

Policy Research Paper

Policy Options for Investment in Infrastructure in Northern Ireland



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About NERI and this publication

The Nevin Economic Research Institute (NERI) has been established to provide information, analysis and economic policy alternatives. Named in honour of Dr Dónal Nevin, scholar, trade unionist and socialist who gave a life of service to the common good, the Institute aims to undertake research that will be of relevance to the Trade Union movement and the general public across the island of Ireland.

This is the first NERI Policy Research Paper (PRP) of the Institute. The purpose of the PRP is to provide analysis and policy options in relation to a matter of public interest.

The analyses and views expressed in this publication do not necessarily reflect those of the Irish Congress of Trade Unions or the unions supporting the work of the Institute.

Dónal Nevin died in December 2012.

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Executive Summary

This policy research paper seeks to highlight the infrastructural investment required in the Northern Ireland economy over the next number of years in the context of on-going economic stagnation and high unemployment. Investing in infrastructure now will be of huge benefit to the economy in both the short term and long term. In the long term it will equip Northern Ireland with a dynamic and smart economy enabling it to compete globally. In the short term, the investment will provide much needed employment and economic activity that is necessary to stave off the long term consequences of stagnating growth and high unemployment particularly among young people.

In the areas of water and energy, Northern Ireland has significant policy challenges to face in coming years and this paper discusses some of them in detail. Even within the constrained budget of the Northern Ireland Executive, there are policy changes and innovations that can be brought forward in the short term. In water specifically, we propose investing in research and development and initiatives to constrain demand as well as safeguarding supply. In energy, the

main challenge is ensuring that the network in Northern Ireland is prepared to take advantage of the abundance of renewable energy technologies and interconnections to secure supply.

These broad, sector-wide proposals are supplemented by a specific proposal in the area of energy efficiency. Energy retro-fitting is a key measure that is required to upgrade the stock of buildings in Northern Ireland to adapt to a high-cost energy future. We propose a scheme similar to the Green Deal in the UK where an agency would make available upfront costs for retrofitting works, prescribed by certified surveyors and carried out by certified contractors. The owner of a retrofitted property would repay the cost of the work through reductions in their energy bills over an extended period dependent on the work carried out. Crucially, the scheme would follow a “golden rule” whereby any retrofit project would only be certified for funding if the energy savings produced exceed the cumulative cost of repayments over the agreed timeframe.

Rather than establish a new state agency to oversee this investment scheme, we propose allocating responsibility for overseeing the project to the Northern Ireland

Housing Executive. The NIHE has existing relationships with contractors and surveyors, and could begin work with its own stock of 90,000 homes giving a boost the scheme at its early stages.

The Northern Ireland Executive's constrained budget would not allow it to finance this scheme alone. For this reason it has been necessary to look at international examples of state led initiatives to leverage private capital into such projects. Once again we do not propose establishing a new agency, or complex system of bank finance. We propose allowing the NIHE to borrow through a bond issuance similar to that undertaken by municipal and local councils in many other countries.

Any borrowing by the Housing executive could be classed as off-balance sheet, but in order to secure a lower rate of return for investors a state guarantee would be required. State guarantees are already being issued under the UK Guarantee Scheme and it is expected that this will be extended to the Green Investment bank in due course. We propose that, under a parity arrangement, the same legislation could be provided for in Northern Ireland.

The scheme would of course be voluntary but inducements could be provided by government in early stages to encourage take up. The impact on unemployment in Northern Ireland could be significant, it has been estimated that every £10m invested could create up to 330 jobs in Northern Ireland. Of course this scheme could not eliminate unemployment by any stretch of the imagination. What it seeks to demonstrate is that even with severely constrained budgets, there are still options open to boost investment and grow our economy. A real recovery will require more imaginative and bold policy making and this proposal seeks to begin that debate.

1 The Case for Investment in Jobs and Infrastructure

The current levels of unemployment are unacceptable and constitute a serious threat to social cohesion and not just the sustainability of the Northern Ireland economy. Failure to make serious inroads on the level of unemployment will cost more in the long-run than any short-term reduction in the UK government budget deficit arising from further fiscal austerity. The biggest single obstacle to creating employment is the depressed state of the domestic economy. The way to tackle this problem is through economic growth, investment and job creation. The market, alone, cannot be expected to fill the gap in investment and consumption left as a result of the sharp contraction from 2008 onwards. There is, therefore, an urgent need to address the deficit in demand for work through a balanced investment stimulus that is state-led or facilitated but that also mobilises investment from private sources. This paper identifies areas of key infrastructural need and deficiency. A model for investment is proposed that can begin to make an inroad into unemployment and reverse the impact of some of the damaging cuts

in public spending that have already taken place.

1.1 The biggest crisis relates to demand in the labour market

The waste involved in unemployment of people is a scandal. It exacts long-term damage on individuals and communities. The true extent of unemployment is under-stated by the Northern Ireland unemployment rate of 7.8% in the three months to February 2012. Work carries out by the TUC estimates that there are further 8.4% of workers are underemployed, an aspect not captured in official unemployment statistics. (TUC, 2012)

If the current crisis of unemployment is primarily due to a deficiency in supply of labour at going market wage rates and associated income and benefit incentives then, inevitably, the focus of public policy and community actions will be mainly on concepts and measures involving 'activation', up-skilling, incentivisation of work, 'reforms' of the labour market and 'flexibility' with regard to hours of work and work practices. Supply-side measures to tackle unemployment are an important component of an overall strategy. However, there is ample evidence that the rapid decline in employment in 2008-2009 was

associated with a collapse in the construction industry. Addressing the deficiency in what economists call 'Aggregate Demand' is a greater immediate priority than measures to enhance skills and match supply and demand at the micro-level – important and welcome as many of these are. A long-term strategy of investing in social and economic infrastructure is also a justification for demand-led initiatives to address unemployment because not only will it directly generate employment but it will also lay the foundations for an improvement in competitiveness and productivity in the longer-term.

1.2 Investment in social and economic infrastructure is urgently needed

The key to generating new employment is investment – investment in people, skills, new products and services. The public, private and voluntary sectors each have a role in helping to lift economic growth. The public enterprise sector, in particular, has a key role in helping kick start growth, lift confidence and complement the role of other sectors in partnership.

Many areas of social and economic infrastructure remain under-developed. There is a risk that by under-investing in needed

infrastructure as a short-term cost-saving measure long-term harm is exacted on communities, businesses and society at large.

Capital investment should deliver three outputs for the economy:

1. A short-term stimulus to GVA associated with the investment expenditure and its multiplier effect in the domestic economy
2. A short-term creation of jobs associated with the investment expenditure and its multiplier effect in the domestic economy
3. A long-term increase in productive capacity, export competitiveness and social well-being.

