have a genuinely transformative impact on our relationship with materials. Since at the moment most producers have no responsibility for their products after sale (other than guarantees) they have little or no incentive to consider the long term implications of how and with what materials a product is designed. Indeed, in fields like 'fast fashion' the economic incentive is to produce products with the shortest possible lifecycle and with no attention paid to the implications of that product after its use period (how reusable, repairable, recyclable or biodegradable the materials are). Producer responsibility laws or schemes would change this; the manufacturer or retailer would retain responsibility for the produce throughout that lifecycle and would be required to take responsibility for its reuse, repair and recycling, and responsibility for sustainably disposing of any residual materials at the end.

There are different ways this could be implemented. For example, waste collection of certain kinds of goods might be ended completely and instead consumers would need to return them to where they bought them and the manufacturer would be required to reprocess them from there. Alternatively, a tax could be imposed on the sale of the product which accurately reflected the final cost of end-of-life processing which could fund its proper reuse, repair or recycling. Producer responsibility would increase the retail price of goods in the shops, but it would result in a substantial drop in the costs paid (through tax) for waste collection, disposal and processing and in other environmental mitigation costs. Indeed, it can be argued that a substantial proportion of the overall cost of the Common Home Plan is Scotland paying the price now for decades past in which the 'true' price of consumer goods was never paid.

Reduction and Redesign

One of the best ways to achieve a circular economy is to 'dematerialise' a product (using less or even no material in its manufacture). Examples of this are newspapers and music which can now be sourced online rather than in a physical form. Innovations to provide more and more services in a digital format are developing all the time. However not all products can make this shift so we need to find ways to reduce the resources involved where a physical product is still required in our society. The key to change here is a fundamental shift in the business models used in our economy. If businesses retain ownership and control of, or responsibility for, the products they produce then they are incentivised to design those products differently. For example:

- Leasing and renting products to make them a service rather than selling new products, thereby incentivising companies to make the products last longer and be repairable – this can work for many things from LED lighting to phones.
- Utilising more sharing economy approaches, such as tool libraries – when a power drill is used on average for only an hour or two a year, why not borrow it from a local tool library rather than own one?
- Finding new ways to fully utilise products rather than them sitting idle for most of the time – autonomous vehicle sharing in the future offers this potential.
- Incentivised return of the product to the producer – Deposit Return Schemes for drinks containers exemplify this but the principle can be applied to anything that works with a deposit; household batteries, mattresses, small electrical items and car tyres are all examples that have potential.

Getting access to the service you need without actually owning the product is important to dematerialise our economy and make it more efficient. This cultural shift is already happening but it can

be achieved faster by government using the right fiscal incentives and creating a regulatory framework that supports this approach. Measures such as mandatory long guarantees, incentives for take back, public procurement leading the way to change markets and designing Producer Responsibility Schemes and Laws appropriately have the potential to speed up this change.

One area that will require change is our education and workforce training. We need the designers and business leaders of the future to understand how our circular economy should work and design their companies accordingly. Scotland's design schools should specialise in 'dematerialised design' – product design which specifically aims to reduce the volumes of materials used in the manufacture of a product and ensure that the materials used are sustainable and can be reused over and over again and recycled at the end of their useful life.

Reuse, Remanufacturing, Repair

After reducing the resources we require in our economy the best thing we can do to reduce emissions is to ensure the resources that we use are kept circulating at the highest possible value. 'Highest value' is important; many people assume that when a material is recycled it returns to its original form, but this is incorrect. Many materials when they are recycled become materials of lesser value, degrading in the process (this is particularly true of plastic). So while they may well be recycled, each round of recycling produces a less complex and less valuable materials – until it is no longer recyclable, perhaps after only one or two cycles. Recycling should always be considered 'the first response to failure', with the long-term aim to achieve the high value 'inner loops' of a circular economy, where products circulate through the processes mentioned above such as renting, sharing, leasing and reuse, which are all far more resource and energy efficient than recycling. Reusable materials and products should become a bigger and more fundamental part of our economy, reducing the production of wasteful, high emission, disposable materials and products.

Sometimes products can be repaired or remanufactured and this is also highly beneficial. A remanufactured product can often have a longer life and guarantee than a new one and also be more reliable. This is because remanufacturing is not a simple refurbishment but is in effect like making a product anew – albeit utilising something like 80 per cent of the original product's parts ensuring a massive saving in embedded carbon. This offers the opportunity to address weaknesses in the original design, hence remanufactured photocopiers, engines and gear boxes can be more reliable and longer lasting than when they were new products. This approach works for highly durable, low turnover products such as automotive and aerospace parts as well as energy infrastructure. Research shows that Scotland already has a significant remanufacturing sector, disproportionately bigger than the rest of the UK.

There are already examples of our culture changing towards greater acceptance of reuse over 'new' for some durable goods. Charity shops and online marketplace platforms which help people buy and sell functioning but used products are all established, popular and growing. For fast-moving materials and products such as packaging, emerging examples of reusable alternatives are beginning to be developed alongside long standing bottle reuse schemes; these are common in European countries where soft drink producers and breweries collaborate on a single reusable bottle design and provide a take-back and washing system. However we need to accelerate the adoption of reuse in our economy and support it with incentives. Some steps that we can take in Scotland include:

- Develop more Reuse and Remanufactured quality standards, such as the Revolve standard for charity shops, to give consumers confidence. It is important to ensure that Remanufactured is treated the same as a new product in such standards.
- Introduce a requirement that public procurement must consider reuse and remanufactured options and where a product fails under a procurement contract it must be replaced with a reused or remanufactured one.

- All Producer Responsibility schemes should prioritise reuse options over recycling and be appropriately incentivised.
- Provide incentives and support for reuse facilities such as Tool Libraries and Repair shops and cafes.

Recycling and Reprocessing

Recycling and reprocessing should be considered as 'the first response to the failure to reject, replace and reuse' and not as a desirable goal; it is a baseline we must constantly strive to better. This will enable all materials to be recovered and reprocessed for the next cycle of production, or in the case of organic products such as food, for this to return to the soil as a fertilizer for the next crop. This means that Energy from Waste (EfW) and landfill are only intermediate disposal options for solid waste that we must reduce to zero as quickly as possible – we should seek to phase these out to an ambitious timetable using pricing measures to make them unattractive options and producer responsibility schemes and laws to incentivise and compel the reuse and recycling of materials.

To achieve this aim, and for recycling to be systematic and widespread in our economy, requires two major investments. The first of these is in the redesign process of the supply chain of materials we commonly use (as mentioned above). Materials in our economy need to be from a simplified palette of options to ensure materials can be easily separated for high-quality recycling without losses due to contamination. This challenge has to be met by the companies producing our goods and the packaging associated with them supported by the right regulatory framework.

The second element is the collecting and reprocessing of materials once they have been used – creating an efficient and effective 'reverse supply chain'. This element involves consumers and businesses. Household waste in Scotland is around a third of the total solid waste material we produce, and it is a very carbon intensive type of mixed waste. Despite great success to get Scotland's household recycling rate above 40 per cent from a low base, much of this has been done on the basis of goodwill

and awareness from householders. Recycling performance has now reached a plateau for household waste; indeed we may see it decline due to the challenging budget constraints on local authority services and infrastructure. Analysis shows that a significant amount of recyclable materials and products end up unseparated by householders and businesses, going instead into bins destined for EfW or landfill. This is recognised as a common issue in many developed economies and therefore new interventions and investment are needed that incentivise the consumer to choose the best options.

We require new interventions that impact on both elements mentioned above, such as Deposit Return Schemes (DRS). This will solve the collection of used drinks containers and also influence future design to make them more recyclable. DRS has the potential to achieve a greater-than 90 per cent capture rate for drinks containers, exactly the sort of level we need to replicate across our economy for all materials/products to build a recycling foundation. As with DRS the key to reaching higher levels is fiscal incentives to provide a value for waste in our economy, but it has to be supported by widespread consumer awareness, appropriate regulation, and convenient and consistent systems for collection. DRS, as in other countries, is a national scheme so everyone in Scotland will use the same system and receive guidance through national-level awareness campaigns and messaging. The materials collected will be separated and processed to the same standard across the country and made available in large quantities for businesses who wish to use them for new production.

However in Scotland the majority of the collections for recycling of household and small business waste are undertaken by local authorities. This means many differing services are provided and their use promoted through local awareness campaigns. The fragmentation of the collection approach means different materials are collected, and the quality varies from region to region making it challenging for businesses to utilise. Users of these systems are often confused as to what material is recyclable and in which container it is to be placed. And this approach relies on no incentive other than an interest in good

behaviour. In effect it is a fragmented reverse supply chain that favours export of the material to countries with lower standards for contamination and quality.

We need to provide sufficient quantities of recycled material at high quality for businesses to base production lines upon. That will require proper incentives and a move to a national system that is consistent like the planned DRS. Some states have started to do this with centralised sorting and reprocessing infrastructure and many others have introduced charging systems for householders to incentivise better sorting and recycling rates. Scotland has made a start with the Household Recycling Charter – aiming to make local authority collections nationally more consistent. This needs to go further, and we may be at that pivotal point for the collection of waste materials that was previously reached for the provision of water, gas and electricity services – we need a national utility type of solution and not a local one. Moving from the current fragmented service format to a National Resources Agency model could ensure the foundation of a circular economy in Scotland. Features of this agency would include:

- Coordinating the materials collected from households by Councils into a central resource for reprocessing and onward sale to Scottish businesses, in a way that creates economies of scale to attract new infrastructure investment and sufficient volumes of material on which to base new production.
- Acting as the national coordination point for fees received from relevant Producer Responsibility Schemes where they help fund and support household collections for their materials/products.
- Eventually replacing the household recycling and waste services function now operated by Councils to create a consistent national service, backed by national awareness campaigns, regulations and household charging to incentivise recycling – effectively removing waste services from the Council Tax and central government funding model.

In the future more high-value products may be collected by separate Producer Responsibility systems, for example batteries, clothes, mattresses and electrical items could all have deposits on them – bypassing our traditional household waste services. Increased levels of reuse, product bans and other options may also alter the mix of household waste further. So increasingly over time we may expect a National Resource Agency to collect a higher proportion of the lower value, bulky materials such as food waste, garden waste, paper/card etc. However it will be better placed to manage and communicate these changes at a national level than distributed over 32 individual local authorities.

