

Sustainability Evaluation Metric for Policy Recommendation

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ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

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- Office of Radiological Protection
- Office of Communications and Corporate Services

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Sustainability Evaluation Metric for Policy Recommendation: Technical Guidance Manual

Prepared for the Environmental Protection Agency

by

University of Limerick and Cork County Council

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Executive Summary

This technical report describes the application of a method aimed at integrating sustainability with national development priorities. The Sustainability Evaluation Metric for Policy Recommendation (SEMPRe) is a method for urban sustainability appraisal and policy prioritisation and is aimed at planners and policymakers. SEMPRE employs a sustainable development indicator framework to provide a decision support system for planners. Through quantification of settlement sustainability and evaluation of sustainability policy, the method provides evidence to inform core strategy and Strategic Environmental Assessment (SEA) of development plans. Indicators were selected as part of a participatory process in partnership with university researchers, local authority planners, Environmental Protection Agency personnel and National Spatial Strategy practitioners. This ensured that settlement-level indicators met stakeholder

requirements, were appropriate and were complementary to regional planning guidelines. An extensive sustainability database was collated and five indicators were developed in each of five themes, resulting in a diverse suite of 25 sustainable development indicators; five of these were identified as key performance indicators. SEMPRE enables settlements to be ranked in terms of sustainability and creates a benchmark against which the rate of progress towards European, national, regional and local sustainability targets can be measured over time. Evidence-based methods were used to support policy implementation and further strengthen linkages between researchers and policymakers. This report presents a clear and transparent method that is designed to be understood by a non-technical audience without prior knowledge of sustainability issues or evidence-based decision making and that can be used to inform the public.

1 Introduction

This manual was prepared for the Department of the Environment, Community and Local Government (DECLG) by the Centre for Environmental Research (CER) team at the University of Limerick. The intended audience for this technical guidance manual is planners and policymakers and its aim is to assist in urban sustainability analysis. Working in partnership with policy advisors in the Environmental Protection Agency (EPA) and the DECLG, the research team developed a clear and transparent decision support tool to quantify settlement sustainability. The research reported in this technical guidance manual has been successfully trialled by Cork County Council to demonstrate its applicability and to resolve any implementation issues.

This method assists with identification of the most sustainable locations for future population growth and provides evidence to inform core strategies, therefore reaffirming the link between national, regional and local policies. Through the adoption of a holistic approach to sustainability assessment, key attributes of settlements that promote or impede progress towards sustainable development were identified, leading to prioritisation of actions that may lead to increased quality of life for Irish citizens.

1.1 Report Structure

Chapter 1 outlines the purpose of this report, providing a brief background and context to the research, and describes key legislation. The requirement for core strategies and the role of the Sustainability Evaluation Metric for Policy Recommendation (SEMPRe) in informing development plans are examined.

Chapter 2 describes the initial scoping exercise to determine key parts of the development plan to be assessed. The selection process for study settlements and indicators and the SEMPRE framework are described.

Chapter 3 outlines the process for settlement baseline data collation. A detailed description of selected indicators is provided, including key performance indicators, indicator definitions, calculations and data sources.

Chapter 4 provides a detailed step-by-step description of the application of SEMPRE, including screenshots of SEMPRE worksheets.

Chapter 5 gives an interpretation of SEMPRE outputs using worked examples. This chapter describes how SEMPRE outputs, such as settlement sustainability kite diagrams and settlement categorisation, can inform core strategy.

Chapter 6 describes policy testing through SEMPRE and policy selection criteria using worked examples.

Chapter 7 discusses the strengths and weaknesses of the methods and the policy relevance of the research, and details the overall conclusions of the research.

Appendix 1 contains a list of policies aimed at increasing settlement sustainability that may be tested through SEMPRE.

Appendix 2 contains a glossary of Census 2011 terms.

1.2 General Context for the Research

The issue of monitoring and evaluation of planning policy is timely in Ireland, against a backdrop of increased emphasis on evidence-based planning and changes to legislation. There is a strong political desire for methods to assess the impact of policy implementation on overall sustainability targets, but this has proved in the past to be very challenging. This is because views on the meaning of sustainability vary, and the methods developed that satisfy scientists' needs for rigour have been deemed too complex and inadequately transparent by decision makers. It is argued here that the evidence base for policy decisions needs to be improved, as policymakers need to learn from what has worked in the past to apply best practice, in order to facilitate a more effective and transparent approach. There is a need for an approach to evaluate policy impact on settlement sustainability in a standardised and quantitative manner.

This research was developed in the context of the economic climate in Ireland between 2008 and 2013, when economic growth, new house building and tax revenue fell sharply and unemployment levels rose. In this

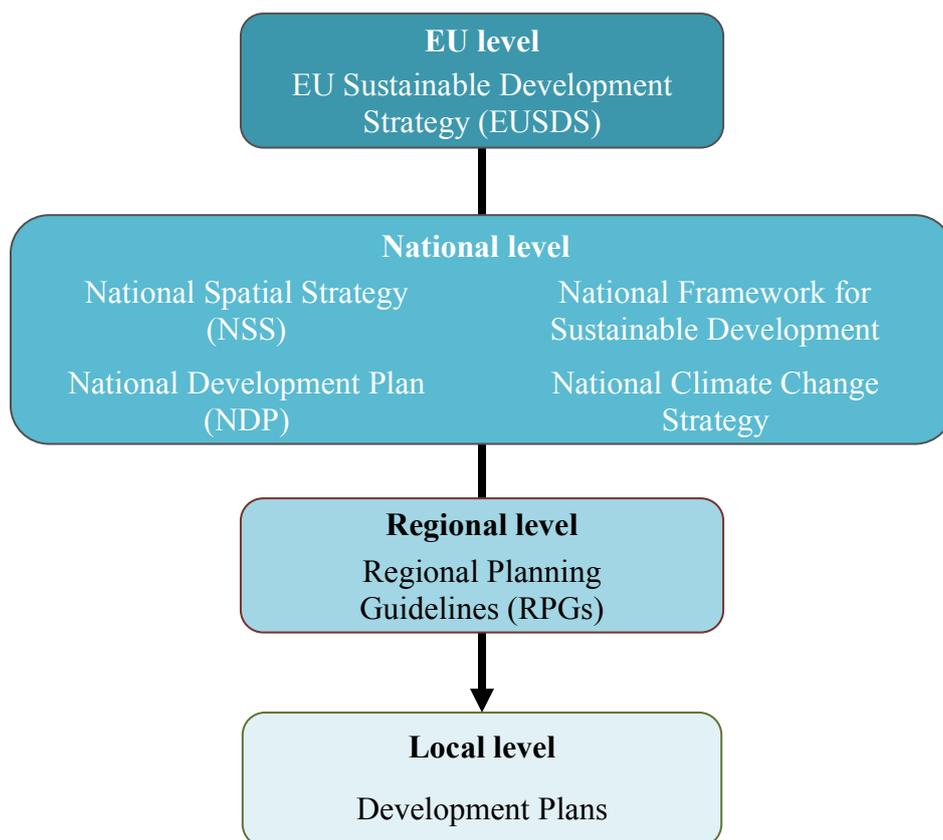


Figure 1.1. Key sustainable development legislation.

economic climate there were few financial resources available for development of new technologies. While technological development is crucial, significant gains may be made by the wider adoption of existing proven technologies through better planning and behaviour change, on the basis that, if such technologies were used to their full extent, there would be a large reduction in human impact on the environment and dependency on fossil fuels (EPA, 2007). Focused environmental policies at the urban level are now needed, as economic and social activities are concentrated in urban areas, and transport and levels of urbanisation are increasing. Implementation of appropriate policies may be expected to act as a stimulus to boost the local economy.