While the first two of these outputs are desirable, in particular given the suppressed nature of domestic economy, the long-term objective of providing welfare enhancing returns to society should be the key criteria for assessing the appropriateness of capital investment programmes. In that regard, any investment strategy should undergo a Cost Benefit Analysis to demonstrate that it is in the long-term interest of society to make these investments (i.e. the benefits exceed the costs).

Investment for greater productivity and competitiveness

Political instability and conflict over many years have not created ideal circumstances for investment in Northern Ireland. The establishment of the Executive and the recent stability of local decision making has begun to rectify this situation. The Executive has produced investment strategies alongside government programmes and this is a welcome development. However the financial crash and UK-wide cuts to government spending may have negated this recent progress. The lack of official data for investment in Northern Ireland limits any discussion of exact figures, though investment in the UK economy as a whole contracted by 2.4% in 2011, and 1.3% in Q3 of 2012. The case for investment is not just to repair any damage done in recent years but to lay the groundwork for future growth. There has been some progress in areas like the road network and the constrained capital budget has still found room for £500m for some regional routes and the health and social care sector. There has also been some progress in electricity interconnectors and gas pipelines while Northern Ireland leads many European countries in its

successful roll out of the broadband network. This work has been necessary to bring NI out of its historical handicap, but may not be enough to meet the needs of future prosperity.

1.3 Rationale for Priority Investment

We need investment not only to give a short term boost to the economy, but also to provide the platform for future economic growth. It is imperative then, that we prioritise those areas of investment that will contribute most to growth and the economy in the future. Climate change will be one of the most significant challenges to future growth in this century across the economy.

Northern Ireland has a staggering 97% reliance on imported fossil fuels for its energy needs (98% of heat and electricity is from fossil fuels, 80% heat and 18% electricity, NI Assembly, 2008) so public and private investment in new sources of energy is urgently needed to reach the EU 2020 target of 15% for renewable energy as a proportion of gross energy consumption in the UK¹. There is a need to start investing now in long-term energy alternatives now.

¹ The Rate was 5% in 2009 in the Republic.

There are many in political life and the business community who remain sceptical about climate change and its impact on future growth. Yet even this perspective must take into account both the volatility and continuing upward trajectory of energy prices. Oil prices have stabilised in recent months but current prices in 2012 are still three times the 2004 price. Moreover the regulatory regime of the coming decades along with laws and directives emanating from the EU will make these investment challenges a reality one way or the other. Northern Ireland needs to begin the development of a domestic renewable energy generation sector to provide energy security. It also needs to address energy efficiency, ensuring that homes and buildings are not using more heat and electricity than they have to. Every pound spent on imported fossil fuels is expenditure that could be made in the local economy.

Recent events have highlighted the disruption that can be caused by lack of investment in Northern Ireland's water infrastructure and the reputational damage this can do to NI as an industrial location. Water has been a politically fraught issue in Northern Ireland, and perhaps consequently receives less attention than the energy sector. Its importance should not be underestimated.

Many other sectors of the Northern Ireland economy require significant investment. Waste management will need substantial investment if NI is to escape fines and sanctions from the European Union (ICE, 2009), there is a case for substantial investment in enhanced recycling and sewage networks across Northern Ireland. The road network is an area of public capital expenditure that has been to a degree protected by the budget while investment in hospital has seen some progress. Many other areas like social housing have not fared as well. Northern Ireland has seen huge increases in demand for social housing, but no increased budget allocation to meet it. Early childhood education is an area of social infrastructure that could provide a boost to educational attainment and also boost female participation in the workforce at the same time. This paper will focus on two sectors of infrastructure where private capital could be leverage to fund investment projects to complement existing government commitments.

1.4 Investing in Water Infrastructure

Water infrastructure plays a vital role in economic development and substantial research has focused on economic impacts of water infrastructure in developing

countries. However the benefits do not end with irrigation and sanitation. Water costs affect business as a direct charge or tax and the availability of a safe supply of water is a key consideration in the decisions surrounding industrial location. In a 2009 report on the impact of infrastructure investment on the US economy Heintz, Pollin & Peltier (2009), argue that an efficient water infrastructure is a key factor in economic competitiveness. Internationally it is acknowledged that decreasing levels of investment in water infrastructure is a global problem and this is especially acute given that the cost of maintaining existing infrastructure is increasing.

An OECD (2007) report on infrastructure details how declining levels of public investment in water infrastructure have not been met by increased private sector involvement. Water infrastructure is nearly twice as capital intensive as comparable projects in the energy sector yet, the projected finance gap in water infrastructure is enormous. The report also highlights the fact that the next phase of water infrastructure may not be of the order of 18th century viaducts and vast installations, instead the focus for the sector may move to demand management. In essence the investment needed may now need to be more focused on

containing the demand rather than increasing the supply of water.

A smart and low cost water infrastructure fits neatly into the industrial profile for Northern Ireland and the kind of enterprise it wishes to grow and attract. A recent report from the American Society of Civil Engineers (2011) highlights the importance of a clean and reliable water supply to the water-heavy industries like food and chemical manufacturing. At a time when Northern Ireland is trying to grow an Agri-food sector and attract high end foreign direct investment, in areas like medical and pharmaceuticals, it is dangerous to underestimate water infrastructural deficits. Interruptions to the water supply can be very costly to business and that they might deter certain companies from choosing Northern Ireland as an industrial location.

Northern Ireland Water is a Government Company charged with supplying and distributing water across Northern Ireland. There have been many arguments that the lack of investment in water infrastructure has been a symptom of public ownership and that if NI Water were privatised this would unlock all the investment required at no extra cost to tax payers. There are two points to make regarding this. Firstly NIW is

at the moment a government company. It is not yet empowered to borrow money but would not need to be fully privatised in order to access further funding, as commercial semi-state companies do in the Republic. Secondly it is worth noting that in England and Wales where water provision has been privatized since the late 1980's, infrastructure investment has not been noticeably greater. According to a recent report by the UK Council for Science & Technology (2009) investment by water companies has only maintained serviceability while reducing costs. R&D spend which constituted £45m in 1990 counts for only £18m as of 2009. The report says that only a small amount of this reduction was compensated for by a fall in prices and it is more likely that frequent changes in ownership of water companies led to a greater focus on short term profits. The OECD say there is a global culture of underinvestment in water, but this is compounded in Northern Ireland by the politicisation of water especially in relation to charging.