Aside from establishing such an agency, other supporting measures for this change should include investment in new centralised sorting and processing facilities for the waste materials collected. And the Enterprise agencies should support companies to identify the business opportunities for this new improved domestic material flow (see further details in 'Learning' above).

Approaches to resources by use category

Some specific products and materials that we should focus on due to their impact:

Food Waste

This has been covered above (see Food).

Packaging

An item of packaging can have a useful life measured in minutes. For this reason packaging is one of the most observable and destructive elements of our linear economy. The increase we see in packaging and particularly plastic packaging has paralleled our move to an 'on the go' culture where we buy packaged food and drink for quick consumption and have an increasing demand for convenience products such as bagged, chopped fruit as opposed to the actual fruit. At the same time packaging has continued to

grow in complexity and quantity reflecting the aim of extending shelf life and its use in marketing a wide range of products from food and drink to cosmetics and toiletries. This means the original purpose of packaging – to protect the product – is not the only driver and we see many examples of excessive packaging due to product marketing – chocolate Easter eggs being one of the best known products in this category.

There has been a producer responsibility scheme for packaging in the UK for two decades but it is fundamentally flawed. It is estimated that only ten per cent of the cost of the environmental impact of packaging falls on the producers of the packaging through this scheme. This means 90 per cent of the cost falls upon taxpayers and there is no incentive to make packaging recyclable. The EU wants to change this and is requiring 100 per cent of the costs to be borne by the companies who benefit from the packaging. In response, a new Producer Responsibility Scheme for packaging is being developed in the UK, with the aim being to have a more effective regime without taxpayers footing the bill for recycling, litter and waste costs. Some key things we need to see in the new proposals to embed real systematic change include:

- A focus on reusable packaging being the new normal and first choice.
- Greater recycled content in packaging delivered via effective tax incentives.
- A simplified palette of plastics and other materials used to facilitate greater recycling and recyclability. Phasing out non-recyclable materials altogether.
- An absolutely definitive labelling system that ensures citizens can know which recycling container to use for which packaging.
- Clarity on where compostable packaging should be used and not used in our economy.
- Redesign of hard-to-recycle laminated packaging to deliver the same performance but with simplified materials.
- A solution to films and bags that ensures these are recycled.

Clothing

The annual production of clothing has a huge carbon and water impact and generates billions of micro particles of synthetic materials contaminating our food chain and oceans. We consume over 80 billion items of clothing a year globally and this accounts for five per cent of all carbon emissions. The UN has calculated that new garments and clothing are now worn for 36 per cent less time than 15 years ago. Fast fashion is having a huge impact on the planet and currently clothing made of mixed synthetic and organic fibres are almost impossible to recycle at the end of their lives. The solutions are not all technical but instead require a significant culture change in our society as to how we see and use our clothing. This change has to be led by consumers, government and other bodies as the clothing industry benefits financially from the fast turnover in fashion. The challenge for Scotland is that most of the clothes we wear are produced overseas and so it is difficult to influence those supply chains. Some simple measures could include:

- A producer responsibility 'levy' on all new clothes sold, and fiscal incentives for clothing reuse vendors, to help pay for the collection and resale of used clothing. This approach is used in other countries and Scotland already has some good collecting and sorting infrastructure for clothes but this needs to be enhanced.
- The EU proposal to mandate the separate collection of clothing, and a requirement to ensure that unsold clothes are distributed for use, should be adopted to minimise the amount of clothing unnecessarily landfilled or incinerated.
- Facilitating recyclability by ensuring regulation encourages clothing made of one fibre type, for example cotton or polyesters, and to encourage greater sustainable sourcing of those fibres. Quality standards that target longevity and repair could also be incentivised by producer responsibility levies.
- Public procurement of clothes such as uniforms should drive innovation and require high quality standards of

organically and ethically sourced clothing designed for longevity and encourage more use of clothing rental schemes; so far these work for baby clothes, niche products and companies renting out high-value dress items – but they could go much further.

- However ultimately we need more research into the environmental and health impacts of clothing, the potential solutions, and development of international collaborations to address over-consumption.

Construction

Construction waste adds up to almost half our waste materials by weight each year. Most of that is made of soils, rubble and other inert materials wasted on construction sites or generated from deconstruction. While this waste generally has a lower carbon impact than household waste the sheer scale of material wastage is significant and the vast majority of this material has a value and can be reused to produce new soils and aggregates. How we build new homes and manage our building stock is discussed above (see Buildings). From a resource and net zero perspective refurbishing, maintaining and repairing existing buildings is much more efficient. There are several actions that could reduce this resource inefficiency and reduce the overall construction sector impact on our natural resources.

- Fiscal measures that ensure this material is reused or recycled. The Aggregates Levy and Inert Landfill Tax rates should work together to reduce new material extraction and encourage reuse and recycling of inert construction material. An escalator for both levy and tax to increase reuse and recycling, as was successfully used for the standard Landfill Tax rate, is required to help industry make the transition.
- Moving construction into the factory as is increasingly common in other countries makes a difference. Buildings made in a factory environment generate less waste and can achieve higher quality standards, insulation values

and draught proofing. A factory is also a better premises for ensuring any materials that are wasted are recycled through onsite collections rather than being dumped in mixed skips on exposed construction sites.

- Moving towards a range of sustainable materials for construction that can be recycled at the end of their lives.
- Making changes to fiscal incentives such as VAT to support Refurbishment and Maintenance over new build – which is currently zero rated.
- Ensuring all public bodies use appropriate procurement standards for soils and aggregates that do not favour virgin supply chains over recycled ones. Public bodies can also drive innovation by favouring refurbishment over new build.

Making this happen

- Establish a National Resources Agency to oversee the move to a circular economy.
- Base this on a hierarchy of deconsumerise – dematerialise – simplify – share – reuse – remanufacture – compost – and only then recycle.
- Create a national waste collection and reprocessing service (run by the National Resources Agency) to standardise and maximise resource reuse at a national level.
- Put in place Producer Responsibility Schemes and Laws to make manufacturers take responsibility for the full lifecycle of the goods they produce.
- Use pricing mechanisms like externality taxes to ensure the price of goods reflects their true lifecycle costs.
- Invest in a wide range of initiatives like National Deposit Return schemes, container standardisation and tool libraries to optimise resource use.
- Regulation to discourage and eventually end the use of most single-use materials.
- Set up a National Consumer Agency to monitor all products, require them to be manufactured along circular economy lines and ban particularly harmful materials altogether.

Contexts for trade

The Common Home Plan focusses on things that we can do in Scotland to reduce and eliminate the environmental harm of our direct actions in a way which enhances social wellbeing. But we live in an globalised world and our way of life results in many secondary impacts beyond our borders. These happen when we travel and when we trade. We certainly don't want to lose these activities – international travel enriches our lives and humans have engaged in trade outside of our immediate community for as long as we have existed. But it is not reasonable for us to turn a blind eye to the harm which travel and trade do simply because it is out of sight. The problems of travel have been considered above (see Transport); this section aims to open a debate about what approach we should take to trade.

There are two ways in which trade can do harm: in the production of traded goods and in transportation. There is even harm done in 'digital trade' via the internet if the enormous power resources required to maintain the internet are not generated renewably. One nation has very little (if any) influence over the laws, regulatory policies and energy profile of another.

This is a controversial issue; the ideology of 'free trade' and the assumption that it is an essential motor of human progress is perhaps the dominant ideology of our era, developed by a group of radical right-wing economists in the 1970s but now adopted by political parties right across the political spectrum. While there was substantial opposition to and debate around 'globalisation' (one of the terms used for free-market ideology) in the 1990s and early 2000s, the Iraq War and financial crisis of 2007 moved the focus of protest and debate on to foreign affairs and the financial system and there is now little challenge to free market ideologies. And yet this ideology has not only failed to reverse the environmental harms of the preceding era, it has accelerated them by intensifying agricultural production, stretching and lengthening supply chains, vastly increasing consumption, greatly expanding non-renewable energy usage and producing more and more waste.

The current mainstream political view on how this problem should be addressed is through multinational negotiation – that progress can only come from all nations agreeing to change their behaviours in the same ways simultaneously. This is supported superficially by the argument that the problem is 'global' and so can't be solved domestically. The theory is that if you produce your food or other goods in a responsible way you will be ruthlessly undercut on the free market by those who don't, and if you regulate domestic activity more rigorously (for example by changing construction practices and building standards), this will act as a 'drain' on your economy in comparison to your 'competitors' and put you at a disadvantage. However, this political view is almost explicitly to argue that the world can only make progress at the rate of the least willing participant and the almost total lack of progress internationally on even agreeing targets for change (never mind taking any substantive steps to meet those targets) suggests that it is likely to be impossible to secure even theoretical agreement for a programme of action by the time that the tipping point for climate change identified by the IPCC has been reached.

It is all very well to be heartened by the sight of a generation of school pupils politically organising to pressurise adults to take action; we must also be aware of the counter campaign which is vastly better organised and even more vastly better funded. That counter campaign is the world of political lobbying: meat producers spend many millions of pounds persuading politicians not to make commitments to reduce meat consumption, supermarkets spend just as much opposing new regulations on recycling or waste reduction – and of course the oil and petrochemical industries lobby constantly against phasing out oil. You will often have heard that these industries are already taking these issues seriously and are making change, but that is largely part of the counter-campaign, persuading politicians that if they do nothing the industries will clean up their act by themselves.

There are a number of layers of context for trade which will apply to Scotland. First there is the World Trade Organisation. It's rules are fairly loose and primarily focus on non-discriminatory practice – broadly you can set whatever rules or tariffs you like,

but they must apply equally to every other nation. Then there is the European Economic Area (EEA) which is an EU-negotiated free trade agreement between European nations (all EU members are members but so are a number of non-EU nations). This imposes substantial limitations on what an individual nation state can do, with binding rules on pricing, state aid and competition laws. The next layer of integration is the European Customs Union which harmonises customs systems for all members and which includes all EU states but not EEA states – unless they chose to join individually. There is then the EU itself which extends the EEA into agriculture and fishing via the Common Agricultural Policy and the Common Fisheries Policy, imposing additional limitations on domestic policy in these areas. There is an additional option for trade policy which is the European Free Trade Area (EFTA). This was originally a competitor body to what is now the EU but has become primarily a series of individual trade deals negotiated with other countries and coalitions of countries. This includes a deal with the EU itself. Finally there is the UK where all trade policy and most regulation and relevant tax policies are reserved. The possibilities for action are defined by which bodies Scotland participates in – for example Norway is in the EEA but not the EU and so is able to put in place a different subsidy and policy regime for its own agriculture which aids its own farming industry.

