

Infrastructure for an island population of 8 million

Summary Report

February 2010

This report has been prepared jointly by the Irish Academy of Engineering and Engineers Ireland, both of which are all-island engineering organisations. The report was commissioned by InterTradelreland.

The Irish Academy of Engineering

The Irish Academy of Engineering is an all-Ireland body, concerned with long-term issues where the engineering profession can make a unique contribution to economic, social and technological development.

Its members are Irish engineers of distinction, drawn from a wide range of disciplines and membership currently stands at approximately 120.

Drawing on the experiences and knowledge of its distinguished members, The Academy works to facilitate communication and dialogue on engineering-related matters. It publishes reports and analyses, some jointly with other learned and professional bodies.

The Irish Academy of Engineering,
22 Clyde Road, Ballsbridge, Dublin 4
Tel: 00353 1 665 1337
academy@engineersireland.ie
www.iae.ie

Engineers Ireland

Engineers Ireland was founded in 1835, has over 24,000 members and is the largest professional body operating on the island. It is concerned with promoting the development of the engineering profession and an environment which will stimulate world-class development on the island. Engineers Ireland is the operating name of the Institute of Engineers of Ireland.

Engineers Ireland,
22 Clyde Road, Ballsbridge, Dublin 4
Tel: 00353 1 665 1300
www.engineersireland.ie

InterTradelreland

InterTradelreland, the Trade and Business Development Body, is one of the six cross-border bodies set up under the 1998 Belfast Agreement. InterTradelreland's mission is "to identify and help realise opportunities to improve competitiveness, generate economic growth and create sustainable, quality jobs in both jurisdictions through increased levels of North/South trade and co-operation on innovation and business development opportunities".

InterTradelreland, The Old Gasworks Business Park,
Kilmorey Street, Newry BT34 2DE
from Republic Tel: 00353 (0) 48 3083 4100
from NI/UK Tel: 0044 (0) 28 3083 4100
www.intertradeireland.com

Acknowledgement

The Irish Academy of Engineering and Engineers Ireland wish to thank InterTradelreland for their kind support for this Report.

	Taskforce Members	04		
	Foreword	05		
1	Introduction	06	7	Information & Communications Technology (ICT) 17
2	City Regions	08	8	Enterprise 18
3	Transport	10	9	Engineering for Health 19
4	Energy	12	10	Infrastructure Integration 20
5	Environment	14	11	Economic Assessment 21
6	Climate Change	15		Annex 1 23

Liam Connellan (Chairman)

Chairman, Veolia Environnement Ireland, formerly Chairman, National Roads Authority

Don Moore (Project Facilitator)

formerly Managing Director, ESB International

Anne Butler

Environmental Consultant, formerly Director, Environmental Protection Agency

Michael Phillips

Dublin City Engineer and Director of Traffic

David Croughan

Head of Economics and Taxation, IBEC

David Gavaghan

Chief Executive, Strategic Investment Board, NI

Jonathan Hegan

formerly Chairman, RPS (Northern Region)

Martin Hynes

Executive Director, Irish Research Council for Science, Engineering & Technology

Billy McCoubrey

formerly Chief Executive, Roads Service NI

Eoin Magennis

Policy Research Manager, InterTradelreland

Gordon Millington

formerly Senior Partner, Kirk McClure Morton

John Power

Director General, Engineers Ireland

Dr Reg Shaw

formerly Managing Director, Wyeth Biotech

Brian Torpey

formerly Chief Engineer, Dublin Port

Brendan Tuohy

formerly Secretary General, Dept. of Communications, Marine & Natural Resources

Gerry Walsh

Director, Spruce Consulting Ltd, formerly Chief Executive, BGE

David Waters

formerly Managing Director, Irish Rail

The Irish Academy of Engineering and Engineers Ireland would like to acknowledge the following, who also contributed to the report:

Martin Spollen

Strategic Investment Board, NI

Johann Gallagher

Strategic Investment Board, NI

Aidan Gough

InterTradelreland

Anne-Marie McAteer

InterTradelreland

David Moore

Aecom Design Build (Ireland) Ltd.

Tom Weymes

formerly IDA

The members of the Taskforce participated in extensive discussions in the course of a series of meetings and submitted comments on a series of drafts of the report. Its content conveys the general tone and direction of the discussions, but its recommendations do not necessarily reflect a common position reached by all members of the Taskforce, nor do they necessarily represent the views of the organisations to which the members belong.

FOREWORD



This report has been prepared by a Taskforce organised by the Irish Academy of Engineering and Engineers Ireland representing the engineering profession on the island of Ireland. It has been commissioned by InterTradelreland.

The purpose of the report is to identify and make recommendations on the long-term infrastructure which will be required in order to achieve world-class competitiveness for the island. Adopting a long-term perspective ensures that economic choices are made and avoids the risk of revisiting incremental decisions based on short-term pressures.

The world economy is going through a period of unprecedented change and adaptation. The rapid growth in the economic power of China and India, the threats posed by climate change and to energy supplies, the global banking crisis and the enlargement of the European Union all present new challenges.

Estimates of the population of the island which were prepared by the Official Statistics Agencies, North and South, before

the onset of the current recession indicated that, based on certain assumptions (used by the CSO), the population of the island could reach eight million by around 2030.

The recession seems likely to postpone the achievement of the eight million estimate by a number of years. It is still important, nonetheless, to identify and put in place in an integrated manner the infrastructure required for an economy with an increased population of eight million given the long-term nature of this activity.