The harsh weather in the winter of 2010 across the island of Ireland has highlighted the poor state of water infrastructure in Northern Ireland. The 2008-2018 Executive Investment Delivery Plan for Water (DRD, 2008) highlighted investment in many

areas and projects including the Water mains rehabilitation and the Belfast Sewers Project. Investment in Water treatment is just one action that can be taken to reduce the industrial and commercial cost base in Northern Ireland. Leakage in pipes accounts for a staggering amount of water lost in the system in Northern Ireland, which in turn leads to more water pumped into the system than is required, leading to rates bill that are far higher than they need to be.

The March 2011 report from the Utility regulator into the water crisis of the previous winter found that 80% of leakages occurred in the private (homes and businesses) pipe network with only 20% occurring on NI Water's pipes. This requires action at the household level in addition to main supply pipes. Reduced water use also has environmental benefits. NI Water is Northern Ireland Electricity's biggest commercial customer, reduced water consumption and thereby reduced energy used in production would lead to sizable reduction in carbon emissions.

There are many projects and specific works that have been identified by government and by others for water infrastructure in Northern Ireland and ideally as many of these initiatives as possible should be

brought to completion. There is however a long term strategy that needs to be put in place to allow research and forward thinking to create a culture of innovation in the water industry to identify the challenges of the water industry before they manifest as problems in the system. The OECD (2007) describe how in the Netherlands, all of the 10 publicly owned water companies pool resources along with sewerage companies, local government and the private sector to share new technology and products. The KWR institute can draw on €17 million of funding for research, from a levy on all the water companies.

So while recent experiences point to the need to upgrade existing infrastructure, international evidence shows that investment in research and technology is just as important in preventing future service disruptions. The challenge for NI Water is to plan that investment in partnership with local government and industry highlighting the collective benefits of cooperation.

1.5 Investing in Energy

One of the biggest challenges facing the Northern Ireland economy over the coming decade will be how to deal with climate change. As noted earlier, Northern Ireland is

dependent on fossil fuels for 98% of its energy consumption. This statistic quite neatly illustrates the depth of the challenge Northern Ireland will face if it is to meet European low-carbon energy targets. In particular the EU's 2020 targets will directly affect Northern Ireland. The goal is 15% of energy from renewable sources by 2020, and this target is set for England & Wales, Scotland and Northern Ireland, so there is no room for piggy-backing on the efforts of the UK as a whole.

The energy sector incorporates both electricity and heating supply, but with recent mergers and acquisitions between gas and electricity companies the distinction between these two industries has become blurred. Even within the electricity sector there are the subsectors of generation, transmission and supply. Northern Ireland has a privatised electricity market similar to that operating throughout the rest of the United Kingdom, and as such, the state is no longer directly involved in producing or transmitting energy.

To progress toward the EU 2020 energy targets though, Northern Ireland will need to actively boost renewable energy generation beyond what has already been achieved. We can see progress in that the Island of Ireland has already

achieved 20% wind penetration and is aiming for 40% by 2020. In Northern Ireland, firms have begun to recognize the natural advantage in tidal energy along the north coast, leases for tidal stream energy in the Rathlin Island and Torr Head area has the potential for an output of 200MW according to a recent Ernst and Young report (2012).

The progress in renewable generation is not only beneficial to the energy sector but also to the wider economy. As the Ernst and Young report points out that the Island of Ireland has enviable wind and ocean energy resources matched with the skilled ICT, engineering and financial capability to exploit them. The sector could add significantly to GDP by 2020. There is no barrier to both the Republic and Northern Ireland establishing a competitive advantage in renewable technologies and exporting these capabilities around the world.

The only significant blockage to the rapid of renewable energy sources on the island of Ireland, and Northern Ireland in particular would be the condition of the electricity grid. Northern Ireland Electricity has already admitted that it has an aging network with many assets approaching the crucial of age 40 years . The grid requires significant

investment over the coming years just to keep service at current levels. Unlike fossil fuels renewable energy must be generated at source and this puts an additional burden on an already strained grid. Renewables must be connected to the grid through new cables or distribution lines and connected to substations at not inconsiderable expense. The cost of upgrading the grid to take on more renewables was reflected in the recent Utility Regulator (Ureg) decision on NIE capital spending plans, but the regulator also capped the increase in levy NIE on domestic and commercial bills. NIE had sought up to £776m for the next 5 years, UReg finally settled on £396m. UReg has also made “special arrangements” to provide £223m over the next 5 years to connect renewables to the grid. NIE have in the past criticized the utility regulator for a lack of stability and precedent in decisions which may lead to adverse financial ratings for NIE in bond markets, limiting its ability to raise outside capital for important network upgrades.

In addition to new generation, energy storage and back-up generation represent a further challenge, this becomes even more relevant as the proportion of electricity coming from renewable sources increases significantly.

Renewable sources will be, by their nature, more volatile in terms of supply and so capacity is required for back-up and this capacity needs to be reflected in the grid and transmission networks.

Deciding how to fund electricity network upgrades spills over into the issue of interconnectors.

Interconnectors between Northern Ireland and the Republic are well established, but they can only be placed in certain area of the grid, limiting the possibility of expansion. While the completion of the East West interconnector between the Republic of Ireland and Wales is welcome, the condition of the existing interconnector between Scotland and Northern Ireland, the Moyle interconnector, has deteriorated in recent years. As the interconnector is owned by mutual energy, the cost of repairs has been passed on to energy consumers. This experience may lessen the attractiveness of mutualisation for projects like this in the future. There are proposals for a privately funded interconnector between Arklow in the Republic and Wales which would be funded through direct charges on energy companies using the interconnector rather than a levy on all consumers. If an additional or replacement interconnector between Scotland and Northern Ireland were

to be built, state guarantees could be made available or this could be achieved through European funding. The type funding provided by the European Commission for the East-West connector could not be made available in Northern Ireland as the East-West connector was between two member states, but further funding options are possible.

“Connecting Europe”, the European commission programme tasked with completing the Single European market for gas and electricity, also has a commitment to connect so-called energy Islands to ensure security of supply. A case could certainly be made for Northern Ireland under these conditions.

While the issues of grids and interconnector are important, it is worth noting that the development of an all-island or all-islands energy policy will only be of benefit if it secures lower prices and a greater role for renewables. The entire effort will have been in vain if it only seeks to enable the creation of an oligopolistic market that has been so prevalent across Europe. Regulation should also seek to go beyond regulating prices or charges. Cooperation in research and development is a more common European experience than not. According to the OECD (2007), the Nordic model provides a clear

example of where firms in a privatised, integrated market can still cooperate on research and development. Transmission system operators collaborate on interconnector capacity through Nordel. Nordel is a body for co-operation between the transmission system operators in Denmark, Finland, Iceland, Norway and Sweden, whose objective is to create preconditions for a further development of an effective and harmonised Nordic electricity market. They adopt measures to improve reliability and price structures to allocate spare capacity efficiently. Investment decisions are taken on the basis that the net economic benefits to the entire Nordic market and not individual markets.