It is important to be aware of the different implications of each of these for the Common Home Plan in Scotland. Inside the UK Scotland has virtually no power over trade at all with policy defined by Westminster. It could be very difficult to 'do the right thing' in Scotland if that is constantly being undercut by a trade policy which makes doing the right thing uncompetitive. If the body setting trade policy for Scotland is the EU, many similar problems would occur. State aid and competition rules might make much of what is envisaged in this report more difficult to achieve, with Scotland dragged through a long series of court cases and dispute resolution processes. In addition, the EU would set agriculture policy and fishing policy which would impact substantially on what could be done (for example, by blocking the route to shifting agricultural subsidies towards promoting

agroecology). It would be a requirement that Scotland integrated all of these rules into domestic law. Whether Scotland had any say in setting these policies would depend on Scotland's constitutional position, but even as a full EU member, Scotland would have limited influence and particularly in an area like agriculture policy, achieving any change at all is notoriously difficult and faces very aggressive lobbying to protect the status quo.

If the framework for Scotland's international trade relations was EEA membership, immediately the need to harmonise agriculture and fisheries policy disappears and Scotland would no longer be bound by the Common Agricultural or Fisheries Policies. However, EEA membership would still require Scotland not only to abide by most EU free trade policies but would also require them to be adopted as domestic law. As with EU membership, this would involve direct exposure to binding rules on competition, state aid and so on. But it would not require Customs Union membership and so Scotland could (if it wanted) introduce an environment-focussed customs system. Membership of EFTA is one further remove. EFTA has a negotiated trade deal with the EU which requires EFTA members to abide by the rules of the European Single Market – but it does not require the integration of those rules into domestic law. That would still give Scotland full access to the single market but with maximum flexibility.

Clearly people will have a multitude of reasons for their constitutional and international relations preferences. If implementing the contents of the Common Home Plan were to be taken as a priority it suggests that the best constitutional position would be Scotland as an independent country, initially with EFTA membership and then, as time progresses, assessing whether full EEA membership becomes preferable and then, after that, whether full EU membership does. Everything in the Common Home Plan should be possible under those circumstances; it is for people to argue for their own constitutional preferences and to explain how the work programme contained in the Plan can be implemented – and to be honest about where it cannot and what alternative approach should be taken.

Externalities

'Externalities' is a term used in economics to describe the cost impacts of the lifecycle of goods and services which are not captured in their pricing. Obvious examples include the enormous cost required to mitigate climate change resulting from the secondary environmental costs of production and transportation which is not captured in the price of the goods, or the cost implications of protecting pollinators across Europe as biocides made food cheaper but at enormous environmental cost. In fact, while people may not realise it, a substantial proportion of your tax bill is in reality a transfer of costs not from the producer to the consumer but from the producer to the citizen. Industry creates the materials that will become waste but you pay for their disposal, intensive industrialised agriculture causes downstream flooding but you pay for the flood mitigation, and so on. The point of externalities is that someone, somewhere, sometime has to pay for them – either with hard cash to mitigate the impacts or through various forms of suffering if we don't. The Common Home Plan is largely focused on fixing the damage done by previous 'externalities' and then preventing them from reoccurring in the future. A nation can control its behaviours and actions domestically, but it can do little about the impact of the other players in the markets in which they trade. What we can do is seek to capture something like the real costs of the externalities in the pricing of goods and services traded in and out of Scotland in a way that makes 'doing the right thing' much more competitive in comparison with 'doing the wrong thing'.

The economic theory behind this is that markets can only truly be 'free' if they enable consumers to accurately understand the genuine costs of goods and services. If a consumer chooses to buy a product they should pay the true lifecycle costs of the product so they can make a more accurate decision about the merits of that product compared to other products, or to other uses of their money. There are a number of ways in which externalities can be much better captured in pricing.

The best way to do it is to invest in and change production processes such that there aren't any externalities in the first place.

That is the aim of the Common Home Plan – to invest collectively to take externalities out of food production, transport, manufacturing, energy and so on. In some (but not all) cases this would result in a slightly more expensive product, but one which required no further interference in cost. This can be achieved domestically and could be imposed internationally (i.e. import regulations would block any products which were not produced without negative externalities), but this would be very difficult to achieve and would largely cut Scotland off from international markets and so could only be an incremental process (see Standards and Regulations below).

A next step in doing this would be to introduce Producer Responsibility Schemes and Laws (see Resources above). That would require producers to accept lifetime responsibility for the products they make and so producers would price products accordingly. This would capture a lot of waste and resource costs in the pricing of goods, but would not capture other externalities related to transportation, pollution and other forms of environmental degradation.

One option would be to use export and import quotas to control the flow of goods based on minimising externalities. This would need to be combined with a coordinated programme of Import Substitution Industrialisation (Scotland would need to be prepared to replace imports with domestic production). There is certainly much merit in reducing the length of supply chains (see below) and quotas could boost the competitiveness of responsibly-produced domestic goods, though they are a pretty blunt tool. Scotland is currently subject to stringent import quotas negotiated by the EU and so in time it might be the case that quotas can be adapted to achieve this aim. But it is unlikely to be a solution in the short term simply because of our current economic reliance on imports.

There are three remaining options for 'pricing in' other externalities. Capturing externalities 'at the border' would mean imposing duties and tariffs on goods which were calculated based on an assessment of real lifecycle costs. There are a number of weaknesses with this approach. One would be the problems this would cause for international trade collaborations and, if Scotland was in the European Customs Union, it would

be entirely impossible. It also fails to capture any residual externalities in domestic production and so might be seen to be discriminatory. It would also be difficult to police this system.

Minimum pricing and price controls could also be used. Just as Minimum Pricing for Alcohol made irresponsibly cheap alcohol more expensive, minimum pricing for other goods could be used to set a 'base level' price for goods which represents something like the lowest cost that product could be sold for if produced responsibly. This would prevent irresponsibly produced products from undercutting responsibly produced ones in price. Another version of this would be the 'Milk Marketing Board' model in which a minimum price was negotiated with producers and the government acting as a 'purchaser of last resort' to ensure the price is maintained. Both of these approaches are made more difficult by European Single Market rules and, depending on trade alignment, might be impossible. This would be challenged in costly and lengthy court cases as with Minimum Pricing for Alcohol and since different prices would be set for different goods, this could become a minefield of legal disputes. Even if achieved, a widespread system of government-set prices would become a constant political football which would not be easy to manage. It is probably the case that this approach would be used only in 'special cases' as with alcohol.

The final main approach to capturing externalities is through tax. For example, VAT could be abolished and replaced with a sales tax which was calculated to capture externality costs (although it would probably require a split scheme as VAT applies to both goods and services and little work has been done on how to measure and embed the externalities of services). This would need to be a 'sliding scale' tax calculated on a formula which would vary from product to product according to their level of externalities. This would clearly not be a simple formula; there are some simple indicators such as 'distance to market' which could be used and could sensibly capture real costs, but other impacts will be product-specific. For example, there could be a series of increments in the tax which would be imposed if certain conditions are not met, such as a 'proportion of plastic used' test or a test on whether pesticides were used

in production. It would also be possible to introduce 'negative' elements in the formula which would reward responsible behaviours, reducing the cost of these goods. In this way a 'basket' of measures could be captured and 'priced in'.

This would not be a routine tax to introduce and would need to be implemented in combination with the 'product assessment' role of a National Consumer Agency (see Us below). Since the original producer of goods would not know all the final destinations of their products and since this would apply to domestic as well as imported goods, the tax would be applied to goods at the point of sale and so would effectively be an environmental sales tax. Either the retailer or, preferably and more realistically, a National Consumer Agency would need to complete an assessment of stock items sold by retailers – but this would only have to be done once, even if the tax rates changed. Any new products would need to be assessed as they are introduced and, if made the responsibility of the retailer, the whole system would need to be monitored through random sampling of products to ensure accurate compliance (with proper sanctions for intentional failure to comply).

A tax approach is most attractive for a number of reasons. First, because this tax would apply consistently to all goods it would avoid various challenges on the basis of 'discriminatory behaviour'. Taxes generally are more compliant with European trade rules as was seen when the whisky industry challenged minimum pricing legislation on the basis that it could be achieved through existing tax measures. Another substantial benefit of the tax-based approach is that it can reduce as well as increase the price of goods. If VAT was scrapped in favour of an environmental sales tax it would certainly make harmfully produced goods more expensive, but it would also make responsibly produced goods less expensive – which is an ideal combination given the aim of the tax. Naturally there would be resistance from large manufacturing and retail corporations, though there is no reason responsible businesses should oppose this measure. But a bigger problem would be acceptance by a public which has been conditioned to expect limitless access to cheap consumer goods and expectations would need to change (see Us below). There

is much work to do to develop a solid proposal for a tax of this nature and it could not be introduced overnight. But it is crucial that a debate is begun on this immediately and progress made; free markets which don't embed the real costs of economic activity are not sustainable.

There is one crucial aspect of any pricing mechanism which must be considered: inequality. The action plan contained in the Common Home Plan will itself reduce social inequality and tackle poverty through the creation of large numbers of good jobs and by limiting wealth-concentrating economic activity which is also environmentally harmful. And while the Common Home Plan is likely to increase the cost of consumer goods and food, it will greatly reduce the costs of heating, electricity and transport and should also bring down housing costs. But this will not happen overnight and causing poverty by raising prices but not incomes would not be an acceptable way to proceed. It is therefore essential that revenue generated by pricing mechanisms is redirected into incomes. At the least desirable end of the spectrum this would involve means testing and benefit payments. At the other end of the spectrum would be using this revenue as the basis of a Universal Basic Income, providing everyone with a living income. Intermediate options like a national 'food budget' (like a Basic Income but restricted to food) might be considered. Tax cuts could be considered to offset higher prices, but this is unlikely to work because of the large number of people who are not net contributors to tax who would gain no benefit from the tax cuts but would face higher prices.