In economic terms, the gross national income per capita of the island economy ranks in the top 13 in the world. An economic growth rate from 2012 in excess of 3% per annum will be necessary to sustain the population increase assumed as the basis for this report.

The pressures of the global economy emphasise the importance of achieving substantial improvement in the infrastructure of the island, which will support an enhancement in economic competitiveness and quality of life for this population.

Chapter 1 INTRODUCTION



Preface

The purpose of this report is to make recommendations on critical elements of infrastructure required on the island of Ireland in order to cater for an increased population of eight million and support a world-class competitive economy. By considering the combined needs on an all-island basis it is clear that there will be economies of scale which will benefit the population.

An advanced competitive economy requires first-class infrastructure, which will deliver efficient and integrated transport systems, high quality technical connectivity, including broadband, cost effective energy, sustainable environmental solutions and an attractive quality of life for its people.

It is our considered view that for the island to take its place amongst the most advanced competitive economies in the world, the following is required:

- a focus on eight City Regions accounting for 90% of the population which will deliver economies of scale and efficiencies necessary for international competitiveness;
- increased urbanisation and density of the city populations, which will allow the delivery of the first-class infrastructure;
- a Dublin–Belfast Corridor with a population of four million and appropriate infrastructure investment which can compete with other major European urban zones. This would be complemented by a South Western corridor linking Cork, Limerick and Galway and comprising a further two million people;
- high quality connectivity both within and between the eight City Regions;
- development of Dublin Airport, complemented by Belfast International, as an international hub to improve worldwide connectivity for business on the island; and,
- use of innovative financing to fund infrastructure development.

The Context

Using the most recent official projections for Ireland (up to 2026) and Northern Ireland (up to 2033)¹ the report estimates that the population of the island will be just over eight million by 2030.² In the South the population increase will be based upon continuing (albeit declining) international migration and constant fertility. Of relevance to this report, it is likely to be accompanied by traditional internal migration patterns and movement of younger people to the urban areas. This will result in a rise from 4.23 million (2006) to 5.69 million (2026).³ In the North natural growth (fertility) and improvements in mortality are the main factors behind the 0.7% per annum increase.

To achieve infrastructural quality comparable with the best in the developed OECD countries and to support the above population it is of critical importance that medium to long-term infrastructural planning takes place. There is clear evidence that there is at present an infrastructural deficit on the island. This deficit must be eliminated and we must then keep pace with developments in the more advanced competing economies, which will continue to drive forward and improve their infrastructure.

Some guiding principles were adopted in preparing our report. We recognised that there are severe limitations on the financial resources likely to be available. It has been demonstrated internationally that cities are the key drivers of economic and social development and are the engines of development within wider City Regions. We have focused on City Regions comprising a circle of 65km radius from the city centre and have identified eight City Regions, which together account for almost 90% of the population of the island and where we believe best value can be obtained from limited resources.

Irish cities are small by international standards. We have therefore also considered the opportunities for the development of one or two conurbations which could have the economies of scale to compete with some of the larger urban zones in Europe. The Dublin–Belfast Corridor is the primary conurbation, and a second possibility exists on the South West Corridor linking Cork, Limerick and Galway.

The globalisation of world trade and travel is a further consideration. It is critical that there is a very high level of connectivity within the island and between the island and international centres of trade. This will involve the development of a major international airport hub on the island.

The cost of providing the necessary infrastructure will be substantial. It will be necessary to harness all the available public and private resources in a manner which will provide the highest return in employment and exchequer revenue to the people of the island. Focus should be on providing essential infrastructure for the high growth City Regions, which have the greatest attraction for inward investment and which will provide the highest return, and lead to higher employment and living standards. The alternative of spreading limited resources too thinly will yield less positive results.

¹ Central Statistics Office, *Regional Population Statistics, 2011-2026 (December 2008)*; Northern Ireland Statistics and Research Agency, *2008-based Population Projections (October 2009)*

² The projections give the island a total population of almost 7.7 million by 2026-30. The eight million total comes from an assumption that Ireland's 1.5% per annum increase up to 2026 would continue at least up to 2030. That would mean a further population increase of 341,000, leaving a total of 6.03 million in Ireland and 1.99 million in Northern Ireland, or 8.02 million in total.

³ It should be noted that these projections were released in October 2008 before the current economic downturn and more recent signs of emigration. What effect this will have on the overall growth rate is open to question.

Chapter 2

CITY REGIONS

Key Recommendations

1. Concentrate on improving the competitiveness of the eight City Regions.
2. Plan for greater urbanisation and an increase in the population density in cities by one-third by 2030.
3. Develop the Dublin–Belfast Corridor with appropriate infrastructure investment between both cities and the important nodal points along the Corridor.
4. Promote a South Western Corridor linking Cork, Limerick and Galway.

Priority should be given to the provision of infrastructure in the eight City Regions, which account for 90% of the island's population and which have the potential to be internationally competitive. The eight City Regions are Dublin, Belfast, Cork, Limerick, Galway, Waterford, Derry/Londonderry and Sligo. The City Regions are based on areas with a 65km radius centred on each city (Figure 1).

Today, 79% of the population of the US and 74% of the population of the EU live in urban areas. By contrast, on the island of Ireland, currently less than 66% of people live in urban areas (defined in this report as settlements with populations greater than 1,500 people) but the trend towards increased urbanisation is evident here also.