1.3 Policy Context for the Research

Addressing a lack of policy co-ordination is a major concern in Ireland. There is a need to test a wide range of policy initiatives to see which achieve their objectives, so that over time we learn from experience. Many sustainability policy studies cover a narrow range of policies that may not be relevant in other jurisdictions. In addition, studies generally focus on one aspect of

sustainability and do not permit policy evaluation across sectors (OECD, 2008). There is a need for an approach to sustainability assessment that takes into account environmental, social and economic considerations.

The rationale for this research was based on the recognised role of urban areas in securing balanced regional development for Ireland. In Ireland in 2011, cities, towns and rural areas accounted for approximately 33.3%, 28.7% and 38% of the national population, respectively (CSO, 2011). Towns and villages have a key role in securing balanced regional development for Ireland.

Spatial planning seeks to find development patterns that balance economic, social and environmental concerns; therefore, spatial planning and the concept of sustainable development are intrinsically linked. Figure 1.1 outlines key policy documents currently governing sustainable development. At a European level, the main policy document promoting sustainable development is the European Union Sustainable Development Strategy (EUSDS) (Council of the European Union, 2006). This provides an overarching policy framework for integrating sustainability in EU policies and strategies. It states that sustainable development is a fundamental

objective of the EU. In particular it recognises the importance of adaption to the effects of global climate change, reducing transport energy use, and the need to reverse declines in biodiversity and natural resources. The National Framework for Sustainable Development for Ireland (DECLG, 2012) broadly follows the themes of the EUSDS and identifies and prioritises policy areas in Ireland where sustainable development may add value.

The National Spatial Strategy (NSS) (DEHLG, 2002) established a national framework for strategic spatial planning, in particular in relation to the location of new housing in urban areas. It aims to create a better balance of social, economic and environmental development in Ireland through development of a poly-centric network of urban areas. Specific settlements were identified as gateways and hubs, whose aim was to form a national network of centres in order to create balanced regional development in Ireland. The National Climate Change Strategy (DEHLG, 2007) sets out a range of measures and a framework for action designed to ensure that Ireland reduces its greenhouse gas emissions. The National Development Plan (NDP) 2007–2013 (Government of Ireland, 2007) creates a link between the NSS and infrastructural investment. The NDP mainly outlines a scheme of targeted large-scale national investments connecting large urban areas in Ireland. The regional planning guidelines (RPGs) create a link between national development priorities and local planning through strategic co-ordination of development plans for city and county councils. There is a requirement that RPGs be prepared in order to support the NSS, including provision for population targets.

At a local level, the development plan details the overall strategy for the proper planning and sustainable development of an area. The Planning and Development Acts 2000 and 2010 define the mandatory objectives that should be included in the development plan. The Planning and Development Act 2000 consolidated planning legislation over the period 1963–1999 into a single piece of legislation. It was designed to ensure that planning was strategic in its approach and introduced the concept of sustainability into local plans. The 2000 Act and its subsequent amendments provide the foundation for the present planning code in Ireland, and describe mandatory requirements of RPGs, development plans and local area plans.

1.4 Requirement for Core Strategies in Development Plans

The most significant change in planning legislation since the 2000 Planning and Development Act was the Planning and Development (Amendment) Act 2010. Although development plans prepared under the 2000 Act have always been intended to be strategic in nature, amendments to the Planning and Development Act in 2010 introduced a statutory requirement for plans to contain a core strategy. This requires local authorities to provide, among other things, details of the quantum and distribution of population in accordance with the provisions of the RPGs. The purpose of the core strategy is to show that the general distribution of population and the new development proposed in the plan is consistent with the NSS and relevant RPGs, taking into consideration statutory obligations of planning authorities to carry out an assessment under the Habitats Directive (EEC, 1992) and a flood risk assessment under the Floods Directive (EC, 2007). In preparing proposals for a draft core strategy, planning authorities must give consideration to any significant environmental effects arising from the implementation of the core strategy as part of the new development plan. SEMPRE aims to provide evidence to support the formation of a core strategy within county development plans including the evaluation of population growth scenarios.

The Planning and Development (Strategic Environmental Assessment) Regulations (2004) as amended in 2011 (S.I. No. 200 and No. 201 of 2011) require planning authorities to carry out a Strategic Environmental Assessment (SEA) of their local area plans (LAPs), taking account of mandatory population thresholds, for all LAPs with actual or target populations greater than 5000. SEA is designed to improve the environmental sustainability of the new plan, raise awareness of environmental issues and compare alternative scenarios. Improved data, and increased expertise and experience among local authority staff, have increased efficiency in identifying and quantifying the potential for significant environmental effects when evaluating development plan proposals. However, there is a knowledge gap in terms of the assessment of significant environmental effects at the strategic level of development plan preparation (e.g. in relation to the environmental assessment of proposals for the general distribution of future populations). The SEA Directive (EC, 2001) does not specify methods to be

Table 1.1. Role of SEMPRe in informing development plans

Steps in the application of SEMPRe	Steps in development plan review process	Steps in SEA of development plan
Initial scoping exercise to determine study settlements, assess data availability and discuss issues	Preparatory work on review of the existing development plan and the creation of a new development plan; background work and data gathering	Consider overall characteristics of the plan to be assessed
Settlement baseline data collation	Formal notice of intention of planning authority to review existing development plan and to prepare a new plan	Determine key elements of plan and environmental issues to be assessed
Application of SEMPRe, sustainability results formulated, settlements ranked in terms of relative sustainability, and sustainability kite diagrams produced	Draft Section 11 Consultation document and SEA environmental report prepared for inspection and receipt of written submissions and observations from the public and other bodies	Develop environmental objectives, indicators and targets
Settlement categorisation, quantitative evaluation of core strategy and policy evaluation	Report on Section 11 submissions and recommendations including responses to issues raised	Include submissions from statutory authorities on the scoping issues paper and emerging issues from draft scoping report
SEMPRe informs formal environmental report draft plan and core strategy	Directions from elected members to prepare draft development plan	Identification, prediction, evaluation, and mitigation of potential impacts including consideration of alternatives and proposed amendments to feed into SEA Environment Report

adopted in such assessments, and authorities have adopted different methodologies, some undertaking the SEA process themselves, others employing external consultants. In either case, the extent to which the SEA process has been integrated into the development plan decision-making process has been inconsistent. A view is emerging among planning practitioners that, to be effective in influencing decisions made as part of the development plan process, authorities need to adopt a systematic and standardised methodology that fully integrates the SEA process within the creation of the development plan.

1.5 Sustainability Assessment

In order to be analysed, sustainability must be measured. Sustainability indicators are at the interface between science, policy and government, and are commonly used as forecasting tools to improve awareness

of sustainable development issues in urban areas. It is argued that indicators are not useful when considered in isolation: their value comes from using combinations of indicators to measure progress towards sustainability. It is the aim of SEMPRe to provide a rational, rigorous and methodological basis to assist planning practitioners in standardising evaluation of the significant environmental effects arising particularly as part of the preparation of core strategies for new development plans (Table 1.1). In particular, SEMPRe can help identify mitigating measures to maximise the sustainability of particular strategies and develop a framework and a standardised set of environmental indicators leading to a more consistent approach to the evaluation of the likely significant environmental effects of plans and programmes. A detailed timetable for the development plan review process is set out in the Act. This ensures that plans are kept up to date and reviewed on a regular basis.