Short supply chains and import substitution

Replacing imported goods with domestically-produced ones (particularly if there are high production standards domestically) is beneficial to the environment and reduces the emissions of greenhouse gasses. However, and again because of the extent to which free market ideology has been adopted across the political spectrum, this is seen as controversial. Free market economics works on the basis that whatever a nation's current

balance of imports and exports, that is the 'correct' balance because markets are self-correcting. 'Interfering' with those self-correcting markets is strenuously challenged. But this takes us back to the issue of externalities discussed above; this could only be true if we were paying the 'true' price of production, which we're not. It is also questionable whether there is any meaning in the concept of 'the right balance', as if it represents some higher 'truth'. And of course, given that countries have different trade balances it suggests that there is a clear element of policy decision involved. It should also be noted that a 'laissez faire' approach to the balance of trade greatly benefits multinational corporations over all smaller businesses and that these companies have enormous lobbying power to influence trade decisions.

There are a number of areas in the Common Home Plan where a preference for shorter supply chains has been raised: in the production of timber-based products for construction, in the desirability of more locally-produced food, in minimising waste streams and so on. The means for doing this have been discussed: public investment to build up and strengthen supply chains, the use of public procurement policy, the development of a national industrial policy and market regulation and intervention to make shorter supply chains more competitive. Linking these together would effectively create a programme of 'Import Substitution for Green Industrialisation', a mildly protectionist policy designed specifically to grow industry sectors delivering decarbonisation and the other public good outcomes set out in the Common Home Plan. It should be noted that many of the existing industry sectors which are harming the environment themselves developed on the basis of previous protectionist policies and it is perfectly reasonable to rebalance the economy on the same basis. Unless the world's economy shifts as one towards a genuinely sustainable form of production and distribution it is entirely reasonable to use domestic policy to displace some of the harmful activity by doing it better domestically. If we care about the future of the planet we must be less afraid to challenge the dogmatic ideology of the free market.

Standards and regulation

The ability to regulate and set standards for products and other economic activity varies across the types of economic activity and depends on current trade relationships and the rules they impose. There are areas where it is easy to set regulations, such as for domestic construction. There are others which will be more difficult; if Scotland is a member of the Common Agricultural Policy then it will need to adopt and abide by EU food regulations. There have been various points throughout the Common Home Plan where regulation has been raised; housebuilding, the property market, electrical goods, a heating act, electricity grid regulation, land use, agricultural production, packaging and so on. All of these fall entirely or mainly into the category of domestic regulatory control and so can be enacted irrespective of trade agreements. Other steps in the report imply regulation, such as winding down the oil and gas industry, and this should also fall squarely within domestic policy. There are others which will be contingent on trade agreements, such as food and product regulation (although there is still scope for some regulatory activity even in these circumstances). It is therefore difficult to propose a final programme of regulatory change and in any case this should be adaptive and responsive and change over time.

Most of the infrastructure for managing regulation has already been discussed; a National Food Agency, a Scottish Energy Development Agency, a National Transport Company and so on. The rest is simply a matter for government. However, there are two additional institutions which might help, one of which is necessary regardless. If we wish to underpin regulation and standards with solid and defensible evidence we need a better statistical basis for it. Scotland must establish a National Statistics Agency and ensure that it is producing the kinds of performance data which will support a dynamic system of standards and regulation. It will also be necessary to monitor progress towards the outcomes which the Common Home Plan is seeking to achieve. Another possibility would be to set up the National Consumer Agency as an equivalent of the British

Standards Institute which creates a wide range of standards for goods right across the economy. As well as setting rigorous standards, the use of 'kitemarking' can help with externality taxes (specifying the criteria threshold at which elements of the tax are triggered). The use of prominent kitemarking can also be an alternative route to encouraging behaviour change in consumption if more direct regulatory routes are blocked, but this is very much a fall-back option.

Exports

Scotland will not want to constrain its exports, but it must regulate the economic activity by which exported goods are made. Just as we cannot turn a blind eye to the impact of our consumption beyond our own borders, likewise we can't ignore the lifecycle impacts of the goods Scotland produces just because the impacts are felt outside Scotland. If the Scottish economy moves to genuinely sustainable production, there is no need to take action on exports. This might make some goods more expensive to produce and so less competitive in international markets. However generally Scotland exports high-cost, high-quality products and these should be much less affected. If Scotland follows the Common Home Plan it should in any case be attempting to develop its international brand as a world-leader in the green economy and should be marketing Scotland abroad as a 'virtual kitemark' of sustainability and quality. This should aid Scottish exporters but also encourage them to gear up for an emerging global market in ethically-produced goods.

There is one other aspect to exporting which should be considered; the 'soft power' which important export industries confer on a country in its trade dealings with others. The importance of Russian energy exports to the European economy is so central to keeping the lights on that it has very clearly influenced EU foreign policy towards Russia. Norway's strength from outside the EU is also based on Europe's reliance on Norway's energy exports, and the same applies to Switzerland

(which has sizable seasonal hydroelectricity exports to the rest of Europe). Scotland has a reputation as an exporter in quality and luxury goods and this can be an expanding market – but these are not essential to the economies of other countries and so don't help confer influence.

The Common Home Plan has set out targets for the expansion of renewable energy generation in Scotland based on domestic requirements – but Scotland has the potential to produce in excess of domestic demand and clean energy is going to be an in-demand export in the near future. Exporting electricity has generally required large and expensive inter-connectors, but technologies are changing. Hydrogen will also be a very sought-after commodity in the future and Scotland (under the Common Home Plan) will have taken a world lead in developing hydrogen-from-electrolysis plants. Perhaps Scotland might dedicate its development of marine-based renewable energy to the production of hydrogen for export. Rather than tidal, wave and particularly subsea current generation being connected to the mainland via subsea cables it could be connected to floating or fixed oil-rig-style electrolysis plants which would fill 'hydrogen tankers', specialist ships which would take the hydrogen straight to European markets and beyond (though the challenge of electrolysing salt water will need to be resolved). Scotland could also take a lead on developing and exporting electrolysis technologies and expertise; this is going to become an increasingly sought-after technical ability around the world. This is only one example of how Scotland could use a process of 'Green Industrialisation' to open up new export opportunities.

Making this happen

- Start a national debate about what we want from our trade policies.
- Explore externality pricing mechanisms including quotas, tariffs, Producer Responsibility, externality taxes, price controls and more.
- Develop an Import Substitution Green Industrialisation strategy.
- Set up a Scottish Statistics Agency to provide better data on imports and exports.
- Set up a National Consumer Agency to regulate the products for sale in Scotland.
- Develop a green export strategy, particularly with an eye to Scotland's position in future trade negotiations.

The challenge for learning is to provide the many skilled workers needed for the Common Home Plan, and also to support organisational development and change and to provide citizens with the understanding, awareness and skills they need to play their part.

Throughout the Common Home Plan are details of the workforce requirements needed to implement it. Workforce supply is one of the biggest bottlenecks to making rapid progress. For example, thousands of new plumbers will be required to fit District Heating Systems and yet there are only about 140 plumbers being trained in Scotland. So the necessary training of this workforce should be made a priority and schools, colleges and universities must be supported to deliver it. It is not possible to properly assess all the training requirements for a number of reasons. Some people will shift from existing areas of work to new ones and some of the activities are not easily assessed in terms of people required. The following table is therefore a summary of training needs identified throughout the Common Home Plan to help to assess the investment needed. This is a complicated task because in many cases we can't wait until an entire new generation of scientists is trained. Over the last couple of decades large numbers of people who qualified in science subjects went into non-scientific careers (the lucrative finance industry was particularly active in graduate recruitment of scientists because they were seeking high levels of numeracy). A large part of the skilled workforce needed will have to come from within the existing workforce.

However, in other areas there just aren't enough skilled people in the workforce (particularly in the trades) and they'll need a much greater supply of entirely new skilled workers. There are other areas again where the training need is substantial but where this will have to be in-work training (this is particularly the case in agriculture where extended breaks from daily work tasks are simply impossible) and this applies to a lot of retraining and diversification. And of course Scotland already produces a lot of graduates and many of them will want to work in this rapidly developing sector, so not all of the new jobs will involve new education and training. In addition, a lot of the relevant training will be 'on the job' training and this will be absorbed as part of the budget of the National Companies. The table therefore makes a series of assumptions based on the unit prices for education and training currently paid to Scotland's universities and colleges

– for example, the total cost of training science graduates is half the unit price to account for recruitment of existing people with that training.

Skills category	Estimated total additional workforce required	Estimated cost of training provision (£ per place)	Estimated total additional cost (£m)
Science and technical	2000	20000	40
Professional and managerial	3000	5000	15
Skilled trades	6000	10000	60
Other skilled	20000	5000	10
Retrain	50000	3000	15
Total			140

This will require substantial expansion of college and university provision which requires a planning horizon for those institutions – discussions should begin early.

Organisational transition support

There are a number of ways in which existing organisations and businesses will need to adapt.

- Changes in core working practices. In some sectors there will be a substantive change in how things are currently done, examples being in the shift from current agricultural practices to agroecology and the move away from using non-renewable materials in construction. This will involve both retraining and support for business and organisational restructuring and is likely also to require investment in new plants and technology.

- Changes in business process. Even where sectors are not changing the fundamentals of what they do, individual businesses and organisations will need to change the processes of how they do it. This will mainly mean resource management, waste minimisation and energy efficiency (including waste heat recovery). This will mean investment both in skills and infrastructure.
- Diversification. Some industry sectors will cease to exist over the course of the Common Home Plan (such as oil and gas and potentially road haulage) and others will have to adapt to different market pressures (such as food retail and 'fast fashion'). But at the same time a whole range of new or greatly expanded industry sectors will be required (hydrogen trading or wood processing). Diversification can help some sectors prevent job losses through adaptation and help businesses in some sectors capture new opportunities.

The task of delivering this agenda will require specialist support for businesses. A Diversification Agency should be set up to support the adaptation of declining industry sectors, the strengthening of domestic supply chains and other interventions to help new and existing businesses to grasp market opportunities. This could also have the capacity to support changes in business process, or a separate Business Transition Agency could be set up. Training and development would be delivered by existing colleges and universities. These new agencies would cover identifying markets and 'matchmaking' between existing supply and new demand, deliver energy and waste audits of manufacturing and processing industries and would liaise between training providers and businesses in developing training provision. They would not lead in areas where other specialist agencies are to be set up (such as in food and agriculture).