Northern Ireland has a comparative advantage in renewable energy generation that could give life to a whole new industry in both parts of the island. The challenge for government and regulators is make sure that upgrading infrastructure whether grids or interconnectors is aligned toward new sources of energy generation and does not simply propagate the status quo. Similarly, in developing the single market, we must ensure that the benefit of this is measured in reduced energy bills for households and businesses and does not lead to market dominance by large energy firms.

2 Investment Project

Northern Ireland's water and energy sectors are key areas of infrastructure vital for competitiveness. They are in need of substantial investment and valuable assets and enterprise should be utilised to leverage capital investment. Obviously these sectors and projects within them differ hugely with regard to funding structures and requirements. This section will focus on energy efficiency and specifically how a mass retrofitting scheme could be established in Northern Ireland. It is not intended that this action alone would be in any way sufficient to address the severe economic distress of the NI economy. The proposal seeks to put forward a template for investment in one area, in one sector. The proposal will hopefully begin a debate on different methods of delivering infrastructure.

2.1 Investing in Retrofitting

Retro fitting has become a popular term in green infrastructure of late, and can be applied to many energy efficiency initiatives. The basic logic of retro fitting is that buildings and homes can be modified in some way to significantly reduce the amount of energy required to heat them thus giving rise to savings in energy bills that would ultimately outweigh the

cost of the modification. The most common example of this is additional insulation.

Looking at previous studies of retrofitting, Jenkins (2010) highlights the 550,000 fuel poor socially housed dwellings in the UK and estimates that between £3.9 and £17.5bn is required to carry out necessary retrofit works on these homes. While this is a large capital investment, he points out that the UK government has spent more than £20bn on fuel poverty benefits and programmes over the last 10 years. All this spending was focused on short term solutions to the problem with no long term gain. Yalcintas & Kaya (2009) draw attention to Hawaii which has a similar level of dependence on imported fossil fuels as Northern Ireland and where federal and state incentives are geared toward renewable energy generation. They describe various energy efficiency case studies and then compare the energy saving to capital cost ratio of these projects with state incentivized renewable energy installations like photo-voltaic panels. They find energy retrofits are more efficient but also that the two schemes are complementary not substitutes. The Energy efficiency savings can make investment in renewable generation installations more sustainable and

economically viable. Clinch & Healy (2009) also bring attention to many indirect and carbon related benefits that arise from retro fit schemes, these included health benefits that reduce hospital visits and increased well-being which lead to less work absenteeism.

Retrofit is not a one size fits all solution and diligent work is required to assess the needs of each home or building and the required level of work. YU, TU & Luo (2011) have produced an initial cost benefit study of retrofitting commercial buildings and they highlight that while costs are immediate and quantifiable, the benefits which accrue are 'soft', meaning that they are speculative and rely on forecasts of future energy costs. Also the benefits may accrue to future owners of the property and this may limit incentives. Power (2008) raises questions about whether in some cases rebuild is preferable to retro fit. The paper suggests that arguments for demolition ignore the carbon costs associated with rebuild (materials and transport) and that the time horizon would not allow sufficient demolition and rebuild to occur. It also points out that various German retro fit schemes have already shown that retro fit can achieve energy standards equal to the new build standards.

Increasing energy prices have focussed the minds of many on efficient energy use, but recent statistics for Northern Ireland show that this investment is especially needed. Fuel poverty in Northern Ireland in 2011 was 42% or 294,000 households, this represents a small decrease on 2009, but still well above the UK average of 19%. Some of this gap is down to the greater reliance on oil for home heating, but is still represents a major problem. The number of properties with no wall insulation is 173,000 or 22.8% of all houses. 414,000 dwellings have loft insulation of less than 150mm. By today's best practice, these dwellings ideally should have loft insulation topped up to 270mm (NIHE, 2012).

2.2 Green Deal

The Green Deal is the UK government's plan to incentivise investment in energy efficiency among homeowners and businesses. The scheme excludes Northern Ireland. It is designed so that banks and various investment groups can be involved in providing "Green Deal Finance" to households and businesses to cover the upfront cost of approved energy retrofit projects. The projects would have to be accredited and the repayments are levied on energy bills. The scheme contains a "golden rule" whereby the

cost of the project repayment cannot exceed the projected energy savings and the period of pay back cannot exceed the lifetime of the particular installation. This clause is very important as it addresses concerns about both the length of repayment and uncertainty over future energy costs. These conditions have been agreed with financial institutions providing finance for these projects who must be convinced that the accredited installations will provide the energy savings that would allow the homeowner to repay the cost of the project with interest. The Green Deal also has a clause, ECO Finance, providing subsidies to households who may not see sufficient savings in their energy bills because they cannot afford to use enough energy to fully heat their home at present. The Green Deal is to play an important role in eradicating fuel poverty (DECC, 2010).

It should be noted that the Green deal has generated some controversy amongst those who believe that in some cases the proposed insulation schemes cannot lead to energy savings of equivalent value. These concerns mostly relate to how the interest rate charged on the green deal loans could still pass the "golden rule"; this is important and issues of finance are covered in the next section of this document. Many have claimed

that the cost of retrofitting varies widely among the housing stock, of the 173,000 in Northern Ireland properties with no wall insulation are 49% are solid wall houses and 51% are unfilled cavity construction. This has a bearing on costs with solid wall being more expensive to treat; depending on house size cavity wall insulation is around £400-£500 whereas external wall insulation could range from £9k to £13k. An important aspect of the scheme is that the method of repayment will be through energy bills. This method is used for two reasons, firstly people are seen as less likely to default or fall behind on energy bills than on an unsecured personal loan. Secondly if repayments are attached to energy bills the repayment schedule can be transferred quite easily if ownership of the property changes. While evidence may back up the first point, reports from the International Energy Agency have shown that the participation of the energy companies in the scheme has led to mistrust and scepticism owing to a level of mistrust surrounding price hikes and mis-selling of products by energy companies. On the second point, transferability of liability can be achieved in other ways, land rents are often transferred with transition of ownership and this would not be markedly different.

2.3 Model for Northern Ireland

The Green Deal provides an excellent framework for Northern Ireland, but a simple extension of the scheme to Northern Ireland would be an opportunity missed. Many of the concerns expressed about the Green Deal surround the establishment of a new agency, amassing expertise and the time it would take to do this. However fixed set-up and administration costs are factored into the cost benefit-analysis of the Green Deal and are still far outweighed by potential benefits. Yet a programme on a scale appropriate for Northern Ireland could more efficiently perhaps make use of existing structures and agencies to manage this scheme.