Higher population density has many advantages. It offers the opportunity to become more urbanised with resultant improvements in services such as transport, energy, education and research and development. Travel to work times can be reduced, productivity improved, energy consumption diminished, international linkages improved and innovative capacity enhanced.

Cities are increasingly seen as the drivers of national competitiveness and of economic and social development.

Across the world cities are focusing on improving their positions in a global league table. They play an increasingly crucial role in the development of national competitiveness in modern knowledge-based economies.

A recent Forfás report states the need to support all cities in Ireland, but it recognises the distinct role of Dublin as the key driver of national competitiveness.⁴ A report on the future of Belfast recommends that “government should start with the big places” and that “the Assembly should support Belfast more as the largest city. It should focus upon competitiveness as well as social cohesion”.⁵

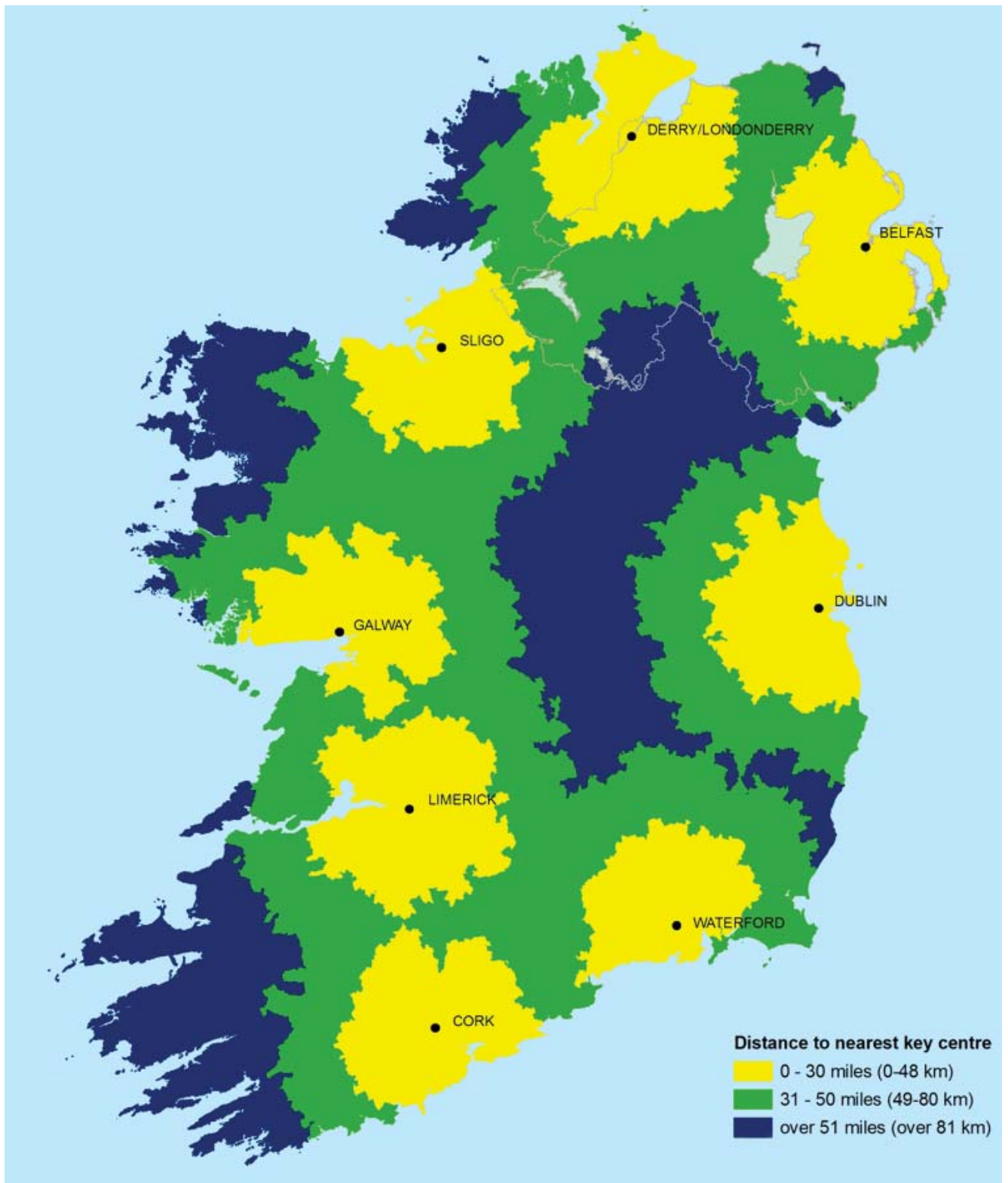
Half the population of the island will be located in the Dublin–Belfast Corridor including the Newry–Dundalk gateway with a population density five times greater than the rest of the island. Improving the connectivity between Belfast and Dublin offers the opportunity to develop a corridor of very high added value per person which can drive the more rapid economic development of the whole island. Economies of scale can enable the corridor to become a more powerful magnet, comparable to European Urban Zones having a population of four million or more. This could attract foreign direct investment, particularly in advanced manufacturing and high added-value business services such as software, international shared services centres, financial and professional services.

About one-quarter of the population of the island will be located along a south western arc comprising Cork, Limerick and Galway. The density of population along the arc is about half that of the Dublin-Belfast Corridor, but considerably greater than in the rest of the island. Here too, economies of scale can be developed by a similar enhancement of interconnectivity between the three cities including high-speed transport services, broadband and access to ports and airports.