Assessing the investment required is difficult, not least because the component elements of business transition will vary greatly; in agriculture the biggest single aspect will be training whereas in manufacturing it is more likely to be process

engineering. In some cases almost all of the investment will go into helping staff do things differently, in other cases major investment in plants and technology may be needed. Working out a total cost to the business sector is next to impossible. Deciding who should pay for it is not straightforward either; all businesses should be investing to adapt for the future and so some of the cost must obviously be borne by the business itself. But at the same time the transition should be as easy and painless as possible and it will not help if the viability of businesses is put at risk. The case for some public investment is therefore strong (although it should also be noted that in most cases a business which has gone through this kind of adaptation is likely to reduce its cost base and therefore increase its profitability).

To estimate the scale of what might be reasonable, we can model what it would look like if the initial audits were paid for publicly with business expected to pick up the cost of implementing the outcomes. There are roughly 345,000 businesses in Scotland of which about 4,000 are medium-sized and 2,500 large. Of the roughly 340,000 small businesses about 100,000 of them have more than one employee (the others being effectively sole traders or are dormant or are holding companies of some sort). The cost of an energy and resource audit will of course vary greatly, from a few hundred pounds for the smallest businesses to very large sums for a multinational corporation. If we assume that very large businesses will be expected to finance their own audits and we take an average of £1,000 for a small business and £10,000 for a medium-sized one (reflecting the cost of existing environmental audits), this would suggest the total cost of auditing Scotland's business base would be in the order of £150 million. Even allowing for some generous support for the costs of implementing the outcomes of audits, if we spread the programme over about ten years, this could be achieved within current budgets and isn't a particularly substantial investment in the context of the Common Home Plan.

Research and development

The process of implementing the Common Home Plan will, in itself, generate a lot of new learning. It will require problems to be solved, processes to be adapted in new ways, new technologies to be created, iterative improvements in the engineering of existing technologies and more. It will also generate a lot of valuable data. If Scotland was to pursue the Common Home Plan it would be the first country in the world to pursue a coordinated plan of adaptation and transition and this gives Scotland the ability to become a genuine world-leader in some of these practices and to establish itself as a centre of excellence. This must all be captured and used effectively so there must be proper investment in problem-solving, information collection, analysis and dissemination. It is easy to forget this crucial aspect, or assume that it will 'just happen'.

This will require effective partnership between the agencies and National Companies delivering the work programme, Scotland's universities and research institutes and organisations and businesses. There should be a research and development unit contained in each of the new bodies being set up (and in any relevant ones which already exist) and these should feed into a single National Research Institute which should be set up for the purpose. It is also easy to underestimate the necessary investment needed to make this happen; broadly speaking it may be reasonable to allocate in the order of one per cent of total spend to research, development and learning (over and above the research and development needed as part of the cost of project delivery). Allocating between £1 billion and £1.5 billion to research, development and learning during the 25-year course of its implementation is the scale of investment needed.

School curriculum and adult education

The Common Home Plan is very cautious about placing too much emphasis on individual behaviour change (for reasons explained in Us below). However there is no question that individual behaviours

will need to change over the period (also outlined below) and that this must be supported with education and training to help people make that change. It should of course begin at school. The school curriculum should embed three elements into the education of every pupil: understanding, awareness and necessary skills. All pupils must be educated to have a basic understanding of the science, economics and politics of the environmental threats facing the world. They must be aware of how we mitigate these problems – that behaviours have to change, both collectively and individually. The third element is to support pupils with the skills needed to make these changes.

Let's take food as a specific example. First pupils should gain an understanding of the science behind the threats to the food system. This requires that they understand the basic natural cycles; the water cycle (evaporation, condensation, precipitation, collection), the carbon cycle (photosynthesis, decomposition, respiration, combustion) and the nitrogen cycle (fixation, nitrification, assimilation, ammonification and denitrification). This can be taught from early primary school onwards and once these and some other natural processes (such as weather systems and greenhouse gas effects) are understood it is easy to help pupils understand the negative impacts of human activity.

This helps them with understanding. Pupils should then be given an awareness of how and why behaviour change can tackle this – seeing how food is grown, understanding the impacts of different food stuffs, being exposed to diverse dietary options and so on. This should include an explicit element setting out what positive approaches to diet look like in practice. Finally skills must be developed; pupils must have a good understanding of how to grow and cook foods by the time they leave school. In particular much more emphasis should be put on cooking skills; it can no longer be assumed that these will be passed on from parents who themselves were not given these skills at school. We do not have space here to fully explore the range of content that should be covered in a revised curriculum; a working group should be set up quickly to make clear recommendations about curriculum changes and how they can help to deliver the aims of the Common Home Plan.

The basic approach should remain the same for adult education – understanding, awareness and skills. However, care must be taken here; it is much harder to change old behaviours than to learn new ones. The risk of climate change education being received as patronising or 'preachy' is substantial and this can be counterproductive. The approach to adults must emphasise the utility of education – it must be seen to have a real, beneficial application in people's lives. The emphasis should therefore be very much on the skills part of the training and the understanding and awareness elements should primarily be integrated into that. There is good evidence that adults learn best in social circumstances so while there is much scope for 'virtual learning' (this can be as simple as short video tutorials), creating the capacity for active and shared activity will greatly help. There is a much lower starting base for adult and continuing education in Scotland as it is not currently a particularly well-resourced aspect of education and lifelong learning provision is patchy and often difficult to access. Tackling this problem is not within the scope of the Common Home Plan, other than to point out that proper investment and development in this area is needed. The importance of adult education on this subject will quickly decline if we get the school education aspect right, but that will take a generation to filter through properly. Colleges and other training providers should be brought together to discuss how to expand the more formal end of adult education, but more informal options should be pursued as well – for example to encourage 'clubs' and mutually-supported learning opportunities. For example, 'cooking clubs' might encourage people to get together and share new cooking techniques and practices, or new recipes. These not only improve people's knowledge, they encourage them to be more confident in using new skills.

The cost of developing a school curriculum would be absorbed by education budgets but investment must also be set aside for staff training. A bigger issue may be provision of facilities; for example, many schools may not have sufficient provision of cooking facilities to expand their food education. It may be the case that there needs to be some investment in school adaptation. Equally, the new aspects of education may

be more expensive to deliver, with the extra cost of ingredients or field trips. Education budgets should plan for this. The expansion of adult education faces an infrastructure barrier, as well as cultural barriers. A detailed plan for this aspect of education should be developed quickly.

Us

Making this happen

- Create a substantial expansion of university and college provision to support workforce development.
- Set up an economic diversification agency to help with industry sectors which will decline as a result of the Common Home Plan.
- Set up a Business Transition Support Agency to provide free audits and adaptation plans to businesses and organisations.
- Set up a National Research Institute as a research and development hub for the entire project.
- Establish a working group on how to adapt the school curriculum in line with the approaches of the Common Home Plan.
- Investment in upgrading school facilities where necessary.
- Develop an ambitious plan for adult education.

The challenge is for us all to reset our expectations about what represents 'a good life' and to reduce the constant pressures on individuals to consume. We also need to alter how we run our businesses and organisations and the way politics, government and the media define national 'success' and 'failure'.

The limits of individual action

There is a good reason why this section (about humans and our expectations, lifestyles and actions and about how we operate the organisations and businesses we create) comes last in this report. As was argued in the introduction, the belief that somehow individual behaviour change might be the primary factor in tackling the environmental threats the world faces is dangerous and deeply flawed. The primary problems are structural: an economy geared largely for continuously-expanding consumption, a range of industry sectors (agriculture, construction) which have not adapted their practices in light of the scientific evidence of the harm being done, and a lack of investment in transitioning to a non-fossil fuel energy system. It is not honest to say that behaviour change could make the major contribution to tackling environmental threats if structural change does not take place. It is an attractive message for those who wish to resist structural change, and for that reason far too much emphasis has been put on individual actions.

This does not mean that many of our specific behaviours don't need to change; they do. But the biggest behaviour changes are institutional rather than personal. Changes to personal behaviour will largely come about as a result of structural change rather than because 'consumers make different market choices'. It is also important to be clear that, even after all the other changes in the Common Home Plan are made, we still can't expect that these will allow us to continue to live as have. While there may be some place for 'nudge' policies (small steps that encourage consumers to do things differently) – they are marginal in comparison to the major engineering and reform tasks which will carry the bulk of the weight in transforming our relationship with the environment.

Deconsumerisation

Until we achieve a circular economy, producing goods in accordance with the Resources plan, almost all consumption will

do damage to the environment. Some forms of consumption will continue to do serious harm (most visibly the impact of plastic pollution on wildlife and the impact of biocides on pollinators and other insects). Until we put more constraints on consumption, it will be impossible to achieve a circular economy and impossible to minimise the impact of our current lifestyles.

So far the least used tools in the climate change and environmental threat mitigation toolbox are the ones that specifically address our consumer lifestyles and our over-consumption of 'stuff'. Governments and businesses have preferred to focus their attention on cutting emissions from electricity generation and transport in ways that imply a 'life as usual' perspective is feasible. They have studiously avoided addressing the issue of our consumer lifestyles or to state that deconsumerisation is even a desirable aim. This is partly due to the UK economy which relies so heavily on services rather than manufacturing and so retail and consumption is essential to current conceptions of economic growth. It is also due to an excessive focus on GDP growth, encouraging the average family to buy more while ignoring the emissions produced as a result (see Externalities in Trade above). Whilst Scotland rightly claims it is a world leader in addressing its domestic carbon emissions, it does this whilst ignoring emissions created by the places (like China) where the stuff we buy is made. This approach also ignores the emissions created in transporting it all here.

Governments across the world have gone so far in trying to hide the impact of our addiction to new plastic stuff, new gadgets, new clothes, new furniture and new cars that they conveniently avoid counting the emissions from marine transport within national accounts. Pollution from shipping is enormous; just 15 of the largest container ships in the world (each carrying upwards of the equivalent of 18,000 20ft shipping containers) produce the same amount of nitrogen dioxide as 760 million cars. And yet these emissions miraculously disappear in the official counting of the impact of our lifestyles on the planet. To put it another way, if shipping was a country it would be the sixth most polluting nation in the world.