2 Initial Scoping Exercise

Initially, a scoping exercise was undertaken to determine the settlements to be analysed. For the purpose of this study, settlements are defined according to the Irish National Census 2011, which divides towns into legal and census towns. A legal town is defined as a town with legally defined boundaries. A census town is defined as a cluster with a minimum of 50 occupied dwellings, with a maximum distance between any dwelling and the building closest to it of 100 metres and where there is evidence of an urban centre. The method is best suited to analysis of small, medium-sized and large towns with populations of between 1000 and 46,747 persons (the population of Ireland's smallest city, Waterford City).

The scoping exercise brought together a wide range of indicators in order to measure urban sustainability. The sustainability indicators in this study were identified following partnership with university researchers, and senior EPA and NSS practitioners in a participatory process, selecting indicators that satisfied both the researchers' need for rigour and the practitioners' need for policy relevance. A literature review of international, national and regional documents identified a wide range of indicators commonly used for sustainability assessment. From these indicators a suitable suite of environmental sustainability indicators was identified that could be developed using settlement-level data readily available to local authorities. Data collation at a settlement level can frequently prove to be difficult owing to some data not being available. A pragmatic approach was taken by examining five key themes for settlement sustainability: infrastructure and location, water and wastewater, population and urban form, transport and energy, and liveability. In some cases indicators may cross multiple themes. These themes were selected with cognisance of data availability and applicability to Irish settlements. In selecting indicators four main filters were used to ensure that:

- indicators used were relevant and not duplicated;
- both trend and condition (not just snapshots in time) could be measured for each indicator;

- indicators were policy relevant and complementary to RPGs and development plans;
- indicators covered pertinent aspects of settlement sustainability.

An extensive sustainability database was collated, and then five indicators were developed in each of five themes, resulting in a diverse suite of 25 sustainable development indicators from a wide range of sources. Subsequently, five of the 25 indicators were identified as key performance indicators (in italics in Table 2.1), i.e. those which are suitable for highlighting trends and communicating the performance of each theme to the public. Indicators link to national, regional and local policy. The indicators chosen are not presented as a definitive set of settlement sustainability indicators, but rather as a comprehensive set of indicators developed deliberately to provide a holistic view of settlement sustainability in an Irish context, taking into account data availability.

The SEMPRE methodology organises indicators in a systematic way under a sustainable development indicator framework (Figure 2.1). A composite indicator or index is an aggregation of indicators using a predetermined methodology. Composite indicators are seen as useful tools for informing policymaking and public communication, as they permit the evaluation of a multitude of aspects expressed as a single index for ease of comparison. The SEMPRE framework was developed in order to measure settlement sustainability and model the effects of additional policy implementation.

SEMPRE was constructed on a Microsoft Excel 2007 platform to provide an interface for its use by non-technical practitioners and was based in the settlement attribute database linked to interface data on separate worksheets. SEMPRE was programmed with the use of simple logic gates and algebraic formulae, constructed to be as user-friendly as possible (for example, settlement attribute data cannot be lost or corrupted), and is programmed separately for each settlement, as values for their sustainability indicators

Table 2.1. Selected sustainable development indicators (key performance indicators in italics)

Indicator no.	Description
<i>Infrastructure and location</i>	
1	<i>Infrastructural capacity for settlement expansion</i>
2	Connected to gas distribution network
3	Index of recycling facilities
4	Proportion of households with broadband internet
5	Presence of farmers markets
<i>Water and wastewater</i>	
6	Water quality of water bodies
7	Wastewater treatment spare capacity
8	Unaccounted-for water
9	<i>Populated area at risk of flooding</i>
10	Urban wastewater treatment status
<i>Population and urban form</i>	
11	<i>Planned population density</i>
12	Proportion of population unemployed
13	Proportion of population with third level education
14	Housing vacancy rate
15	Distance to nearest large retail centre
<i>Transport and energy</i>	
16	Average transport CO ₂
17	Settlement walkability
18	<i>Number of public transport services/1000 population</i>
19	Average household heating CO ₂
20	Proportion of population travelling to work by private car
<i>Liveability</i>	
21	<i>Distance to nearest acute hospital</i>
22	Tidy Towns points score
23	SAC, SPA, NHA within 5km of settlement
24	Distance to nearest park, nature reserve or wildlife park
25	Presence of 24-hour Garda station

NHA, National Heritage Area; SAC, Special Area of Conservation; SPA, Strategic Planning Area.

vary. A unique SEMPRe interface is required for each settlement. SEMPRe consists of four worksheets: worksheet no. 1, *Baseline environment*, where raw data are stored; worksheet no. 2, *Analysis layer*, where raw data are transformed and processed into meaningful indicators; worksheet no. 3, *SEMPRe interface*,

where metric calculations are performed and policies may be tested; and worksheet no. 4, *Results interface*, which summarises settlement sustainability results and produces a sustainability kite diagram to assist in the identification of more or less sustainable attributes of settlements.