⁴ Forfás/National Competitiveness Council, *Our Cities, Drivers of National Competitiveness*, 2009

⁵ *Where is Belfast Going? Professor Michael Parkinson, Liverpool John Moores University July 2007*

Figure 1 Distance by Road to the Largest Settlement in Each of Eight City Regions



Source: Strategic Investment Board NI

Chapter 3

TRANSPORT



Key Recommendations

1. Improve transport connections, including a high speed, high frequency intercity rail system, between the cities of Dublin and Belfast.
2. Develop a second transport corridor along the South Western Corridor between Cork, Limerick and Galway.
3. Improve the motorway network to meet the projected increased traffic flows between the eight principal cities and links to ports and airports.
4. Determine the complementary role of road and rail when planning to improve traffic flows between the main centres.
5. Make capacity available in Dublin Port by relocating the Oil Zone to a new dedicated port with pipelines to supply aviation fuel directly to Dublin Airport.
6. Develop Dublin Airport, complemented by Belfast International, as a major international hub to improve worldwide connectivity for business on the island.

The quality of transport infrastructure determines the ease with which people can interact within City Regions and between cities and is a key consideration in determining the

competitiveness aspect of any location. High-density cities make feasible the provision of public transport systems which use less energy and emit less greenhouse gases. High quality rail and road connections reduce travel times, and stimulate business and social interaction. They contribute to the achievement of economies of scale where the strengths of cities can be combined.

Roads

It is assumed that the annual rate of increase in road traffic over the period to 2030 will be 3% in Ireland and 1.5% in Northern Ireland when growth resumes at a rate to achieve a population of eight million on the island after the current recession. The Dublin–Belfast Corridor linking the two main cities is likely to have the highest volume of inter-urban traffic and to require an expanded motorway which will ensure that users can travel at an average speed of up to 110km per hour. The quality of the road corridor will be a key factor in increasing trading and business interaction between the two cities and will enable maximum advantage to be taken of the potential for specialisation of services based on their respective strengths.

Rail

Each of the eight cities is connected by rail to at least one other city. The Dublin–Belfast route has the greatest number of passenger journeys. Rail traffic on this route has increased by 70% over the past decade, albeit from a low base (**Table 3.4, Main Report**).

The Dublin–Belfast Rail Link should be the spine of the transport corridor between the two cities. A high-speed and high-frequency intercity rail system linked to efficient urban rail and bus systems at the termini and along the route will be a critical building block in the creation of a European scale conurbation on the island.

Rail passenger patronage between all the main cities has the potential to grow significantly by 2030. There is also considerable scope to develop rail links along the South Western Corridor connecting Cork, Limerick and Galway where road traffic is projected to increase sharply.

It is important that all plans to improve traffic flows between the main centres determine the complementary role of road and rail and how investment in the different forms of infrastructure can best contribute to efficiencies and support each other.

Intercity services should be linked with commuter rail, light rail and bus in a single overall timetable design with ease of transfer between modes. An integrated public transport system should be developed for each city. Where feasible a “fish bone” traffic design approach should be adopted to feed in traffic to the highest capacity transport mode available.

Ports

The great majority of goods traded to and from the island go through the eastern ports. Seven ports account for 86% of total port traffic. These are Dublin (28%); Belfast (17%); Shannon (14%); Cork (13%); Larne (7%); Rosslare (4%); and, Waterford (3%).

More than half of the island’s trade with Mainland Europe is transported via Great Britain. This trend will continue. Dublin, Belfast, Rosslare and Cork are the primary ports for direct Continental traffic.

It is estimated that the volume of goods traffic through Dublin and Belfast ports will double by 2030.

Capacity should be made available in Dublin Port by relocating the Oil Zone to a new dedicated port with pipelines to supply aviation fuel directly to Dublin Airport.

Airports

Five airports account for 97% of air traffic on the island (Dublin; Belfast International; Shannon; Cork; and, Belfast City). These airports provide a total of 320 scheduled services to external destinations (off the island). An efficient road and rail network between the key nodes and the main airports will play a major role in offering competitive choice and maximum international connectivity to airport passengers.

Air traffic to and from the island is expected to double to about 75 million by about 2030. The number of destinations served is likely to increase substantially reflecting the growing diversification of Irish trade in response to the increasing role of the BRIC countries (Brazil, Russia, India and China) and the oil producing countries in world economic consumption. It is also possible that the island may have an expanded role as an intermediate fuelling destination for intercontinental flights to Asia and the Middle East. This success is dependent on international connectivity. It is important, therefore, that Dublin Airport, complemented by Belfast International, is developed as a major hub to improve international connectivity for business.

Chapter 4

ENERGY



Key Recommendations

1. Prioritise investment in research and development of offshore wind, marine renewables and smart grid technologies
2. Determine the optimum share that gas, coal and nuclear should contribute to the non-renewable segment of electricity generation.
3. Prioritise the location of new wind farms adjacent to the high tension electricity grid.
4. Increase energy security by providing long-term strategic storage capacity equivalent to 20% of annual natural gas usage on the island in line with international norms.
5. Make district heating (DH) a requirement in all new high-density residential and commercial developments.