Smith & Swan (2012) make the case for social housing as the best structure to deliver UK retrofit. Specifically they point to the immature nature of the retrofit industry and that housing associations have been involved in maintaining and refurbishing of properties for decades. They have a level of “client led project management and supervision” unmatched by the private sector, which is especially important when supply chains and skill sets for retrofit are as of yet underdeveloped. In Northern Ireland responsibility for

social housing is vested in The Northern Ireland Housing Executive. The NIHE has direct oversight of 90,000 stock of social housing in Northern Ireland in addition to connections with housing associations. It is also the body tasked with regulations for home energy conservation. They have a staff of over 3,000 and have knowledge and expertise in maintaining their stock of housing and relationship with sub-contractors. This would not entail further bureaucracy, but rather taking advantage of the structure of the NIHE and its network and experience built up over the last 40 years so that a scheme of the required scale could be delivered efficiently under a realistic time frame, while also avoiding many of the larger set up and administration costs.

NIHE could begin by retrofitting their own stock of housing, which would provide an economy of scale but also build up a network of accredited contractors that could then be spread out into the private domestic sector.

In this scenario the NIHE would establish a division modelled on that of the Green Deal, provide assessors, accredit local businesses as installers and make the contractual

arrangement with the consumer. Finance matters will be discussed in the next section but for now the scheme would involve 5 stages

1. After an application, an independent accredited assessment/survey of the property is carried out to ascertain what retrofitting could be carried out and what the projected energy saving would be.
2. If the work required passes the "golden rule", The NIHE would offer to engage a certified subcontractor to carry out the necessary works.
3. If the offer is accepted by the homeowner, they would sign a contract where a schedule of repayments is specified and secured on the property.
4. Repayments would then be made on the same schedule as energy bills, sustaining the link between the payments and energy savings.
5. When the payments are concluded the homeowner is then entitled to gain from the retrofit works. (i.e. increase in property value).

In order to assess a scheme like this, the scale and scope in terms of numbers of buildings needs to be estimated. While there is no way of knowing what the eventual take up of the scheme would be we can set ambitious targets based on the current state of energy inefficiency. Of the 700,000 occupied homes nearly all could be considered for retrofitting but according to the latest 2011 Northern Ireland Housing Condition report, 228,020 homes in Northern Ireland have a SAP (Government Energy Efficiency) rating of 54 or below, which the Scottish Government classes as "energy inefficient".

Even with an indicative figure for the houses which could be encouraged to take part, the varied requirements for different houses, like solid wall or cavity wall, make any overall cost calculation futile. The Green Deal was set to provide grants of £6,500 when originally conceived. This could rise to £10,000 when the scheme is eventually launched. As cost of treatments vary between properties, we cannot estimate what the total requirements would be until surveys calculate what the most efficient type of installation would be.

2.4 Estimated Employment Impacts

In addition to reducing Northern Ireland's carbon emissions and a long term reduction in costs across the economy, the proposed investment could give a much needed boost to employment in Northern Ireland in a sector which has been adversely affected by the recent downturn. The construction sector lost 30% of employee jobs from 2008 to 2012 (NI LFS) which gives Northern Ireland an abundance of skilled workers and small and medium sized firms that could take part. The latest impact assessment report from the Green Deal (2012), estimates that a total capital investment of £1.08bn could create over 35,000 jobs in the UK by 2015. The ratio of job to capital spending they use for construction and maintenance is 32.6 jobs per £1m of output.

In order to produce an indicative figure for Northern Ireland a simple input-output table for Northern Ireland was used. There is no official Input-Output table for Northern Ireland, but some academic work (see annex) has constructed a table derived from UK data. The details of this table and its derivation are explained in the appendix of the paper. The table produces a lower figure of 23.9 jobs per £1m invested

in the construction sector. The reason this figure is slightly lower is that the UK multiplier refers specifically to retrofitting, whereas the Northern Ireland figures capture all construction activity. Retrofitting has a higher multiplier effect than new home-building as a sizeable proportion of output in that activity relates to acquiring land. A greater proportion of output is associated with labour in the output of retrofitting. Even so 23.9 jobs represents a much larger employment effect than many other sectors of the economy including manufacturing. It is important to note that the employment figures estimated here are just that, estimates. Input-Output effect and multipliers are often misapplied and misused in attempts to justify projects that do not stand up to traditional cost-benefit analysis. To be clear, a mass-retrofit scheme must stand alone as a worthwhile investment, any related employment boost to the economy is supplementary. As Fjeldsted (1990) points out employment effects estimate but do not predict outcomes.

3 Options for Sourcing Funds for Investment

Energy efficiency is a key infrastructural target for Northern Ireland. It will reduce energy dependence, meet international obligations and provide a much needed boost to the local economy. The scheme proposed earlier will need to leverage private capital to fund an initiative of this nature.

3.1 The Need for a State-led Initiative

One of the first questions to arise about this plan is the need for a government scheme of any kind. If retrofit provides such an obvious financial gain for households, why would homeowners not voluntarily carry out retrofit, and why would banks not provide finance for such an obvious investment return? In a paper outlining the financial context of Green investment to the Department of Business, Innovation and Skills, Vivid Economics (Vivid, 2011) outlined seven barriers to green investment. Of the seven barriers, four directly apply to market failures in the retrofit sector. The first is Risk Aversion, which is particularly appropriate when there is no track record for this type of investment.

The second is incomplete information; consumers can just be unaware of the potential savings from such an investment. Thirdly there are principal-agent problems, especially if the scheme involves landlords and tenants and information asymmetry over energy savings. Finally there is policy uncertainty; government energy policy for the future has to be known at the time of investment. It was mentioned earlier how energy price uncertainty can affect investment decisions, and this is a similar point.

Owing to this market failure the natural response in many countries has been for government to step in and provide the capital and recoup its investment through a levy, also creating reduced carbon emissions as a public good. This does however pose a challenge to Northern Ireland. With a severely constrained capital budget decided in Westminster, The Northern Ireland Executive could not fund this initiative independently, thus the need to look to private capital.

3.2 Pension funds

Pension funds provide a source of long term financing that is ideal for infrastructure investment, and there has recently been a move in the industry away from higher risk equities which provide an

opportunity for infrastructure programs. In testimony to a UK House of commons committee on the subject David Paterson, Head of Corporate Governance at the National Association of Pension Funds, emphasised that UK pension funds are in “de-risking mode”, where they are selling equities and buying up government or corporate bonds. This means that pension funds are looking for safe investments with long-term potential rather than more risky, high-yield equities.