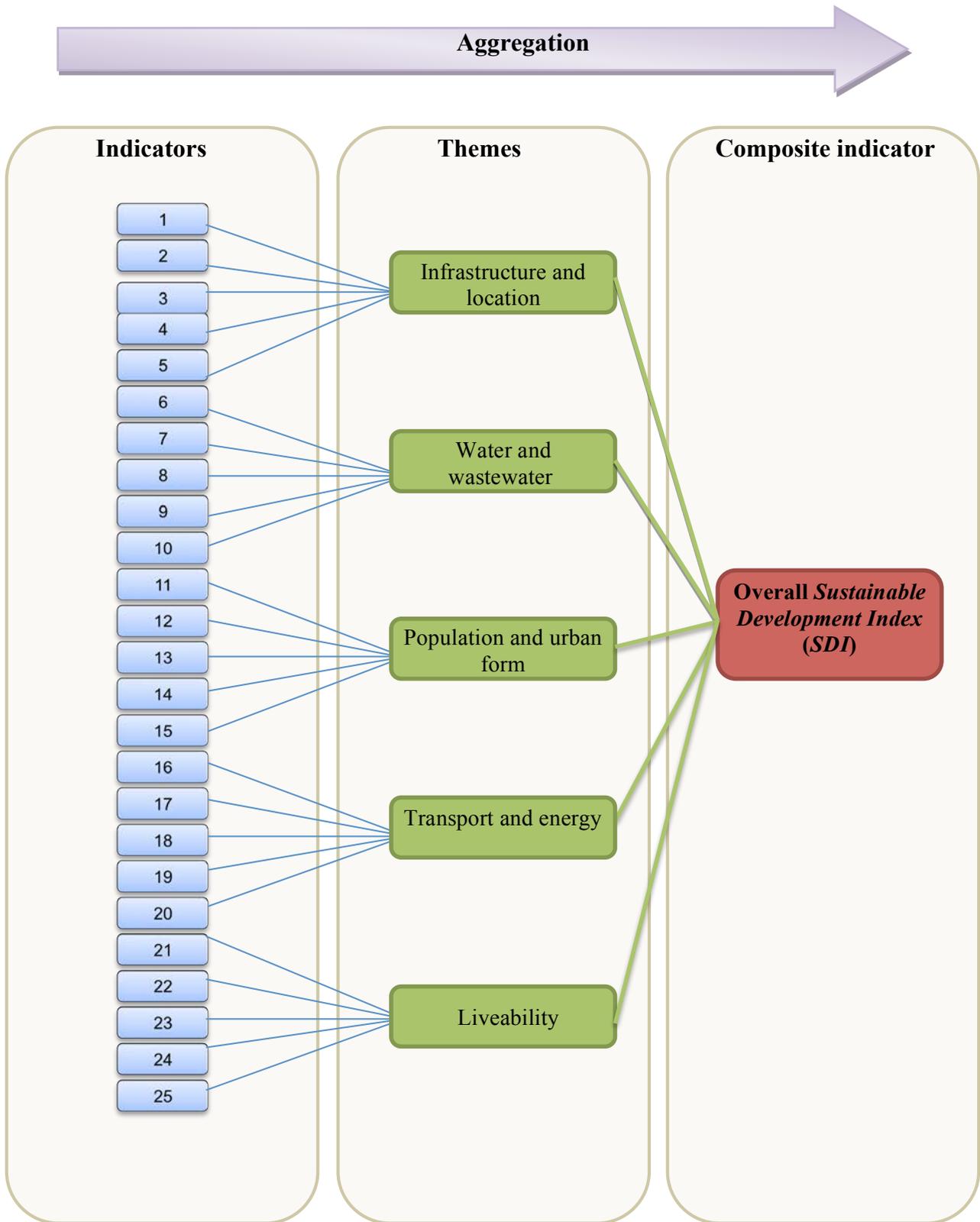


Figure 2.1. Sustainable development indicator framework.

3 Settlement Baseline Data Collation

For many of the indicators, Irish National Census 2011 data were employed. Central Statistics Office of Ireland Small Area Population Statistics are available online at: <http://www.cso.ie/en/census/census2011smallareapopulationstatisticssaps/>

On the Census 2011 Small Area Population Statistics web page, option 2 permits data to be downloaded in Microsoft Excel format (Figure 3.1). Data are available at a range of geographic scales; for the purpose of this study, data on towns/cities (settlements) were employed; these are available for 824 settlements in

Ireland. Appendix 2 contains a glossary of the Census 2011 terms used here.

Once settlements for analysis have been identified, the next stage involves compilation of a sustainability database. This chapter describes the 25 selected sustainable development indicators. For each settlement under investigation, it is essential that data on all 25 settlement sustainability indicators are collated. Indicator definitions, calculations and data sources are shown in Tables 3.1–3.5.

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Census 2011 Small Area Population Statistics (SAPS)

Small Area Population Statistics are Census 2011 statistics produced for a range of geographical levels from state to small areas. There are three options available for viewing/downloading SAPS information.

Option 1 INTERACTIVE MAPPING TOOL (SAPMAP) incorporating excel and pdf downloads

The interactive mapping tool allows you to access SAPS through an interactive map search. SAPMAP allows users to navigate to their location of interest by using the address search facility or by pinpointing a location on the map. They can then select the geographic boundary they are interested in and access all of the 2011 Census tables that have been produced for that area. These tables can also be downloaded in pdf or excel format.

There are 46 Small Area Population Statistics (SAPS) tables organised into the following 15 themes.

Note: To view this application please ensure that Adobe Flash Player Version 10.0.0 or greater is installed. ([Download Flash here](#))

Theme 1: Sex, age and marital status	Theme 9: Social class and socio-economic group
Theme 2: Migration, ethnicity and religion	Theme 10: Education
Theme 3: Irish language	Theme 11: Commuting
Theme 4: Families	Theme 12: Disability, carers and general health
Theme 5: Private households	Theme 13: Occupation
Theme 6: Housing	Theme 14: Industries
Theme 7: Communal establishments	Theme 15: PC and internet Access
Theme 8: Principal status	

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Option 2 SAPS CSV DOWNLOADS

This option allows the user to download the full range of SAPS tables in CSV format for any of the geography levels below.

To download, please click on one of the 17 Geography levels listed below:

Geography	Availability Download Tables	Availability SAPMAP WEB Mapping Tool
Counties (34)	All	All
Electoral Divisions (3,409)	All	All
Small Areas (18,488)	All	All
Dáil Constituencies 2007 (43)	All	All
Dáil Constituencies 2013 (40)	All	All
Seachtáin Areas (7)	All	All
Legal Towns and Cities (85)	All	All
Towns/Cities (Settlements) (824)	All	All
Local Electoral Areas (171)	All	All
Regional Authority Areas (8)	All	All
Provinces (4)	All	All
Dioceses (24)	All	All
Dublin Parishes (197)	All	All
Garda Regions (6)	All	All
Garda Divisions (28)	All	All
Garda Districts (95)	All	All
Garda Sub Divisions (563)	All	All

Option 3

This option allows the user to download a .zip file containing all available levels of geography for Census 2011 SAPS. Please click on [Complete Set of SAPS 2011 \(ZIP 17.111KB\)](#) tables to download.

When downloading the csv tables above, please refer to [Glossary of terms for SAPS 2011 table headings \(XLS 33KB\)](#) for the explanations of table headings.

Boundary files for all levels of geography above are also available to download. Please visit the [Census 2011 Boundary Page](#) for further details.

Figure 3.1. Central Statistics Office Census 2011 web page for data download. Source: Central Statistics Office of Ireland.

Table 3.1. Infrastructure and location indicators

Indicator	Infrastructural capacity for settlement expansion
Indicator definition	Describes the capacity of the settlement to cater for additional population; it accounts for road, water and wastewater treatment infrastructure in the settlement
Indicator calculation	Number of residential units which can be accommodated in the settlement within 6 years
Data sources	Local authority
Indicator	Connected to gas distribution network
Indicator definition	Describes whether a settlement is connected to the national gas distribution network
Indicator calculation	Connected to gas distribution network = 1 Not connected to gas distribution network = 0
Data sources	Bord Gáis network map available online at: http://www.bordgaisnetworks.ie/en-IE/Get-Connected/Can-I-get-gas/
Indicator	Index of recycling facilities
Indicator definition	Describes the level of recycling facilities available in a settlement
Indicator calculation	Presence of civic amenity site in the settlement = 2 Presence of bring sites in the settlement = 1 No recycling facilities in the settlement = 0
Data sources	Local authority
Indicator	Proportion of households with a broadband connection (%)
Indicator definition	Describes the availability of broadband internet in a settlement
Indicator calculation	(Number of households with broadband internet connection/Total number of households in settlement)
Data sources	Central Statistics Office of Ireland, Irish National Census 2011 Small Area Population Statistics: (T_15_3_B)/(T_15_3_T)
Indicator	Presence of farmers markets
Indicator definition	Measures whether local sources of food are available for the inhabitants of a settlement
Indicator calculation	More than one farmers market in the settlement per week = 3; one farmers market in the settlement per week = 2; one farmers market in the settlement per month = 1; no farmers markets in settlement = 0
Data sources	http://www.bordbia.ie/aboutfood/farmersmarkets/pages/default.aspx http://www.countrymarkets.ie/

Table 3.2. Water and wastewater indicators

Indicator	Water quality of water bodies
Indicator definition	Water quality of river water bodies close to a settlement; Q values indicate average water quality at a particular location
Indicator calculation	High status = 5; good status = 4; moderate status = 3; poor status = 2; bad status = 1
Data sources	Water Framework Directive Ireland water maps available online at: http://www.wfdireland.ie/maps.html
Indicator	Wastewater treatment spare capacity
Indicator definition	Measures the percentage spare wastewater treatment capacity in a settlement
Indicator calculation	$[(\text{Current wastewater treatment capacity (m}^3\text{)}/\text{Current wastewater treatment demand (m}^3\text{)}) - 1] \times 100/1$; where there is no treatment plant at the settlement, or existing plant is overloaded, wastewater treatment spare capacity = 0
Data sources	Local authority
Indicator	Unaccounted-for water (%)
Indicator definition	Measures the proportion of unaccounted-for water in a settlement; unaccounted-for water is water lost due to leakages, metering inaccuracies or theft
Indicator calculation	Unaccounted-for water is the percentage difference between the quantity of water supplied by the settlement's network and the metered quantity used by the customer
Data sources	Local authority