Ireland today produces some of the most expensive electricity in Europe. For industrial users the cost of electricity is currently 28% above the EU average (excluding taxes). The future prosperity of the island of Ireland will depend on our success in the international traded sector. This in turn is

dependent on competitive input costs, one of the most important of which is electricity. Future policies for the electricity sector must include a price impact analysis.⁶

New Technologies

By 2030 new technologies and systems should materialise in a fully economic and environmentally sustainable manner. It is essential that investment in research and development of offshore wind, marine renewables and smart grid technologies is prioritised in order to take full advantage of these advances in a way which will enhance Irish economic development.

Primary Fuel Mix

In the long term Ireland must allow for a significant change in its primary fuels as technology develops further and our competitors steadily make the best and most economic choices. By 2030 renewable generation (mainly wind) will provide approximately 30% of electricity generation. The key policy decision will be to decide on the mix of the remaining 70% of generation and to determine the

⁶ Irish Academy of Engineering – Irish Energy Policy: Update on Electricity Price Competitiveness, December 2009.

optimum share that gas, coal and nuclear should contribute to the non-renewable segment of electricity generation.

Network Investment

To attract the high-tech industry which will be the basis for the new economy, all the City Regions will require high-quality, high-voltage bulk power supply at 220kV and above. This will require a doubling in the capacity of the bulk transmission circuits over the next 20 years. A significant part of this investment is required to facilitate wind generation connecting to the system. The location of new wind farms adjacent to the high tension electricity grid should be prioritised.

Smart Grid Technology

Most forms of renewable energy are intermittent in nature, depending on wind, wave or tides to generate power and making it difficult to match generation with peak demand. Smart metering should be installed which will allow variable pricing and control switches to large energy consuming devices so that they consume power when it is cheaper to produce, thus reducing the need for costly standby generation.

Gas Storage

Ireland is uniquely vulnerable given its location on the far western edge of the European gas network, dependent in part on a single piece of infrastructure for importation of 90% of its needs and 65% dependent on gas for power generation.

In order to increase energy security long term, strategic storage capacity equivalent to 20% of annual natural gas usage on the island should be provided in salt caverns,

depleted gas fields and liquified natural gas (LNG) tanks. Part of this long-term strategic storage could also be provided by obliging gas fired power stations to hold increased supplies of oil distillate which can be used as an alternative fuel.

Diversity of Supply – Liquified Natural Gas (LNG)

An LNG terminal located on the island will ensure that we do not become energy dependent on any region or country and could add around 11mcm/d of import capacity. It would also alleviate concerns in the electricity market concerning over reliance on gas delivered through a single pipeline in Scotland.

District Heating

In 27 European countries DH is distributed to 100 million people, this is 23% of the population of these countries. DH offers advantages in terms of higher efficiency, significantly reduced CO₂ emissions and reduced consumption of energy resources. DH should be a requirement in all new high-density residential and commercial developments.

Chapter 5

ENVIRONMENT



Key Recommendations

1. Base development plans for all City Regions on clear sustainable principles.
2. Establish appropriately sized waste to energy (WTE) plants and strategically locate them to cater for residual waste from the City Regions.
3. Manage demand for water with an emphasis on conservation, loss reduction, metering and an economic charge for water.
4. Develop a shared water mains network which will allow for bulk transfer of water between sources of supply and population centres.
5. Undertake a programme of sewer renewal in urban areas. Have separate storm and foul water sewers where practicable.

Waste

Generation of waste should be decoupled from economic development. An integrated waste management approach should be applied to waste generated with the objective of minimising disposal to landfill. Each city catchment should establish accessible facilities to service its own needs.

Waste to Energy

Appropriately sized waste to energy (WTE) plants should be established and strategically located to cater for residual waste from the City Regions. Regional transfer of waste by rail should be permitted to give economies of scale where required.

Water

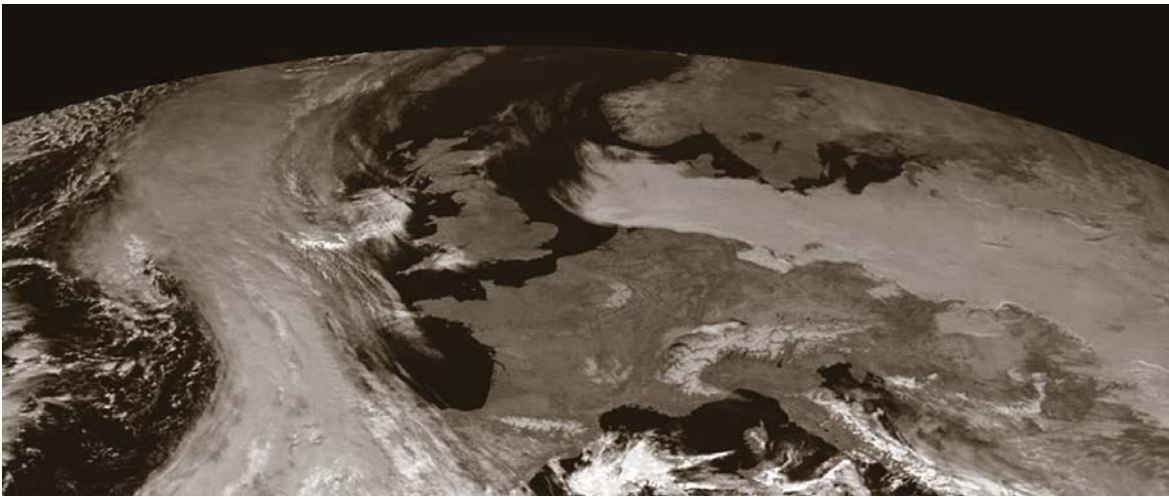
An increased population of eight million will be distributed approximately 5.5 million in the east of the island and 2.5 million in the west. The increase, especially in the eastern part of the island with the lowest rainfall, will require a shared water mains network which will allow for bulk transfer of water between sources of supply and population centres.