An OECD report (Ottson, 2011) examines how access to finance for national governments has become constrained and that a ‘natural match’ exists between pension funds and infrastructure projects. The obstacles to this match stem from regulatory barriers and the way in which infrastructure projects have been marketed in the past. A certain level of government guarantee can also increase the level of exposure that pension funds can have to investments of this kind. A government guarantee can significantly reduce the return that pension funds would require for investing in infrastructure. While infrastructure funds provide the kind of long term yield and diversification that pension funds require they do not at present constitute a large portion of pension investments.

Green investment carries many of the advantages of infrastructure investment and the industry is beginning to recognize this.

Another OECD study into the role of pension funds in Green Investment (Della Croce, Kaminker & Stewart 2011) looks at the experiences of green investment finance to date. The report focuses on green infrastructure bonds and alternative investment classes as methods for green financing. Green bonds are defined as fixed-income securities issued by governments or corporations that raise capital to finance projects that contribute to lower carbon emissions. Different kinds of capital are appropriate at specific stages of green development, with venture capital most appropriate at the early development of unproven technology, usually renewable energy generation. Green infrastructure bonds are more appropriate in operational refinancing stage for established green infrastructure, like retrofitting.

The same report also notes that bonds make up 55% of securities held by OECD pension funds and yet most of green infrastructure is at present financed through more risky equities. Equities limit the participation of smaller pension

funds who cannot take on the level of risk in these instruments. Green bonds would represent the predominant asset class at present and the most desirable in the future.

In the UK the Green Investment Bank set up by government, has already signed a memorandum of understanding with two of the UKs largest pension funds for investment in infrastructure projects. Internationally the World Bank has issued over USD \$2.3bn of green type bonds and the European Investment Bank has raised €1.15bn in climate awareness bonds since 2007.

The US provides some interesting examples of Green Bonds that have been used in the past such as Clean Renewable Energy Bonds (CREBs) which were used to finance public sector renewable energy projects. More interesting is the case of Property Assessed Clean Energy or PACE bonds. PACE bonds provided security because they used a special type of lien which gave the scheme priority over existing mortgage providers. If the house was repossessed the PACE finance provider would be first in line to recoup losses in the case of foreclosure or repossession. Unlike other liens the PACE lien does not have to be repaid if the property was sold but could be transferred to the

new owner. In addition to the security of PACE bonds, The US environmental Protection Agency (EPA, 2011) notes that PACE bonds are the most appropriate finance tool to fund energy efficiency initiatives, if no government or public funds are available and private finance is required. These bonds were issued by local municipalities who then organised assessments and implementation for residential and commercial properties. The scheme required no upfront costs and repayments are typically made over a 15-20 year timeframe. This is similar to the UK Green Deal, where utility companies are involved and green bonds would be used to refinance the investment. Once again many cite the lower risk of default on energy bills as allowing such bonds to have a higher investment grade.

In the absence of government capital for infrastructure investment, pension funds represent a natural source of finance. At an international level it can be seen that bonds represent a large proportion of pension fund assets and that this trend has hit funds in the UK as well. They also represent the best financial instrument for the kind of green investment that is advocated.

3.3 A Model for Northern Ireland

In proposing a model for Northern Ireland the international experience of green infrastructure financing is taken into account. The experience of retrofit financing in Great Britain also needs to be taken into account. The Green Deal, in Great Britain was designed to borrow money at a very low interest rate to provide upfront costs for retrofit. This would be achieved by setting up the Green Deal Finance Company. This company is consortium of public and private sector companies established as a not-for-profit mutual to provide low cost financing to households for retrofit. The idea was that all these large companies coming together would reduce the risk and thus the interest rate of green deal finance. This initiative has not achieved a great deal of success with many prospective members of the consortium declining to become involved thus jeopardising finance for the green deal project. The failure of this structure should seek to highlight the fact that a large scale national retrofit scheme cannot be achieved through a purely market led initiative.

Another significant development mentioned previously was the establishment of the Green

Investment Bank. This institution was initially planned as an investment fund which would provide much needed seed capital to infant green industries with a preliminary government investment of £3bn. Since then it has morphed into an actual investment bank, with plans to leverage the initial £3bn investment in private capital markets to provide a greater boost to green investment nationally. The GIB will however only be allowed to borrow once government debt as a proportion of GDP begins to fall. Given that this date has been pushed by three years in the last two budget statements, it may be granted this power earlier than expected.

It isn't difficult to make a connection between these two institutions. Many have argued that the Green Investment Bank should be used to provide finance for the Green Deal, indeed there is international precedence for this, KfW Bankengruppe the German green Investment bank has provided large amount of finance to retrofit projects. However, if this course were chosen it would leave many wondering why the Green Investment Bank, is needed as a middle man for Green Deal finance. The attractiveness of the Green Investment Bank is its borrowing capabilities and state guarantee. It would of course be

much more straightforward to simply grant state guaranteed borrowing powers to the Green Deal. Although the current coalition government have linked the introduction of GIB borrowing powers to the government debt reduction target, they are more than happy to extend government guarantees to infrastructure projects under the UK Guarantee Scheme, for which Green Deal would be an obvious candidate.

In the previous section the Northern Ireland Housing Executive was presented as an ideal candidate for overseeing a retrofit scheme given its relationship with contractors and the large stock of housing on which it could begin work. With nearly 90,000 houses in its stock and the income that this generates the NIHE is also well suited as the organisation to finance this program. Allowing the NIHE to issue retrofit bonds similar to the PACE bonds issued by municipal councils in the US is a convenient model. Unlike other parts of the UK, responsibility for housing in Northern Ireland was devolved from councils to the Housing Executive in 1971. For this reason the NIHE is more appropriate financier than local councils. Furthermore the NIHE is a much larger than district councils and has an asset base worth up to £3.3bn and would have the clout necessary to gather requisite finance.

At present the NIHE is a Non-Departmental Public Body linked to the Department for Social Development. If NIHE were simply allowed to begin borrowing or issuing of bonds carried they could be classified as “off-balance sheet”, i.e. not counted toward general government debt. The ONS follow European guidelines for national Accounts ESA95 and according to the Chartered Institute of Housing in the UK, council housing and ALMO (arm’s length management organisations like housing associations) are classified as part of the corporate public sector because the majority of their income is from rent.