We cannot allow this to carry on any longer; all options

must be on the table and there are encouraging signs that policy makers, opinion leaders and citizens now realise that transformative changes are needed in our lifestyles if we are to live sustainably in our common home. 'Doing our bit' by separating our household waste for recycling isn't enough and hasn't been for years.

Just as we've been trained to assess our level of social 'success' or 'failure' in terms of how much we own (see below), so the national economy and by extension the economic performance of governments is now assessed on the basis of GDP growth and therefore largely on the basis of how much consumption expands. This has left both individuals and nations addicted to unsustainable consumption and frankly afraid even to discuss this as an issue. This is a problem right across the political spectrum; the right has been driven by a free-trade ideology for a long time but the contemporary left often sets out its agenda in terms of poorer people getting the access to consumption enjoyed by wealthier people and even Green politics has at times highlighted organic materials or recycling rather than reducing consumption.

Deconsumerisation (weaning the economy off its addiction to constantly-expanding consumption) has been a politically untouchable subject. This has to change and politicians must get out of a bidding war in which each claims to offer the most effective route to greater individual consumption. They must learn to argue for deconsumerisation not defensively but positively. The fear is that voters won't vote for 'less choice', so they must be shown that they can still have choice, lots of it, but from a set of sustainable options and opportunities to live different forms of lifestyle than the limited ones constraining us today.

Resetting expectations

It would be reasonable to argue that in this consumer society, over the last 40 years, our expectations of what and how much we can own, use, eat, visit, wear, individualise and throw away,

have grown more than at any other time in human history. The impacts of this consumption have been discussed a number of times throughout the Common Home Plan, particularly in terms of its externalities (see Resources). We cannot continue to expect to have the same amount of stuff and live in balance with our planet.

This is one of the core message of the Common Home Plan, that our expectations of how we will live our lives absolutely must change and we also need to understand that transformational change is coming no matter what. Many, many people understand this already in relation to climate change. Many more understand that we need to change but know this from their experiences of poverty, debt, and insecure, low paid work that brings ill-health, lack of opportunity and low wellbeing. These are also consequences of an economic system focussed on satisfying consumer demands at the lowest prices. The flip side of all this is that the sustainable, circular economy promotes greater equality, a better quality of life and provides the conditions for greater wellbeing for everyone.

Perhaps the more significant driver in setting our current expectations (other than the 'persuasion industry' of advertising and marketing discussed below) is the pressure of social status. This is the set of 'soft measures' of how we all perceive ourselves and others in our communities and societies as 'successful' or 'good'. We have been trained to confer social status on others and to assess our own social status primarily in terms of ownership and consumption – consumption represents wealth which represents power which represents success. But social status did not always revolve around consumption and ownership. We used to value and respect people for their skills and contributions – the status of a farmer did not come from owning a tractor, the status of a doctor was not related to her car, the person we knew we could turn to for advice was not respected because of a big television. The shift in how we measure social status was not accidental; at the beginning of the 20th century, when technology meant that humankind could now manufacture much, much more that was needed to live comfortable lives, industries asked how they could get

people to buy these new products. The solution was to make people feel self-conscious if they didn't own them, to make them believe that they should feel shame for not possessing items even though they had no real need for them, and to persuade people that it really was consumption that conferred social status. This is what led to advertising and marketing as we know them now and over the last 100 years uncountable amounts have been spent trying to persuade us that we'll be more sexually attractive if we buy the car, more loved by our children if we buy them the elaborate toys, more respected by our neighbours if we replace our sofa regularly.

We need to take steps to rebuild our sense of ourselves and to change how we confer social status. This doesn't mean we have to live without modern comforts or new technologies, but it means that we should stop telling ourselves they're anything more than a sofa, a TV, a car. We can rebuild community and place more value on contribution (what people do) and less on 'wealth-signalling' (what people own). In a Common Home Scotland we will have greater freedom to build our sense of who we are and our place in society than simply relying on what we own. Released from the unrelenting messages to consume more, with access to social spaces, healthier transport, and better working hours, the evidence derived from studies of those who live in this manner is that we will enjoy greater freedom and sense of satisfaction when we choose to form our sense of our self using the skills we have and what we do, be it through our paid and unpaid work, our actions in our communities, our pastimes or our hobbies.

At a broad level, our lifestyles will be affected by every change outlined in the Common Home Plan. What we eat, how we travel, how we work, how we heat our homes and find comfort in our places of work – all of these will change; but this is a normal process, repeated throughout the millennia of human existence as technology has developed and our access to resources has changed. Our bodies and minds have evolved to deal with periods of abundance followed by periods of scarcity; we will be OK, we are flexible, creative, inquisitive, strong and resilient.

What will not change are the core motivations for why we travel, eat, heat our homes, give gifts, celebrate and socialise. For a whole host of evolutionary and therefore cultural reasons, we still need to be nourished, stay warm, stay connected, and stay entertained. We will still want to feel attractive, still need to work, feel safe and secure. Will still need to socialise, relax, recharge, learn new things, experience new places. So whilst the actual products and services will change, and though overall we will access fewer of them, the core motivations underpinning our lifestyles will stay the same.

Part of our task in this plan is to highlight how the changes required (if the voluminous research into happiness, wellbeing and health promotion is accepted) will, over all, make us happier, healthier and improve our wellbeing but still enable us to satisfy the needs which are at the heart of our lifestyle expectations. The sustainable future is not a bleak joyless exercise in survival, devoid of luxury, laughter and comfort; it can provide these aspirations – but not wrapped in plastic by goods that have circled the world as companies seek the cheapest labour and most lax environmental regulations to keep the prices low and profits high.

Underneath these wider and macro level changes there is a broad range of things we can do that come together under the heading of resetting lifestyle expectations. We have been taught to expect consumer lifestyle that give us access to more goods, more novelty, more services, more convenience, continually lower costs, wider selection, more personalisation and an enhanced ability to be 'unique'. New technologies (such as additive manufacture – 3D printing) may still facilitate some of these desires. But ultimately (and this is the tough part) we have to reset our expectations so that we own fewer products, sometimes need to add our own labour to them (cooking rather than buying ready meals) and to expect that many of the goods will come from more local destinations. The less difficult aspect of this is to be clear on what goods we will have less of – not televisions or kitchen appliances or furniture, but rather disposable novelty goods, poor-quality clothes we will only wear a few times and things we own but simply don't need to (like tools we should

borrow from a tool library on the rare occasions we actually use them). Above all, shopping as a hobby or pastime in and of itself must come to an end. We must shop for things we want and need, not to chase the short-term and addictive neurochemicals which are released when we buy things.

What will change in a Common Home Scotland is that we cannot expect to always have more, travel to more places more often, replace items more quickly. We have to remain satisfied more with what we have while ensuring much more equitable distribution of it. We used to live without the expectation of cheap and heavily processed imported foods, owning so many clothes to the point of needing to rent storage and without replacing our hire purchase sofas every three years. We will soon look back and realise we don't miss this. So as choices for purchasing cheap symbols, hollow luxury and status consumption narrow, our reset expectations will refocus leisure time on participation, relaxation, and socialising that is personally fulfilling, environmentally supportive and community-building, our travel will become less reliant on cars and more on health-building active travel. These options for living will increase prosperity, connectedness and skills with safe, warm, well fed lives.

Lifestyles built on a circular economy

The circular economy model (see Resources above) is a well-established model which mimics nature. Nature is circular; whatever waste is created by an animal or plant is used by other organisms in their lifecycles. In a circular economy model waste produced by one process is always used as an input into another process and is therefore regenerative by design. Our current economic model is linear; we dig, use and then dump, with society and the environment paying the price.

What are the lifestyle consequences of circular economy? First, we will see significant reductions in packaging waste and what is left will be safe enough to compost in your garden or at municipal sites. Goods will be made that can be repaired and allow modular replacement, so if the camera breaks on your

phone this becomes easy and cost effective to replace as opposed to buying a new device. This sort of innovation has been discussed and debated for years, but up until now this idea has been less popular with manufacturers whose business relies on selling you a new version and whose marketing makes the idea of repair seem almost dirty and less desirable, reducing consumer demand for it when organisations bring this option to market. Consumers have been trained to favour 'brand new' – for example, modular phones that can be repaired have been viewed as 'lower status' by many consumers. But this is changing; the pace of mobile phone renewal has slowed down dramatically and if we take steps to make all manufacturers design in this way the 'status through disposal' element of products will decrease. These activities hint at the types of repair, remanufacturing and repurposing businesses that will develop, creating skilful local jobs, in central locations.

'Circular lifestyles' also include a focus on performance rather than ownership so rather than purchasing certain goods outright, we will rent them because we understand that ultimately what we want is clean clothes or fast flexible transport between two points, rather than wanting a washing machine or a car. If we rent, then the companies providing the devices are incentivised to create high-quality, highly-efficient solutions that break down rarely, can be easily repaired and need limited servicing – after all, this reduces their costs. If we add to the mix tax regulations promoting repair and remanufacturing then not only do we increase the likelihood of stable jobs performing these functions but waste is reduced further. Examples of the performance economy based on leasing means we might purchase 300 washes per year from a washing machine manufacturer or 2000 miles of car services from a car rental company. That car rental businesses may in turn purchase 10 million miles from their tyre supplier who in turn produce tyres that are highly durable, as once again they are making money from performance, not selling new tyres.

A further, transformative idea is that the producer retains ownership (see Producer Responsibility in Resources above). This would be a particular powerful way of reducing the impact of

mining. It would work like this: rather than selling the gold and coltan to microelectronics manufactures resources companies would lease them to manufacturers who would have to design products in ways that makes reclaiming the materials easy. They would have to ensure that after the product has been used, reused, repaired, and remanufactured, that the raw materials could be handed back (though in reality they would be used to produce new goods) rather than the current model where rare and scarce materials are forgotten about and go to waste. So in a Common Home Scotland with a circular economy, we would see less sorting of waste performed at a household level as waste is designed out of the system.