Wastewater

Planning and implementation of the timely expansion of wastewater treatment infrastructure will be required in all City Regions to cater for both population growth and industrial development. A major programme of sewer rehabilitation and replacement should be undertaken in urban areas and where practical, a key element of these works will be the separation of foul and storm sewers.

Chapter 6

CLIMATE CHANGE



Key Recommendations

1. Increase the energy efficiency of residential and commercial buildings
2. Develop new non-greenhouse gas (GHG) emitting baseload electricity generation, coal or gas with carbon capture and storage technology and imported nuclear power.
3. Plan for the protection of cities in coastal areas and river basins against flood damage and rising sea levels.
4. Establish a register of critical infrastructure vulnerable to climate change. Carry out a flood risk assessment for each critical infrastructure asset identifying its frequency of exposure to a hazard, its resilience to exposure and the consequences of its failure.
5. Focus climate research on identifying key parameters critical for infrastructure design.

Introduction

Climate change will impact on the island in two ways:

- the requirement to reduce GHG emissions will demand a very different approach to energy production, transport, building design and agriculture; and,
- increased sea levels, rainfall patterns and extreme weather events will necessitate major adaptations to the island's infrastructure.

Policy targets for energy and climate change are driven by the EU commitment known as the 20-20-20 Initiative. This initiative aims to reduce GHG emissions by 20%, to increase the share of renewables in energy use by 20% and to improve energy efficiency by 20%.

These proposed measures include initiatives in the energy, transport, construction and agriculture sectors. In particular, new base load generation – nuclear (imported via an interconnector or from a plant on the island) and the replacement of the 900MW coal fired plant at Moneypoint with a new coal plant with carbon capture and storage technology – will be required.



Protection of Critical Infrastructure

A rise in sea level in the range 0.5-1m is predicted by the end of the century. All of the island's principal cities are situated in coastal estuaries and will be vulnerable in varying degrees to storm surges. Protection will be required in the form of enhancement of existing coastal defences, with substantial works required in Dublin, Belfast and Cork.

It is likely that river stream flow will increase by approximately 20% by mid century. Flood events are likely to become more frequent with the current 50 year event likely to be associated with a circa 10-year return period.

Flood defences should be designed into all new infrastructure areas, avoiding flood plains. A robust and acceptable methodology should be developed on which to base the delineation of flood plains.

Road and rail transport routes will be particularly vulnerable especially when following coastal and river valley routes. Cuttings and embankments will require alterations and improvements to cope with increased flooding, as will water infrastructure dependent on electricity for pumping.

All owners of energy infrastructure should carry out a preliminary climate change risk assessment and prepare a

climate change asset risk register. This should be carried out using climate change parameters decided by the energy regulator in both jurisdictions in consultation with the two climate change Lead Agencies and the owners of energy infrastructure.

A register of critical infrastructure vulnerable to climate change should be established with a formal flood risk assessment carried out for each critical infrastructure asset.

Design Standards

The engineering profession and climate change researchers should co-operate in identifying which climate change parameters are critical to infrastructure design and what further climate change research is required to enable the engineering profession to amend current design standards. In the interim, it would be prudent that new construction should allow for a sea level rise of at least 0.5m.

Chapter 7

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

Key Recommendations

1. Develop a high speed and large capacity information highway which will match the performance of that in the most advanced global economies. Prioritise the high density population corridor linking Dublin and Belfast and also the South Western Corridor.
2. Harness the potential of advanced IT and communications technologies to improve efficiencies and enable a sustainable competitive economy.
3. Establish a direct connection to Europe, in addition to routes through Great Britain, using advanced communication technology, thus enabling Ireland to be a virtual extension of the main internet exchanges in mainland Europe.

Ireland ranks well below the EU average in terms of availability, speed and access to broadband. To be successful in 2030, the island of Ireland should build a smart economy based on knowledge and sustainability. This will require the development of a high-speed and large capacity information highway which will match the performance of that of the most advanced global economies. Digital technologies will provide the smart tools to drive the sustainable energy agenda in conservation, generation and transmission.

Broadband

At present in Ireland only 3% of subscribers have download speeds in excess of 10Mbps. Ireland ranks 25th in the OECD in terms of its readiness to support next generation video and web services and is also below today's required standard. Ireland's fixed broadband penetration is below the EU average. Growth in penetration is at EU average.

Fibre to the home technology will be essential for the speedy transfer of large volumes of information across wide bandwidth. As a first step it is recommended that the Communications Regulators on the island should examine



the feasibility of requiring that all new residential buildings in excess of a minimum size should have fibre to home connections installed with an appropriate sharing of cost between the provider and user. This requirement should be imposed initially on the Dublin–Belfast Corridor and the South West Corridor linking Cork, Limerick and Galway.

International Connections

A direct connection to Europe should be established, in addition to routes through Great Britain, using advanced communications technology. This will enable Ireland to be a virtual extension of the main internet exchanges in mainland Europe and extend choice.