Table 3.2. Continued

Indicator	Populated area at risk of flooding (%)
Indicator definition	Measures the area of zoned land in a settlement at risk of flooding
Indicator calculation	Settlement zoned area of possible flooding (hectares)/Planned population 2022 (persons) × 100/1
Data sources	Local authority
Indicator	Urban wastewater treatment status
Indicator definition	Measures whether a settlement's wastewater treatment plant passed or failed the urban wastewater treatment standards 2011
Indicator calculation	If settlement's wastewater treatment plant passed urban wastewater treatment standards 2011 = 1; if settlement's wastewater treatment plant failed urban wastewater treatment standards 2011 = 0; if there are no data available for a settlement's treatment plant in settlement = 0
Data sources	Local authority

Table 3.3. Population and urban form indicators

Indicator	Planned population density
Indicator definition	Measures the planned population density in persons/hectare according to the population targets set out in the relevant development plan; here it is assumed that higher population densities are more sustainable
Indicator calculation	Planned population of settlement in 2022 (persons)/zoned area of settlement (hectares)
Data sources	Local authority
Indicator	Proportion of population unemployed
Indicator definition	Measures the proportion of the population of a settlement which is unemployed according to the 2011 National Census
Indicator calculation	Percentage of settlement's population which is unemployed
Data sources	Central Statistics Office of Ireland, Irish National Census 2011 Small Area Population Statistics: (T8_1_ULGUPJT/T8_1_TT) × 100/1
Indicator	Proportion of population with third level education
Indicator definition	Measures the proportion of the population of a settlement having a third level education according to the 2011 National Census
Indicator calculation	Percentage of settlement's population with a third level education
Data sources	Central Statistics Office of Ireland, Irish National Census 2011, Small Area Population Statistics: (T10_4_ODNDT + T10_4_HDPQT + T10_4_PDT + T10_4_DT/T10_4_TT) × 100/1
Indicator	Housing vacancy rate
Indicator definition	Measures the proportion of vacant units in a settlement according to the 2011 DECLG National Housing Development Survey
Indicator calculation	(Total number of vacant units in settlement according to DECLG Housing Survey/total number of units in settlement according to Census 2011) × 100/1
Data sources	(Status Vacant _ Hs + Status Vacant _ Apt/T6_1_TH) × 100/1; Central Statistics Office of Ireland, Irish National Census 2011, Small Area Population Statistics; DECLG National Housing Development Survey 2011 available online at: http://www.viron.ie/publications
Indicator	Distance to nearest large retail centre
Indicator definition	Measures distance to a large tier 1 retail centre; the tier 1 retail centres in Ireland are Dublin, Cork, Limerick, Galway and Waterford; the distance in km via road from the centre of a settlement to the centre of the nearest large retail centre is calculated via AA route planner
Indicator calculation	Distance in km from the centre of a settlement to the centre of the nearest large retail centre
Data sources	Relevant local authority retail planning document; AA route planner, available online at: http://www.aaireland.ie/routes/

AA, Automobile Association.

Table 3.4. Transport and energy indicators

Indicator	Average transport CO ₂ emissions
Indicator definition	Measures the average transport CO ₂ per inhabitant due to commuting to work, data are sourced from the 2011 National Census
Indicator calculation	Average time spent travelling to work in minutes (Census 2011) × Average CO ₂ emissions per km of new cars in 2010 (133g/km)
Data sources	Central Statistics Office of Ireland, Irish National Census 2011, Small Area Population Statistics: (T11_3_D1 × 7.5 + T11_3_D2 × 22.5 + T11_3_D3 × 37.5 + T11_3_D4 × 52.5 + T11_3_D5 × 75 + T11_3_D6 × 90) / T11_3_T
Indicator	Settlement walkability
Indicator definition	Measures the proportion of inhabitants of a settlement travelling on foot or by bicycle to their place of work
Indicator calculation	Central Statistics Office of Ireland, Irish National Census 2011, Small Area Population Statistics: (T11_1_F + T11_1_BI / T11_1_T) × 100 / 1
Data sources	Central Statistics Office of Ireland, Irish National Census 2011
Indicator	Number of public transport services per 1000 persons
Indicator definition	Measures the average number of public transport services (bus and rail) per 1000 inhabitants, data are sourced from Bus Éireann, private bus operators and Irish Rail
Indicator calculation	(Total number of services per weekday connecting settlement with the nearest large settlement in the region / Total population of settlement) × 1000
Data sources	Bus Éireann available online at: http://www.buseireann.ie/ ; Irish Rail available online at: http://www.irishrail.ie/
Indicator	Average household heating CO ₂
Indicator definition	Measures the average household CO ₂ emissions based on household heating type data from Census 2011 and emissions factors of fuel type
Indicator calculation	(For each category of fuel type: number of units in settlement using fuel according to Census 2011 × emission factor) / total number of units in settlement; (T_6_5_OCH × 263.9 + T6_5_NGCH × 204.7 + T6_5_ECH × 528.2 + T6_5_CCH × 340.6 + T6_5_PCH × 374.4 + T6_5_LPGCH × 229.3) / T6_5_T
Data sources	Central Statistics Office of Ireland, Irish National Census 2011
Indicator	Proportion of population travelling to work by private car
Indicator definition	Measures the proportion of inhabitants in a settlement whose primary mode of transport to work is private car
Indicator calculation	Number of inhabitants travelling to work by private car / total number of inhabitants in settlement; (T_11_1_CD + T11_1_CP / T11_1_T) × 100 / 1
Data sources	Central Statistics Office of Ireland, Irish National Census 2011

Table 3.5. Liveability indicators

Indicator	Distance to nearest acute hospital
Indicator definition	Measures the proximity of a settlement to acute/general hospital services
Indicator calculation	Distance in km by road from nearest acute/general hospital to settlement centre is calculated via AA route planner
Data sources	Location of hospitals available online at: http://www.hse.ie/eng/services/maps/ ; AA route planner, available online at: http://www.aaireland.ie/routes/
Indicator	Tidy Towns points score
Indicator definition	Measures the tidiness of a settlement
Indicator calculation	Points score in the 2012 Tidy Towns Competition; where a settlement has not been entered in the Tidy Towns competition, a score of 0 is attributed
Data sources	Tidy Towns results book 2012 available online at: www.TidyTowns.ie