The nature of goods

Part of the process of changing our relationship with stuff will be changing the nature of the stuff available. We currently have agencies which control what products are available – for example in controlling the availability of different medicines. This approach must be applied more generally. A National Consumer Agency should be set up (working closely with the Resources Agency proposed above) which should monitor more closely what is allowed to be sold in shops and online. Key principles here would include an expanded list of banned products, based on strict liability and higher standards of proof that the product is safe to use for all lifeforms. Right now in the UK you can buy expanding foam which the warning label tells you must not be used by pregnant women – yet this product is used to fill holes and gaps left in construction and therefore becomes embedded in our homes. This is not acceptable. Control over what can be bought will also be guided by legislating the need for companies to provide independently-tested lifecycle and input/output assessments of their products. These methods set out what resources (such as water, energy or land) are used to make a product and what pollutants they have created (CO₂, other greenhouse gases, particulates and microplastics). It is unrealistic to expect products to demonstrate zero environmental

harm in a short timeframe, so the principal of demonstrating annual improvement will underpin what can be imported to, exported from and manufactured in Scotland. A summary of the information from input/output analysis will then form the basis of labelling with full disclosure available in an open and transparent fashion. It will also form the basis of externality taxes (see Resources above).

Related to this, the products should adhere to 'Design for the environment' principles, which includes packaging (see Dematerialisation in Resources above). Again, not all solutions currently exist, but iterative improvements must be compelled. Where clear guidance exists and is already achievable, it must be enforced by the National Consumer Agency – for example banning single use plastics and hybrid packaging materials (combining two recyclable materials, such as cardboard and clear film windows in food packaging, to produce something that cannot then be recycled). To achieve all this the Agency will require a copy advice team, helping companies produce communications that fall within what is factual. It will require a team of part-time experts keeping advice on technical issues regarding known harms up to date. It is possible to create the Agency large enough to license every product before it is marketed, though in some sectors such as pharmaceutical, health care and building products this 'white list' approach is essential. For consumer goods, standardised methodologies, automated collecting of data and independent laboratories will allow the results of input/output analysis to be tracked and improvements ordered. This will be supported by targeted testing of a sample of products, similar to doping control in sport. Offending products will be banned from sale and with strict liability applied to those running the company. This is the task of a product inspectorate.

Prices and ownership

At a broad level, many of the changes we will see to our consumer lifestyles will be driven by the increased price of polluting goods and services as companies are forced to

internalise costs that up to this point they have been allowed to externalise. Under the Common Home Plan the costs of these externalities will be borne by the manufacturer – the role of externality taxes and how they might operate has already been considered (in Trade above). It has been long recognised that these measures are as close as we will get to a magic bullet – but there are clearly issues in terms of global product markets (these international implications have also been explored in Trade above).

Through internalisation of the cost of pollution, the price of certain goods will rise, reducing demand. Business will respond in creative and innovative ways to reduce these costs by reducing how dirty and resource-intensive their goods are. This is what the measures intend. From existing consumer lifestyles perspective, this will impact internet shopping and the cost of delivery. The current system of uncoordinated delivery by multiple courier firms using internal combustion engine vehicles to single addresses on a daily basis will be reduced either because of higher costs, or if that doesn't work, then through regulation and modal shift (though the development of coordinated driverless delivery may change this in other ways).

Culture Change

It's easy to state that our expectations can change but what we are really talking about is a resetting of culture. Commentators have been calling for culture change for years –for example, it can become socially unacceptable to drive a petrol-fuelled 4x4 in a city for short journeys. However, we have not been successful in achieving the widespread cultural shifts necessary. Academics have developed a deep well of knowledge about what culture is and how it forms and develops. This tells us that if you want to change culture, you have to change the underlying institutions, structures and practices of society. We know what to do, but as of now have not had the courage, motivation and in some instances the powers to do it. The Common Home Plan presents a blueprint for this kind of widespread systemic change,

to develop a fairer, more equal, healthier and prosperous society. Changing culture and changing our expectations will require direct intervention, both at a structural level and then in the marketing industry, resetting the rules by which companies can develop and market products.

First, let's address the major cultural forces that require reform. Early interventions should include transformational land reform (see Land above), the reorganisation of local government to be more local and more powerful, and democratic reform to current institutions that invest power in the few with most to gain from continuing the current system. Once we've adopted a circular wellbeing economy and no longer discuss growth-based economics (whether or not it is sold using language such as 'inclusive' or 'sustainable') we will address finance, removing the control over available capital in Scotland from a few dangerously large banks. A regional network of mutual or public local banks such as those existing in Germany will help. We also need a diversified media, one not solely owned by those complicit in perpetuating consumer society because, through advertising, it pays their bills. We need to make sure it is not subverted by multinational businesses whose business models rely on advertising revenues, or from dark money. We will then align what is taught at each level of formal education with the values of a sustainable Scotland (see Learning above) and focus on developing the knowledge and skills to contribute to building and maintaining this form of society. While the details of all of these policies are not included in the Common Home Plan, all of them are covered in other Common Weal policy papers.

A crucial step in enabling us to change the consumption practices of our daily lives is that governments adopt a consistent narrative around the need for transformational change and the economics that will take us there. Calls for this are becoming louder – governments in their speeches, interviews, press releases, legislation and policy guidance must all consistently refer to a wellbeing-focussed circular economy and explain how GDP growth is no longer appropriate as a measure of progress. After a period of time, growth will not be mentioned at all. This also means removing all mentions of a growth economy from publicly-

established goals and indicators. The narrative consistency should be supported with an extension of the definition of harm whose avoidance underpins much of our legislation, for example work governing health and safety, employment and corporation law. Avoiding environmental harm must become a guiding principle of all government legislation. Areas where this will have a profound and obvious effect include building and planning regulations and food production (see Buildings and Food above). But it will have significant effects on our schools and universities, where for example, in addition to showing that research and teaching do not cause harm to humans, researchers will only gain approval for their projects if they can show that they will not perpetuate growth economies or cause environmental damage. This will have a profound effects on what is researched. It will call into question petroleum and gas engineering and plastics and non-organic polymer science and will effect what the government funds and what funding from the oil and gas, plastics, automotive and banking industries is allowable.

Having achieved all that, we will have changed the institutions of government, land ownership, democracy, finance, education, media, language use and the economy. We will have changed the structural impediments to a Common Home Scotland and we will finally give ourselves a fighting chance of changing lifestyle practices.

We then need to address the influences on individual actions (and how they are interconnected) that make up our consumer lifestyles. A key driver of our consumer lifestyles that has gone unchecked and needs to be controlled is the £825 billion a year persuasion industry. The marketing industry has bombarded us with advertisements on television, radio and newspapers. Now it does less of that but may know more about your consumption habits than you do yourself via your browsing history, purchases and mobile data. It uses this to send laser-accurate messages for products that they have worked out you will be interested in. As importantly, it sends these at the right time and when you are in the right place (walking by a shop or in an online store at the time of day you usually buy that type of product). It has also used all this data along with neuroscience

research to construct the messages in such a way that the words, images and sounds stimulate your hormonal system to overwhelm what cognitive defences you might have.

What chance do public-good messages sponsored by public agencies have to encourage walking to work when its up against the might of the car industry, with its fathomless pockets employing these persuasion tactics, all supported by their corporate lobbyist influencing decision-makers. It's not a fair fight. And that's before we mention all the media content (TV programmes, films, news articles, editorials, features) we readily consume on our devices that are designed with the needs of the consumer goods manufacturers in mind. This ensures that what the stars do, wear, eat, smoke, drive and how young and beautiful they all are for their age, reinforces your understanding and desires that to be successful, loved, and popular, we need only to buy new and have more. Marketing must be controlled to give us space to consider other ways of living our lives and to turn off the tap of damaging consumption.

To achieve this more specific control, we need stronger regulatory control of marketing and a pro-environment, pro-citizen National Consumer Agency to support the broader range of participative, social, skilful, engaged ways of living. Currently in the UK advertising and marketing are controlled by a self-regulatory system overseen by OfCom. The Advertising Standards Authority, implementing a code written by the Committees of Advertising Practice oversees how organisation advertise their products. The key principles it works to are that communications should be legal, decent, honest and truthful. More recently it added stereotyping to the their list of 'banned' activities. Ultimately, they have very limited powers beyond removing offending material and putting companies on a 'naughty list'. They are not independent of government, shown by the fact that advertising by political parties during campaigns is not covered by its regulation, the reason essentially being that the main political parties have demanded it be excluded. We need a co-regulatory system that extends the principles of 'legal, decent, honest and truthful and does not perpetuate stereotype' to include 'does not undermine people's sense of

self'. It is through undermining a sense of self and providing a new, improved product solution that much of consumer-based marketing works. The Agency will also be charged with policing where and when advertising is allowed, ensuring that it is not seen in schools and social spaces frequented by vulnerable groups and that sponsorship of sporting, cultural and community organisations by products with known social, health and environmental harm is not allowed.

We can even go beyond this and start to debate more fully what role advertising and marketing actually plays in society. There was a time when advertising was seen simply as 'providing information about the nature of the product', but this was revolutionised in the early 20th century. The concept of 'manufactured desire' (no longer seeing advertising as a way to help people fulfil their needs but rather seeing it as a mechanism to continually create a sense of new and fundamentally unmeetable needs) is simply assumed to be a fundamental aspect of the economy. There is no public-good reason why this should be seen as the case in a circular economy. This is already recognised with some products, for example the prohibition of tobacco advertising. The case for extending that to more products is strong. For example, in food it is virtually impossible to create a business case for advertising the kinds of foods we really ought to be encouraging but easy to advertise exactly the foods we should be discouraging. Put simply, it is easy to create a business case for advertising a highly-process, salt-sugar-and-palm-oil-filled pizza manufactured in a factory in Eastern Europe but almost impossible to do the same for a carrot. There is a strong case for moving quickly to ban the advertising of food altogether. If this principle is accepted we can begin to question exactly what really should be advertised.

Most radically, new technologies have created new ways to help consumers choose between products: customer ratings. Online technologies mean that we are already routinely used to selecting hotel or other accommodation on two bases; basic information (location, facilities, photographs of rooms and restaurants) and the experiences reported by previous guests. Why not move increasingly to using this approach for more

(perhaps eventually all) products? If you need to buy a new coffee maker you can read all of the technical specifications and performance features, see a photograph and then read both professional and customer reviews – but what you can't do is be exposed to pictures of glamorous Hollywood film stars using the machine and be made to feel that by purchasing this product you too can signal that you are successful, glamorous and rich (not least because that is patently not true). We do not need to assume a future with advertising in the form we currently have it.