A Eurostat definition reads as follows,

1. *Government Deficit and Debt statistics report on the activity of the General Government sector (S.13) as defined in national accounts. This sector is defined in ESA95 as all institutional units that are non-market producers whose output is intended for individual and collective consumption, and mainly financed by compulsory payments made by units belonging to other sectors, and/or all institutional units principally engaged in the redistribution of national income and wealth.*

2. *Non-market producers are units that do not obtain most of their income from the sale of goods and services, and so the definition excludes government-owned trading businesses (often referred to as public corporations). The public sector is usually defined as general government plus public corporations*
(Eurostat, 2010)
- *and it has substantial day to day operating independence so that it should be seen as an institutional unit separate from its parent departments*
(PESA, 2011)

The Treasury defines a public corporation as

Public corporation is a term from National Accounts, which are based on the European System 8.5 of Accounts (ESA95). The Office for National Statistics (ONS) therefore determines which bodies are public corporations. A body will be classified as a public corporation where:

- *it is classified as a market body*
 - *a body that derives more than 50% of its production cost from the sale of goods or services at economically significant prices. Some charge for regulatory activities, where these provide a significant benefit to the person paying the fee, for example through quality testing;*
- *it is controlled by central government, local government or other public corporations;*

The Northern Ireland Housing Executive is classified in the latest treasury public sector classification as a public corporation but this classification is subject to change. While it is true to say that the Housing Executive receives its income from commercial rents, it has also been funded by central government to carry out projects which have distorted the proportion of its income coming from commercial activities. Whether NIHE bond issue is given a state guarantee, as may be required by investors, it will be automatically be entered on government balance sheet.

As discussed previously, the state guarantee to be granted to the Green Investment Bank or the UK Guarantee Scheme have set a precedent for such state aid in the UK already, all that should be required would be for the relevant legislation to give effect to such guarantees in Northern Ireland. There is certainly an argument to be made that parity between Northern Ireland and Great Britain requires such legislation. Granting state guarantees to NIHE

borrowing, which has a large and healthy asset base to act as security, would represent one of the more prudent schemes approved.

Leveraging private capital to fund retrofitting schemes is well established in the US and other countries. Green bonds have been commonly used to in order to finance such programs and would be most conducive to attracting long term investors such as pension and insurance funds. With housing responsibility devolved to the Northern Ireland Housing Executive and an asset base of £3.3bn, it is the best placed organisation to both oversee the scheme and to finance it. Even with this large asset base and reliable income some sort of state guarantee would be required to ensure a feasible rate of return on bonds. This should not be an issue as infrastructure projects and green investment in Great Britain will benefit from state guarantees, legislating for this in Northern Ireland should not be represent special treatment, but a matter of parity.

4. Conclusion

The aim of this paper has been to show that investment in key infrastructure is necessary for future growth in the Northern Ireland economy. Meeting this challenge will require a coordinated programme driven by the Northern Ireland Executive. Both the Energy and Water sectors will require significant investment over the coming years and energy efficiency is just one area that was discussed in greater detail. Energy efficiency was chosen to show that even though the Executive may be constrained fiscally by budget decisions made in Westminster this does not close all doors and that it is still possible to take action for Northern Ireland.

It has been shown that in addition to reducing Northern Ireland's carbon emissions the scheme could help alleviate fuel poverty and boost competitiveness by lowering energy costs for businesses. Additionally the scheme could provide a much needed boost for employment in the construction sector, which has been so badly affected by the current crisis.

Retrofitting schemes are a good place to start and hopefully the model outlined here will provide guidance for other projects that could be initiated. While it is acknowledged that the Executive faces many constraints not experienced by most governments, there remain many options available to it to take positive action for the Northern Ireland Economy.

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Appendix

The Input-Output Model for Northern Ireland

The added benefit and impetus to carry out this programme of works now is to give a boost to employment and output so as to stimulate the Northern Ireland economy. When discussing a stimulus plan, outcomes and impacts are usually calculated using multipliers from national economic models. Northern Ireland however is a regional economy and the lack of official data prevents the construction of such a model.

However there is scope to use a more simplified model of the productive elements of the economy, something called the input-output model. To put it simply, an input-output model is a table which divides the economy into sectors with outputs. As with most developed economies the output of one sector is required as an input in production of another sector. For example car manufacturing requires mining outputs for metal, rubber and plastic used producing a car. These relationships and interdependencies exist throughout the economy and also take into account imports used in domestic production and output that is not domestically demanded

either as input or consumption, i.e. exports.

This is a very simple model of the economy and there are many other aspects and relationships that could be taken into account. According to European commission report "Input-output analysis is essentially, therefore, a method of systematically quantifying the linkages between various sectors in an economy" (EC, 1999). It is used, however in many cases for regional economies and has a predictive power to rival that of many more sophisticated models. No official input-output table exists for Northern Ireland, but past studies have constructed models from available data. Most recently Hyland, Jennings & Tol (2012) constructed an input-output table for Northern Ireland which they used to estimate how outputs of carbon dioxide are affected by increases in demand in Northern Ireland and the Republic of Ireland. They construct an I-O model for Northern Ireland using data from the Republic and the UK where NI data was not available. An input-output table was used in Kronenberg, Kuckshinrichs & Hansen (2012) to find the macroeconomic effects of a German programme of retrofitting. They use a static open model, static in that increases in demand and production do not affect relative prices. The chief area of

interest in this paper is the effect of increased demand for construction, by way of a retrofit scheme, on public finances. This is beyond the effects we are looking to calculate but it does set an interesting precedent.

As there are no official input-output tables for Northern Ireland any calculations will as such be based on models drawing on existing data sources. To date the Economic Research Institute of Northern Ireland (Iparraguirre D'Elia, 2008) has

produced a model based on the Kronenberg (2007) model of the German region of Hamburg. The Northern Ireland model produced in 2008 uses the 2004 UK input-output tables to derive a regional model in much the same way using employment shares of industry to present a regional picture. Exports and trade balances for Northern Ireland are calculated for Northern Ireland as well. The headline results were the output multipliers derived from the matrix and they are presented below

Table 2.1 NI Output Multipliers

Sector	Multiplier
<i>Agriculture, forestry & fishing, Mining and Quarrying</i>	1.499
<i>Manufacturing</i>	1.353
<i>Electricity, gas & water supply</i>	2.225
<i>Construction</i>	2.162
<i>Distribution, hotels and restaurants</i>	2.519
<i>Transport and communications</i>	1.63
<i>Banking, Finance and insurance, and business services</i>	1.299
<i>Public administration and Defence, Education & Health</i>	1.647
<i>Other services</i>	1.449
Total	15.782

Source: Iparraguirre D'Elia *ERINI* (2008)

These output multipliers show the increase in total output required to satisfy an increase in final demand for a particular sector. This calculates that for a £1 increase in final demand for Agriculture there is a 1.499 increase in output throughout the entire economy. What is initially clear is that these multipliers identify the sectors of the economy which depend most on other sectors for output and that an increase of £1 in demand in the retail sector will have a much larger effect on total output than say the same increase in demand for manufacturing. These multipliers deal with effect on output of increases in demand. However more recently among economic indicators attention has turned more towards employment and unemployment as a more accurate measure of economic health. For this reason it is perhaps more intuitive to focus on the effects on employment in assessing the impacts of the proposed scheme.