Table 3.5. Continued

Indicator	Special Areas of Conservation, Special Protection Areas, and Natural Heritage Areas within 5 km of settlement
Indicator definition	Measures the biological and cultural heritage of the area surrounding the settlement
Indicator calculation	Using relevant heritage and conservation maps or Myplan.ie the number of designated areas within 5 km of a settlement is ascertained; if one or more Natural Heritage Areas is within 5 km of the settlement = 1; if one or more Special Areas of Conservation is within 5 km of the settlement = 1; if one or more Special Protection Areas is within 5 km of the settlement = 1; these scores are added to give a total score out of a maximum of 3
Data sources	County Development Plan heritage and conservation maps; www.Myplan.ie
Indicator	Distance to nearest forest park, nature reserve or wildlife park
Indicator definition	Measures the access of inhabitants of a settlement to recreational areas
Indicator calculation	Using the Coillte and National Parks & Wildlife Service websites the locations of forest parks, nature reserves and wildlife parks are found; the distance from the centre of the settlement to the nearest forest park, nature reserve or wildlife park is calculated via AA route planner
Data sources	AA route planner, available online at: http://www.aaireland.ie/routes/ ; location of forest parks, nature reserves and wildlife parks available online at: http://www.coillteoutdoors.ie/ ; http://www.npws.ie/nationalparks/ ; http://www.npws.ie/naturereserves/
Indicator	Presence of 24-hour Garda station
Indicator definition	Measures the access of the settlement to a 24-hour Garda station
Indicator calculation	Data are acquired from An Garda Síochána on locations of 24-hour stations through contacting the district headquarters of the relevant Garda district; if settlement has a 24-hour Garda station = 1; if settlement does not have a 24-hour Garda station = 0
Data sources	www.garda.ie

AA, Automobile Association.

4 Application of SEMPRe

The first stage in the application of SEMPRe is to collate the relevant data for the 25 indicators described in Chapter 3 and input the raw data into worksheet no. 1, *Baseline environment*; a screenshot of this database is shown in Figure 4.1.

In worksheet no. 2, *Analysis layer* (screenshot shown in Figure 4.2) SEMPRe automatically applies normalisation equations to allow for comparison and aggregation among indicators quantified in mutually exclusive units. Normalising equations reduce the baseline data in each indicator to a transformed score between 0 and 1, where higher values imply more sustainable states. The accessing of this data and application of transformation equations occurs automatically in SEMPRe. The same

normalising procedure is adopted for all 25 indicators. It is a powerful technique that allows comparison and aggregation of indicator data and places the data for each settlement indicator in the context of how high or low that indicator level is compared with other settlements in the database, allowing identification of relative strengths or weaknesses within individual settlements.

Figure 4.3 shows a screenshot of the SEMPRe interface. Through the use of quadratic equations and logic gates, the modelling interface extracts data from worksheet no. 1 and 2 running in the background to quantify the impact of selected policies on settlements. For further information, SEMPRe has been published by Fitzgerald *et al.* (2012).

Settlement/Indicator	Ballincollig	Bandon	Bantry	Blarney	Buttevant	Carrigaline	Carrigtwohill	Castletownbere
Infrastructure and location								
Infrastructural capacity for settlement expansion (No. of units)	4872	961	1393	2792	482	2423	3656	443
Connected to gas distribution network	1	1	0	1	0	1	1	0
Index of recycling facilities	1	2	1	1	1	2	2	2
Proportion of households with broadband (%)	76	62	54	69	49	78	74	56
Presence of farmers markets	2	2	2	2	2	2	0	1
Water and wastewater								
Water quality of water bodies (Q value)	2	4	5	5	2	3	2	5
Wastewater treatment spare capacity (%)	24	144	6	0	85	0	0	0
Unaccounted for water (%)	40	55	50	40	47	40	51	62
Populated area at risk of flooding (%)	6.7	6.8	1.9	7.8	3.0	10.4	3.0	2.5
Urban wastewater treatment standards 2011	1	1	1	1	1	0	0	0
Population and urban form								
Planned population density (Person/hectare)	26	15	13	20	11	27	17	9
Percentage of population unemployed	8	12	10	9	15	10	11	7
Proportion of population with 3rd level education (%)	33	21	16	25	12	30	30	16
Housing vacancy rate (%)	21.2	14.6	7.5	30.3	36.6	16.1	29.6	20.1
Distance to nearest largest retail centre (km)	9	31	85	10	45	13	16	125
Transport and energy								
Average transport CO ₂ (kg/day)	1.6	2.4	1.7	1.7	2.3	1.8	2.2	1.2
Settlement walkability	13.4	17.4	26.3	8.6	21.7	13.7	11.6	30.3
Number of public transport services/1000 population	2.5	4.8	1.8	16.0	15.9	2.4	10.5	2.2
Average household heating CO ₂ (gCO ₂ /kWh)	241	279	295	243	279	226	224	303
% Travelling to work by car	74	66	60	77	73	61	72	50
Livability								
Distance to nearest acute hospital (km)	9	28	1	10	10	17	22	52
Tidy Towns points score	75	70	76	64	0	70	57	68
SAC, SPA, HA within 5km	1	1	1	1	3	2	3	1
Distance to nearest park (km)	2.0	20.0	20.5	12.0	6.0	7.2	5.0	35.0
Presence of 24 hour garda station	0	1	1	0	0	0	0	0
Projected population 2022	22430	7765	5484	7533	1501	17870	11618	1439
Population (Census 2011)	17,368	6,640	3,348	2,437	945	14,775	4,551	912
Area zoned land (hectares)	876	513	434	374	133	661	676	161
Tidy Towns score	298	278	302	255	0	279	228	272
Area of possible flood (ha)	58.91	35.05	8.12	29.06	3.96	68.77	20.47	4.05
Number of unfinished units	1313	370	97	265	156	801	489	78
Settlement/Indicator	Ballincollig	Bandon	Bantry	Blarney	Buttevant	Carrigaline	Carrigtwohill	Castletownbere

Figure 4.1. Worksheet no. 1, *Baseline environment*.

Indicator	Minimum observed value	Maximum observed value	High or low values for greater sustainability	Equation used
Infrastructure and location				
Infrastructural capacity for settlement expansion (No. of units)	71.00	5877.00	High	1
Connected to gas distribution network	0.00	1.00	High	1
Index of recycling facilities	0.00	2.00	High	1
Proportion of households with broadband (%)	48.59	78.00	High	1
Presence of farmers markets	0.00	3.00	High	1
Water and wastewater				
Water quality of water bodies (Q value)	2.00	5.00	High	1
Wastewater treatment spare capacity (%)	0.00	144.00	High	1
Unaccounted for water (%)	25.00	73.00	Low	2
Populated area at risk of flooding (%)	1.87	16.25	Low	2
Urban wastewater treatment standards 2011	0.00	1.00	High	1
Population and urban form				
Planned population density (Person/hectare)	3.96	27.03	High	1
Percentage of population unemployed	6.83	16.01	Low	2
Proportion of population with 3rd level education (%)	11.80	33.03	High	1
Housing vacancy rate (%)	3.08	46.95	Low	2
Distance to nearest largest retail centre (km)	7.24	124.70	Low	2
Transport and energy				
Average transport CO ₂ (kg/day)	1.17	2.76	Low	2
Settlement walkability	8.60	30.30	High	1
Number of public transport services/1000 population	1.75	16.00	High	1
Average household heating CO ₂ (gCO ₂ /kWh)	224.00	319.00	Low	2
% Travelling to work by car	48.99	77.12	Low	2
Livability				
Distance to nearest acute hospital (km)	1.00	56.00	Low	2
Tidy Towns points score	0.00	77.25	High	1
SAC, SPA, HA within 5km	1.00	3.00	High	1
Distance to nearest park (km)	1.20	35.00	Low	2
Presence of 24 hour garda station	0.00	1.00	High	1
Maximum (most sustainable) values shaded in yellow				
Minimum (least sustainable) values shaded in blue				

Figure 4.2. Worksheet no. 2, Analysis layer.