Data Centres

Encouraging the location of data centres should be a key part of future information and communications technology (ICT) strategy. Data Centres will attract further companies to the island and will drive the content industry and ancillary business. Success in this area will be dependent on the availability of competitively priced electricity produced with low GHG emissions.

Chapter 8

ENTERPRISE

Key Recommendations

1. Encourage the development of specialised industrial clusters and innovation hubs in each city.
2. Maximise the enterprise opportunities arising from the island's climate advantage.
3. Support research and development (R&D) and innovation in higher education institutions. Support industrial investment in R&D.

The development of the island economy is dependent on increasing the productive capacity of manufacturing industry and internationally traded services. The main growth sectors are likely to be pharmaceutical and medical devices, information and communications technology (ICT), energy, green enterprise, food and forestry and business and financial services. The dominant factors influencing the location of industry are those impacting on international competitiveness (for example, taxation, operating costs, productivity and quality of education). The main elements of infrastructure such as transport, energy, broadband and specialised sectoral skills and R&D also play a very important role. As competition for international investment becomes more intense, it is essential that infrastructure planning supports enterprise needs.

Industrial Clusters

There must be a continuing focus on the establishment of industrial clusters and innovation centres in City Regions. This will enable specialisation in R&D, education, knowledge and skills and provide economies of scale in the provision of support services.

In the knowledge economy of 2030, business services projects servicing global markets will be established in the catchment of cities which can provide access to a high-quality labour force, fourth-level education and research institutes, competitive energy, and top quality international

transport connectivity. Evidence over the last decade suggests that a greater proportion of these projects tend to be located in the higher population cities which are in competition for investment with cities of similar scale in other countries. An intensive development of the Dublin–Belfast Corridor is likely to deliver a concentration of high income business services FDI jobs along the corridor by 2030.

Food and Forestry Sector

The food and forestry sector has a strong indigenous base and will become even more important in the future because of the island's "climate advantage", which will allow the further development of food production. Following climate change, North Western Europe, including the island of Ireland, will become a main centre for global food production. There are positive implications for strong medium term development of Irish food production and forestry.

Education and R&D

R&D activities will play an increasing important role in developing the island economy of the future. These activities generate high incomes and employ highly qualified staff. Already they account for almost one quarter of new foreign direct investment (FDI) in Ireland.

It will be necessary to sustain a continued high rate of increase in the number of researchers to meet the needs of an island of eight million people.

The key enterprise clusters should continue to be supported by associated investment in high skills (particularly research Masters & PhD) and capacity in research and technological development. The complementary nature of the major research capabilities should be supported by all-island grant and incentive mechanisms, particularly those facilitating the trend towards increased enterprise–academia collaboration.

Chapter 9 ENGINEERING FOR HEALTH



Key Recommendation

Build an advanced IT infrastructure within the healthcare system linked to the broadband network which will enable the use of sophisticated personal-use diagnostic devices and allow for early detection of life-threatening events.

Introduction

Consideration of the critical elements of infrastructure required on the island of Ireland, to cater for an increased population of eight million and to support a world-class competitive economy, must include recommendations in relation to an appropriate health infrastructure.

Opportunities

Today the island is a world manufacturer of pharmaceuticals and medical devices. However, once products become commoditised it becomes easier to manufacture them in low cost locations. To continue to grow the economy it will be necessary to switch from being investment driven to being innovation driven. Research and development (R&D) will be crucial as we deliver new and better products and services to the market. The pharmaceutical, chemical,

medical devices and diagnostic sectors will provide good opportunities for growth while also contributing to improvements in national health and well being.

ICT Infrastructure

An advanced IT infrastructure linked to the broadband network has the capacity to bring significant benefits to the population and to the delivery of healthcare on the island. When harnessed, advanced IT and communications technologies have the potential to improve efficiencies, reduce errors, free up staff to concentrate on patient care and reduce costs of provision. The availability of sophisticated personal-use diagnostic devices will allow for early detection of life-threatening events.

Chapter 10

INFRASTRUCTURE INTEGRATION



Key Recommendation

Adopt an integrated approach to all infrastructure planning to ensure improved efficiency, effectiveness and competitiveness at minimum cost.

Road and Rail Integration

The planning of road and rail infrastructure must be coordinated so that each will play its appropriate role in transport between the cities and in access to and within cities.

Gas Storage, LNG, and Oil Distillate Storage at Power Stations

An LNG terminal would diversify supply sources and also provide storage facilities. Most of the gas fired electricity power stations can be switched to operate on oil distillates. There will be an optimum economic balance between gas storage, LNG and oil distillate storage.

Electric Cars and Wind Energy Storage

Electric cars offer the possibility to be a means of storing electricity generated from wind energy at night. This will influence the economics of using electric cars and of the production of wind energy.

Increased City Density and District Heating

Increasing residential density in cities will create the opportunity to introduce district heating schemes powered either by combined heat and power plants or by waste to energy (WTE) plants.

Increased City Density and Energy Use in Transport

Decisions to improve the quality, frequency, speed and reliability of public transport will prove economically effective when combined with regulations regarding land use.

Tidal Barriers and Transport Infrastructure

The cost of construction of embankments and tidal barriers will take account of the possibility of using such embankments as a foundation for road and possibly rail infrastructure. An integrated approach will be more cost-effective in some cases.