There are employment multipliers that directly calculate the effect on

employment in the whole economy from changes in employment in one sector. This multiplier does however require more data and can only describe employee job effects and excludes self-employment. The Employment effect, which we will calculate, is the impact upon employment throughout the economy arising from a change in final demand for an industry's output. A Scottish government report shows the calculation of employment effects from output multiplier as follows. Where L_{ij} is the total of all domestic inputs required to produce a unit of output from industry j .

$$(O_{MULT})_j = S_i L_{ij}$$

The employment effect is defined as follows, where w_i is the rate of employment to total output in each sector.

$$(E_{eff})_j = S_i w_i L_{ij}$$

The table for the rate of employment to £1m of output is displayed below, as the rate to £1 is not a practical figure to work with,

Table 2.2 NI Employment per Total Output Ratios

Sector	Employment per Total output
<i>Agriculture, forestry & fishing, Mining and Quarrying</i>	5.546
<i>Manufacturing</i>	3.63
<i>Electricity, gas & water supply</i>	4.692
<i>Construction</i>	13.731
<i>Distribution, hotels and restaurants</i>	37.532
<i>Transport and communications</i>	8.918
<i>Banking, Finance and insurance, and business services</i>	4.397
<i>Public administration and Defence, Education & Health</i>	23.24
<i>Other services</i>	12.072

Source Iparraguirre D'Elia *ERINI* (2008) & NOMIS

What we can see from this table and the preceding one is that construction has the third highest output multiplier and is the third highest employment/output industry. The next step is to multiply each ratio of employment to output by the corresponding coefficient in the total requirements matrix (see appendix). This is important as every industry sector increases output which makes up the output multiplier. The increase in output in various industries will give rise to varying increases in employment in that sector leading to an overall employment increase. We aggregate

these individual increases to calculate employment effects for the economy as a whole arising from increased output in construction. The figure calculated is 23.91. This means that for every £1 million increase in final demand for construction, the cumulative increase in output spread among the other industries is £2.162m. This in turn creates 23.91 jobs throughout industries based on their increased level of output.

Following Kronenberg, Kuckshinrichs & Hansen (2012), and as is common in the input-output approach we consider spending associated with

the retrofit scheme as exogenous final demand impulse. It is worth noting that the above calculations only reflect initial effects and that it is possible to calculate first round effects. This means that if output from the mining sector is needed to produce inputs for the construction sector, output from other industries may be required to provide inputs to the mining sector. The extra production involved in producing mining sector inputs has its own employment effects as well. These 1st round effects iterate throughout the model eventually approaching zero. This would suggest that if anything the above figures are conservative.

We can see from table 2.1 that manufacturing has the second lowest output multiplier, but if we apply the same calculations as above to the manufacturing sector, the total jobs created per £1m increase in demand is 5.3 jobs. This is obviously a crude calculation, but this point has been made to the UK government in a forthcoming Foresight Office Report. It highlights the need for home building in the UK which did not reach the boom levels it did on the island of Ireland and represents a significant area of potential investment.

From: Iparraigue D'Ela J. L. (2008) Northern Ireland's input-output table: an application of Kronenberg's derivative approach, ERINI Monograph 32. Economic Research Institute of Northern Ireland: Belfast

Leontief Matrix (not productivity-adjusted)

	Agriculture, forestry & fishing, etc	Manufacturing	Electricity, gas & water supply	Construction	Distribution & hotels	Transport & communication	Finance & business services	Public administration & defence, Education & Health	Other services
Agriculture, forestry & fishing, etc	0.92842	-0.02445	-0.22957	-0.01674	-0.01451	-0.00077	-3.2E-05	-0.00078	-0.0007
Manufacturing	-0.11627	0.83307	-0.06951	-0.17538	-0.33151	-0.09283	-0.01432	-0.14841	-0.05161
Electricity, gas & water supply	-0.01296	-0.00795	0.70244	-0.00175	-0.01511	-0.00435	-0.00169	-0.00828	-0.0037
Construction	-0.01888	-0.00139	-0.01626	0.67968	-0.01206	-0.00893	-0.0124	-0.01582	-0.00427
Distribution & hotels	-0.01158	-0.00129	-0.00366	-0.00777	0.95567	-0.01306	-0.00577	-0.01087	-0.00511
Transport & communication	-0.02516	-0.01316	-0.00682	-0.00751	-0.21515	0.83986	-0.02573	-0.02807	-0.01936
Finance & business services	-0.06357	-0.02979	-0.04695	-0.12766	-0.38021	-0.11839	0.86824	-0.10184	-0.11734
Public administration & defence, Education & Health	-0.00344	-0.00152	-0.00283	-0.00249	-0.00805	-0.00897	-0.00932	0.90249	-0.00042
Other services	-0.00459	-0.00262	-0.00238	-0.00102	-0.01332	-0.008	-0.00395	-0.0184	0.88723

Total Requirements Matrix (not productivity-adjusted)

	Agriculture, forestry & fishing, etc	Manu- facturing	Electricity, gas & water supply	Construction	Distribution & hotels	Transport & commun- ication	Finance & business services	Public admin- istration & defence, Education & Health	Other services
Agriculture, forestry & fishing, etc	1.08832713	0.0356767	0.36061316	0.0380196	0.03817166	0.00835456	0.00252724	0.0119159	0.00537355
Manufacturing	0.17526306	1.21305162	0.19261429	0.33269842	0.48273973	0.1544989	0.03571071	0.22359838	0.08409013
Electricity, gas & water supply	0.02310856	0.01477908	1.43345973	0.00935939	0.03242775	0.01049023	0.00390749	0.01708661	0.00784663
Construction	0.03410946	0.00520896	0.04795034	1.47858264	0.03579382	0.02074235	0.02253451	0.03108763	0.01129161
Distribution & hotels	0.01513664	0.00284186	0.0118833	0.01497696	1.05554161	0.01832975	0.00803886	0.01520458	0.00784771
Transport & communication	0.04335363	0.02273985	0.03333989	0.0313375	0.29724106	1.20476378	0.03927288	0.05083059	0.0348662
Finance & business services	0.10624398	0.05109822	0.1292934	0.24447665	0.53448108	0.18525288	1.16787049	0.16134583	0.16642162
Public administration & Defence, Education & Health	0.00628108	0.0030245	0.00810277	0.00778889	0.01906136	0.01444182	0.01266683	1.11092449	0.00287384
Other services	0.00746742	0.0043541	0.00756307	0.00467027	0.02305385	0.01281688	0.00609231	0.02525125	1.12864625

¹ The rate was 5% in 2009 in the Republic.