Settlement: Ballincollig		Baseline data	Equation	Transformed score (equal weighting)	SDI weighting	Weighted transformed score	Candidate Policy
Infrastructure and Location	Infrastructural capacity for settlement expansion (No. of units)	4872.00	1	0.83	2.00	1.65	
	Connected to gas distribution network	1.00	1	1.00	1.00	1.00	
	Index of recycling facilities	1.00	1	0.50	1.00	0.50	
	Proportion of households with broadband (%)	75.98	1	0.93	1.00	0.93	
	Presence of farmers markets	2.00	1	0.67	1.00	0.67	
Infrastructure and Location Index				3.9		4.8	
Water and wastewater	Water quality of water bodies (Q value)	2.00	1	0.00	1.00	0.00	
	Wastewater treatment spare capacity (%)	24.00	1	0.17	1.00	0.17	
	Unaccounted for water (%)	40.00	2	0.69	1.00	0.69	
	Populated area at risk of flooding (%)	6.72	2	0.66	2.00	1.32	
	Urban wastewater treatment standards 2011	1.00	1	1.00	1.00	1.00	
Water and Wastewater Index				2.5		3.2	
Population and Urban Form	Planned population density (Person/hectare)	25.61	1	0.94	2.00	1.88	
	Percentage of population unemployed	8.23	2	0.85	1.00	0.85	
	Proportion of population with 3rd level education (%)	33.03	1	1.00	1.00	1.00	
	Housing vacancy rate (%)	21.24	2	0.59	1.00	0.59	
	Distance to nearest largest retail centre (km)	9.00	2	0.99	1.00	0.99	
Population and Urban Form Index				4.4		5.3	
Transport and Energy	Average transport CO ₂ (kg/day)	1.62	2	0.72	1.00	0.72	Eco-driver training
	Settlement walkability	13.40	1	0.22	1.00	0.22	Eco-driver training
	Number of public transport services/1000 population	2.48	1	0.05	2.00	0.10	
	Average household heating CO ₂ (gCO ₂ /kWh)	241.00	2	0.82	1.00	0.82	
	% Travelling to work by car	73.96	2	0.11	1.00	0.11	
Transport and Energy Index				1.9		2.0	
Livability	Distance to nearest acute hospital (km)	9.00	2	0.85	2.00	1.71	
	Tidy Towns points score	74.50	1	0.96	1.00	0.96	
	SAC, SPA, HA within 5km	1.00	1	0.00	1.00	0.00	
	Distance to nearest park (km)	2.00	2	0.98	1.00	0.98	
	Presence of 24 hour garda station	.00	1	0.00	1.00	0.00	
Livability Index				2.8		3.6	
Overall Sustainable Development Index				62.1		62.8	
SDI 5 Key Indicators				66.7			
Projected unweighted sustainability change due to Policy				0.76%			
Projected weighted sustainability change due to Policy				0.61%			

New indicator level due to Candidate Policy	Projected new data	New transformed score	Sustainability weighting	Scores - improvement weighted	New transformed weighted score	Quantified improvement due to policy	Units of measurement
	4872.00	0.83	2.00	1.65	1.65	0.00	Infrastructural capacity for settlement expansion (No. of units)
	1.00	1.00	1.00	1.00	1.00	0.00	Connected to gas distribution network
	1.00	0.50	1.00	0.50	0.50	0.00	Index of recycling facilities
	75.98	0.93	1.00	0.93	0.93	0.00	Proportion of households with broadband (%)
	2.00	0.67	1.00	0.67	0.67	0.00	Presence of farmers markets
		3.9		4.8	4.8		
	2.00	0.00	1.00	0.00	0.00	0.00	Water quality of water bodies (Q value)
	24.00	0.17	1.00	0.17	0.17	0.00	Wastewater treatment spare capacity (%)
	40.00	0.69	1.00	0.69	0.69	0.00	Unaccounted for water (%)
	6.72	0.66	2.00	1.32	1.32	0.00	Populated area at risk of flooding (%)
	1.00	1.00	1.00	1.00	1.00	0.00	Urban wastewater treatment standards 2011
		2.5		3.2	3.2		
	25.61	0.94	2.00	1.88	1.88	0.00	Planned population density (Person/hectare)
	8.23	0.85	1.00	0.85	0.85	0.00	Percentage of population unemployed
	33.03	1.00	1.00	1.00	1.00	0.00	Proportion of population with 3rd level education (%)
	21.24	0.59	1.00	0.59	0.59	0.00	Housing vacancy rate (%)
	9.00	0.99	1.00	0.99	0.99	0.00	Distance to nearest largest retail centre (km)
		4.4		5.3	5.3		
90%	1.46	0.82	1.00	0.82	0.82	0.16	Average transport CO ₂ (kg/day)
103%	13.74	0.24	1.00	0.24	0.24	0.33	Settlement walkability
	2.48	0.05	2.00	0.10	0.10	0.00	Number of public transport services/1000 population
	241.00	0.82	1.00	0.82	0.82	0.00	Average household heating CO ₂ (gCO ₂ /kWh)
	73.96	0.11	1.00	0.11	0.11	0.00	% Travelling to work by car
		2.0		2.1	2.1		
	9.00	0.85	2.00	1.71	1.71	0.00	Distance to nearest acute hospital (km)
	74.50	0.96	1.00	0.96	0.96	0.00	Tidy Towns points score
	1.00	0.00	1.00	0.00	0.00	0.00	SAC, SPA, HA within 5km
	2.00	0.98	1.00	0.98	0.98	0.00	Distance to nearest park (km)
	0.00	0.00	1.00	0.00	0.00	0.00	Presence of 24 hour garda station
		2.8		3.6	3.6		
		62.5			63.2		

Figure 4.3. Worksheet no. 3, *SEMPRe interface*. The worksheet has been split into two parts for ease of reading. The first part provides baseline information for Ballincollig and indicates that a new policy (Eco-driving training) was tested, resulting in projected increases in sustainability (purple section). The second part shows the basis for this calculation: implementation of the policy impacted two indicators, and the contribution of each to enhanced sustainability is shown.

5 Sustainability Results

SEMPRe aggregates all indicators and produces a weighted and unweighted overall SDI score out of a maximum of 100. Weighting indicator scores serves to express quantitatively the importance of each indicator relative to others. The weightings allocated indicate the priorities of the decision maker. Initially, all indicator scores are weighted equally (here a common weighting of 1 is described as unweighted), to avoid complication and maximise transparency. The model also provides a weighted settlement sustainability score (whereby five key performance indicators are given a higher weighting of 2). Using SEMPRE to provide an aggregated SDI for settlements, it is possible to rank settlements in terms of relative sustainability.

Worksheet no. 4, *Results interface*, provides settlement sustainability results, including developed indices, key performance indicators, a sustainability kite diagram and an overall weighted SDI score out of a possible maximum of 100. An example for the settlement of Ballincollig in County Cork is shown in Figure 5.1. An important output of the model is the sustainability kite diagram, which graphically displays relative settlement sustainability in five sustainability themes. The area enclosed by the line represents the sustainability of the settlement; the greater the area the more sustainable the settlement. Ideally, the area should be a uniform shape, thus demonstrating balanced sustainability. SEMPRE enables the identification of settlement attributes that impede or facilitate progress towards sustainable development. It enables policies to be tailored towards the weaker aspects of settlement sustainability, therefore ensuring greater likelihood of success.