R&D, Education and the Development of Strategic Industrial Sectors

An integrated approach to combining R&D, education and training, and the development of the most important strategic industrial sectors will increase the possibility for synergy between all three activities at optimum cost.

Chapter 11 ECONOMIC ASSESSMENT



Key Recommendations

1. Finance the development of infrastructure using a combination of innovative financing sources including the Exchequer, public private partnerships (PPPs), a possible island of Ireland infrastructure bank, capital markets and the European Investment Bank.
2. Develop a framework which will allow the private sector to increase its share of investment in the provision of infrastructure.

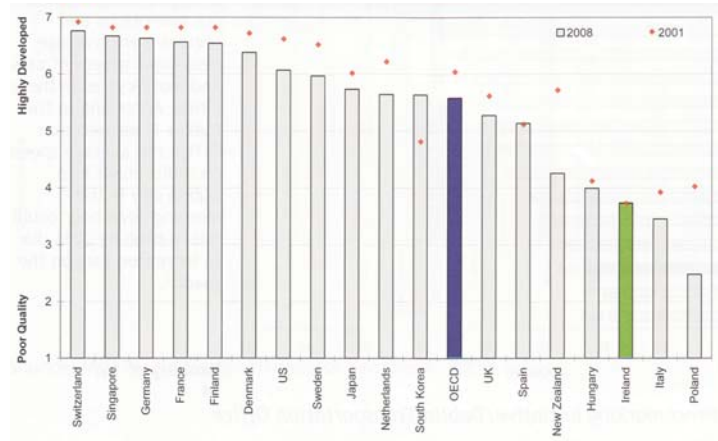
Over the past decade the annual rate of investment in gross fixed capital formation in Ireland has been about 25% of gross domestic product (GDP). This comprises all investment in productive machinery, buildings and infrastructure and includes both public and private investment.

The growth of productive investment raises the future potential growth rate of the economy, while at the same time directly contributing to growth and employment in the year in which the investment is undertaken.

There has been historically a long-term deficit in the levels

of infrastructure investment on the island of Ireland. Executives' perception of Ireland's infrastructure place Ireland significantly below the OECD average (Figure 2).

Figure 2 Perception of Overall Infrastructure Quality (Scale 1-7) 2008



Source: WEF Global Competitiveness Report 2008/09 in Forfás National Competitiveness Council Annual Report 2009

A number of competitiveness surveys point to the significant infrastructure gap on the island. Although Ireland's relative investment in infrastructure compares well with other countries, it is still perceived by the business community to be inferior to that of competing countries as it is coming from a lower base.

To achieve infrastructural quality comparable with the best in the developed OECD countries it is of critical importance that the island continues to invest on average over 5% of its combined GDP annually over the next 20 years either directly by means of Government funding and/or through mechanisms such as PPPs and/or where appropriate by direct private investment.

Additional Projects and Potential Sources of Funding

The additional projects recommended in this report would, if financed solely from Government funds, account for approximately one-twentieth of the public capital programme over the 20-year period to 2030. It is worth noting that in a study published earlier this year the Council for Science and Technology in the UK anticipates that 65% of UK infrastructure funding will come from the private sector; 6% from PPPs and the balance of 29% from public funds over the next decade or longer. It is readily apparent that this contrasts with the experience on the island of Ireland. It would be helpful if some research was undertaken to explore the implications of this difference on the competitiveness of the island of Ireland.

Funding the Island's Infrastructure Investment

There is now intense competition for finance across the globe and the financial crisis of the past two years has radically altered the business model. Public finances on the island are likely to be constrained for a number of years and it is essential that alternative sources of finance are investigated with some urgency as at times when exchequer finances are under pressure, capital expenditure may bear the brunt of cutbacks.

More needs to be done to explore new sources of funding and it is recommended that consideration be given to the development of an infrastructure bank on the island to provide long-term funding for infrastructure projects.

Such an initiative would clearly require the support of both governments although it would be important to ensure that state control/ownership did not result in its commitments being classified as public expenditure. In addition, it would also need the support of institutions including the pension funds and the European Investment Bank, which is increasingly supporting infrastructure investment on the island of Ireland. Consideration could be given potentially to some tax advantages for investors and there are a number of international models to inform the model that could be developed. Because public finances on the island are likely to be constrained for a number of years, it is essential that alternative sources of finance are investigated with some urgency as at times when Exchequer finances are under pressure, capital expenditure may bear the brunt of cutbacks.

In conclusion, the magnitude of the challenge to reach and sustain the necessary rate of infrastructure investment to achieve a world class competitive economy will require the use of new and innovative approaches to funding such public infrastructure.

ANNEX 1

Indicative costs of projects having an island emphasis

The following are indicative costs of additional investment projects over the next 20 years recommended in this report.

Project	Cost
Dublin–Belfast High-Speed Rail Track and Rrains:	€2.5bn
Motorway Development: 200km of fourth lane to motorway and 500km of third lane to motorway.	€5.0bn
Water Mains Network: Water Mains linking Shannon and Lough Neagh to Dublin and Belfast including water treatment plants.	€1.5bn
Information Highway: High speed large capacity information highway linking the eight City Regions including fibre to home.	€1.5bn
District Heating Pipe Network in Cities:	€250m



Engineers Ireland

22 Clyde Road

Ballsbridge

Dublin 4



Irish Academy of Engineering

22 Clyde Road

Ballsbridge

Dublin 4

T: +353 1 665 1337

E: academy@engineersireland.ie

www.iae.ie