Finally, promoting wellbeing and sustainable lifestyles will require a Sustainability and Circular Economy Engagement strategy and team. The aim will be, at one level, to engage and prepare people for the transformational change required. It will then also look to address key high carbon and other unsustainable practices such as car driving or air travel. These practices cannot be targeted in a narrow fashion and will be understood and addressed taking into account how they link to other practices, such as work, caring responsibility and food provision. If that approach is acted upon it has the power, along with the other steps outlined here, to realign our lifestyle expectations and our values.

Goals for lifestyle and behaviour change

To summarise what it would look like if the Common Home Plan is implemented successfully, the following explain how various organisational, social and individual attitudes and behaviours would change.

Government and media	Now	Future
Prioritising	Growth and profit are the primary indicators which drive government decisions.	Governments will emphasise actions which deliver development (making things better, not just bigger) and sustainability (that what we do now is regenerative and does not harm future generations)

Government and media	Now	Future
Influence	Governments are heavily influenced by commercial lobbyists.	Governments must prioritise real outcomes rather than projections of growth. Commercial interests must be checked against scientific advice on impact.
Timescales	Politics encourages a short-term planning horizon.	Society must move to much longer planning horizons and stop chasing short-term outcomes at the expense of long-term outcomes.
Planning	Most economic, land and social planning is dominated by the outcomes of free market behaviours.	We must return to a planning approach in which we plan collectively and are driven by public-good goals and not by commercial goals. We must stop behaving like complex social change can be achieved solely through demanding the public make different behavioural choices.
Language	The language of politics and the media is obsessed with size and growth – as if these are inherently signs of improvement.	The language of politics and the media should focus more on 'security' – not how much bigger things can be but how we can be sure our quality of life is secure from economic, mental health and environmental threats and how it can then be improved.
Businesses and organisations	Now	Future
Development	All the public policy drivers encourage businesses to be purely profit-driven. This has led to low levels of future investment as these reduce profits in the short term (even if they'll increase them in the long term).	Businesses must be development-focussed, considering always what health the business will be in ten or 20 years from now. They must accept a tighter regulatory environment where environmental harm will be designed out of their systems and products.

Businesses and organisations	Now	Future
Success is not a quarterly report but what you leave the next generation of managers of the business.	Politics encourages a short-term planning horizon.	Society must move to much longer planning horizons and stop chasing short-term outcomes at the expense of long-term outcomes.
Resources	Businesses treat resources as a cost; if the cost of managing them well is more than the cost of managing them badly, they will be managed badly.	Businesses must treat all resources as an asset and minimise their wastage.
Energy	Energy is treated as a cost but its wastage is not priced; for example, residual heat from an industrial process is treated as waste rather than a resource.	Energy must be integrated into a fully circular economy; there should be no energy wastage.
Production	The manufacture of goods has a sales focus – the producer has little interest in what has been produced after a sale is made, removing incentives to improve product longevity, reparability and the ability to reuse or recycle its component parts.	Producers must take a lifecycle approach to manufacturing and retail, expecting to bear responsibility for the impact of the product from its production to its final reuse. They must understand the specific resources inputs embedded in their products and services and the pollution outputs and use this as management information to iteratively inform product improvements toward net zero and sustainability.
Sourcing	Businesses have a cost focus to their sourcing, using more harmful materials if they are less expensive than ethically sourced ones.	There must be an impact focus when it comes to sourcing, with producers being made responsible for the impacts of their supply chains and not just their own actions.
Sector	Collectively Scotland's economy is retail and consumption-focussed, with an unhealthy reliance on aspects of financial speculation.	Scotland's economy must move towards being more about activity, repair and reuse, reducing harmful economic activities and a range of other social-good outcomes.

Individual	Now	Future
Consumption	We buy too much, dispose of too much and have turned the process of consumption into a pastime in and of itself.	We must buy less and buy better, and dedicate more of our time to being active. We must expect to buy from local suppliers and demand short supply chains.
	Businesses treat resources as a cost; if the cost of managing them well is more than the cost of managing them badly, they will be managed badly.	Businesses must treat all resources as an asset and minimise their wastage.
Food	We have a highly-processed, unhealthy diet which is largely pre-prepared and we have reduced the amount we cook ourselves.	We must eat better and cook more, consume fewer processed foods and eat less but better meat.
Travel	We make too many unnecessary journeys (in part because of urban planning decisions), don't walk enough, find it hard to cycle because of poor infrastructure and travel too much by air.	We need to redesign towns and the economy to make more available to people within walking distance (especially food shopping), must walk and cycle more, stop traveling in large cars with single occupancy and change our relationship to travel, accepting longer journeys in return for more time off work.
Energy	We tend to have poor knowledge about energy efficiency and how simple changes in our lives can make real savings.	We will be so used to behaving in energy efficient ways we won't even notice we're doing it.
Waste	We have a disposable culture and expect products to have a short life.	We will no longer have the concept of 'waste' but of resources, sharing more, reusing more and buying products of much better quality with much longer lifespans.

Individual	Now	Future
Work	We work too many hours to generate income to feed a consumption-driven economy, leaving us insufficient time for walking, cooking and the many other changes we need to enact.	We will work fewer hours and do more for ourselves.

Summary of actions and approaches

There are a number of tools which can be used to encourage transformative changes to our lifestyles. However, it should be noted that most of these policy tools are designed to enact structural change rather than individual change and, again, it must not be read that these can simply be introduced into a free market economy as if they will succeed in shifting those markets. They won't, at least not as a result of individual behaviours.

- Infrastructure and planning. This is most important; our infrastructure drives our actions. If all shopping is out-of-town, cars become essential for shopping. If these longer journeys become unavoidable, we seek to minimise them by bulk buying. When we do large volumes of shopping in one go we make bad decisions which lead to more food waste. The single most important thing we can do is plan our infrastructure such that it makes it easy for us to 'do the right thing' – and much harder for us to do the wrong thing.
- Regulation and law. Certain behaviours must simply be curtailed or prevented; there are a number of places in the Common Home Plan where specific regulations have been proposed. One legal approach which should be emphasised more is a 'rights-based' approach, such as a legal right to healthy and ethical food. This places an additional legal pressure to stimulate transition.
- Tax and incentive. Pricing mechanisms are considered

above (see Trade). These are not primarily designed to 'nudge' behaviour but rather to make people responsible for the impacts they are already having. This is more about making responsibly-produced goods more competitive against cheaper, poorly-produced goods, but will inevitably also have impacts on how people spend. There is some scope for other incentives (such as payments, tax discounts or funds to encourage people to do things or to stop doing things) but these largely assume market solutions (such as home feed-in tariffs for renewable energy generation) and most of the work needed will be done and paid for collectively, reducing the need for targeted incentives.

- Measurement and accounting. There is a very wide literature on why our current indicators for measuring social and economic progress are flawed, particularly for their failure to value externalities and the incentives towards bad behaviours they create (such as by relying on GDP measurements). The need to stop these current indicators dominating political debate is well known, as is a wide range of other measurement options. These must be adopted and used. However, measurement has in part become such an important part of political debate because of the decline in collective planning; we should not be adopting an approach of 'stand back, look at the indicators and then nudge policy levers accordingly' but rather one of collective planning and monitoring of progress towards outcomes.
- Education. This has been considered above (see Learning).

These are the range of actions which can help to change individual and organisational behaviour. Their specific application has been discussed throughout the Common Home Plan. Changing political behaviour is much more difficult. This report is not the place to discuss this in depth, but our current political structures are designed in a way which reinforces poor decision-making processes. Ineffective regulation of commercial lobbying

continually leads to bad decision-making, short term electoral cycles leads to short term planning, an overly-commercial media reinforces commerce-friendly debate at the expense of proper reporting of the wider impacts of commerce, a focus on personalities reduces the amount of focus put on policy scrutiny and proper evaluation of long-term outcomes and so on. Common Weal has published a range of work on democratic reform, from new modes of participatory democracy to ways to make lobbying much more transparent (and to limit its impacts). While it is hard to argue that the Common Home Plan is impossible without democratic reform (including land reform), it will be much more difficult to sustain momentum politically if reforms aren't made. In particular, unless action is taken to diversify the media and limit the impact of commercial lobbying, there will be a well-funded and organised attempt to prevent many parts of the action programme because they will interfere with the short-term interests of different commercial groups.

Making it happen

- Set an explicit policy of deconsumerisation and promote its benefits to individuals.
- Change our cultural expectations and lifestyles with the full range of structural changes proposed in the Common Home Plan.
- Make all of our consumption habits operate within a circular economy model by implementing proposals in the Resources and Trade sections of the Common Home Plan.
- Establish a National Consumer Agency with the aim of regulating all goods sold in Scotland.
- Radically reform the role of advertising and marketing by changing definitions of 'fair' advertising.
- Adopt a planning rather than market approach to change and expect governments to work to much longer-term timescales.
- Replace existing measures of economic success which promote growth and replace them with measures of wellbeing and social development.

Conclusion

So this is the Common Home Plan, a comprehensive programme to avert environmental crisis in Scotland, transform the nature of our society and to build an economy which delivers higher quality of life with much lower negative environmental impact. It is certainly ambitious and it will involve an enormous amount of work, some serious investment and much creativity. It would be the biggest task for an entire generation of Scots and would change everything. But the rewards are also enormous and the alternatives petrifying. We can't just wait for the impact of environmental crises. We can't just let more generations grow up with poverty, rising inequality and declining mental health. We can't just stand around and hope it will be OK.

People may disagree with one bit of the plan or another, but this has been the work of dozens of experts in their field and if there are better ways to do it, we've not found them. Of course there must be debate, but time is running out. Scotland must agree to a plan soon or pay the price.

But there is more to hope for than be afraid of. If we achieve this, if we are the generation that stands up to be counted, we will not only change our own lives but fundamentally change for the better the lives of generations to come. Our generation will be remembered for one thing or the other, for acting or not acting. Let us be remembered for the right thing, not for turning a blind eye but for courage and determination.

The top half of the page features four large, abstract, organic shapes in a vibrant green color. These shapes are scattered across a plain white background, creating a sense of movement and natural form. They resemble stylized leaves or perhaps the folds of a piece of fabric.

This is the Common Home
Plan, a Green New Deal for
Scotland developed by the
Common Weal think tank.

£10