5.1 Settlement Sustainability Categorisation

Inputting settlement SDI results into ArcGIS software (ArcGIS: www.esri.com/software/arcgis) allows for the development of a thematic map of settlement sustainability. ArcGIS allows for settlement SDI results to be divided into a number of separate classes based on natural groupings inherent in the data. This permits

Ballincollig	Weighted Results
Overall Sustainable Development Index	62.8
SDI 5 Key Indicators	66.7

Developed Indices	
Infrastructure and Location Index	4.8
Water and Wastewater Index	3.2
Population and Urban Form Index	5.3
Transport and Energy Index	2.0
Liveability	3.6

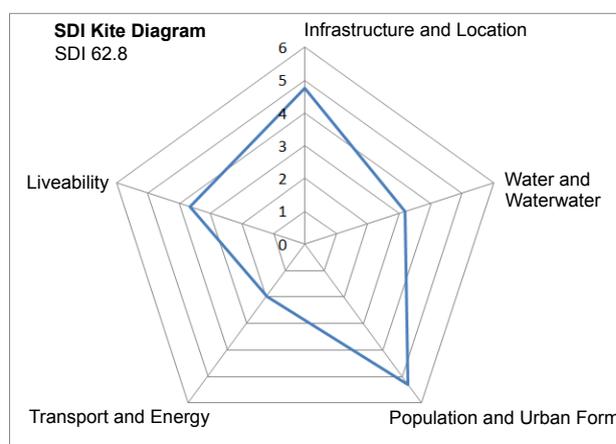


Figure 5.1. Worksheet no. 4, *Results interface*.

assessments of the sustainability of settlements at a glance. Divisions of values based on natural breaks, as in the Jenks classification system, will identify the class breaks that best group similar values. The Jenks classification may be employed to divide SDI results into any number of sustainability categories. For the purpose of this study, in order to keep analysis as clear as possible, three categories were developed as follows; category 1 settlements are settlements with the highest SDI results, category 2 settlements have intermediate SDI results, and category 3 settlements have the lowest SDI results.

It can be observed in Cork that, in general, larger settlements are more sustainable, and, as distance to Cork City decreases, settlement sustainability increases. Detailed analysis of settlement attributes reveals further insights into settlement sustainability and tailored settlement-specific policy recommendations.

Box 5.1. Worked example of settlement categorisation in Cork

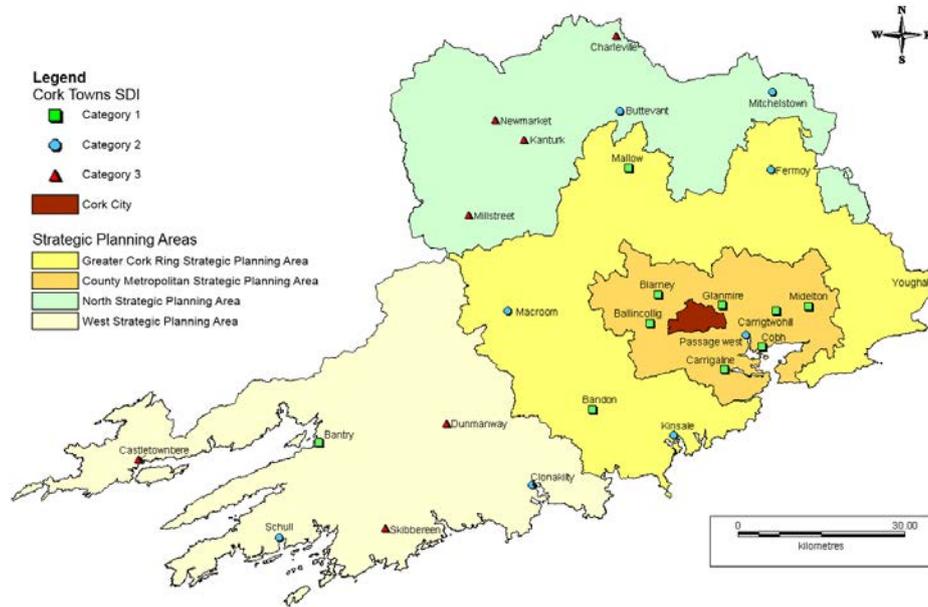


Figure 5.2. Thematic map of overall weighted settlement sustainable development indices.

Figure 5.2 displays a map of Cork County displaying settlement SDI results divided into three settlement categories based on the natural breaks (Jenks) classification system described earlier.

Category 1 settlements – highest sustainable development index results

Category 1 settlements range in population size from Blarney (2437 persons) to Ballincollig (17,368 persons). The average SDI of category 1 settlements was 56.3. In general, category 1 settlements are relatively large in terms of population size (with an average population size of 9400 persons) and located in relatively close proximity to Cork City. Category 1 settlements benefit from economies of scale in terms of infrastructure and services. All settlements in the county metropolitan strategic planning area (SPA) are category 1 settlements with the exception of Passage West.

Category 2 settlements – intermediate sustainable development index results

Category 2 settlements have intermediate levels of sustainability (with an average SDI of 47.3) and range in population size from Schull (658 persons) to Fermoy (6489 persons). In general, category 2 settlements have smaller populations (with an average population of 3871 persons) and are more peripheral relative to Cork City than category 1 settlements. Certain category 2 settlements such as Schull and Buttevant have populations of fewer than 1000 persons and have peripheral locations, yet fall into the intermediate sustainability category. Passage West is the only settlement in the County Metropolitan SPA that is a category 2 settlement.

Category 3 settlements – lowest sustainable development index results

Category 3 settlements are the least sustainable (with an average SDI of 38.4) and range in population size from Castletownbere (912 persons) to Youghal (7794 persons) with an average of 2682 persons. In general, category 3 settlements are smaller settlements sited in more peripheral locations relative to Cork City, and are mainly located in the north and west SPAs.

5.2 Scenario Evaluation

An important part of the SEA of the county development plan involves evaluation of the likely environmental effects of different scenarios in terms of proposals for the distribution of future population. SEMPRe enables quantification of the environmental effects of proposed scenarios.

The total population in 2011 in each of the three settlement categories was calculated and therefore the population proportion in each settlement category. This provided a baseline against which the effects of future scenarios could be evaluated. Higher population proportions in the most sustainable category 1 settlements indicate greater overall sustainability, while higher proportions in the intermediate category 2 and

least sustainable category 3 settlements indicate lower overall sustainability. When evaluating scenarios, it was assumed that infrastructure and service provision increased on a pro rata basis in line with population growth. Scenarios proposed by the SEA team are realistic and capable of implementation within the statutory and operational requirements of the county development plan. Using scenario population projections proposed by the SEA team, it was possible to quantify the proportion of projected population in each category of settlement for the various scenarios. This enables determination of whether a particular population scenario will result in the population being accommodated in relatively more or less sustainable settlements. A worked example for County Cork is shown below.

Box 5.2. Worked example core strategy evaluation in Cork County

Scenarios were proposed by the Cork County Council SEA team and are realistic and capable of implementation within the statutory and operational requirements of the county development plan. Three scenarios were evaluated as follows:

- Scenario 1 consolidates growth in the wider metropolitan area, the Greater Cork Ring Strategic Planning Area, the north and west SPA and concentrates growth along an east–west axis between Midleton, Cork City (Kent Station) and Ballincollig and along other public transport corridors.
- Scenario 2 is an alternative employment-led growth scenario that focuses a higher level of growth in a number of key settlements in which employment-led growth can be delivered.
- Scenario 3 focuses on public investment, primarily in water and wastewater infrastructure, within the main settlements therefore providing a more efficient provision of infrastructure.

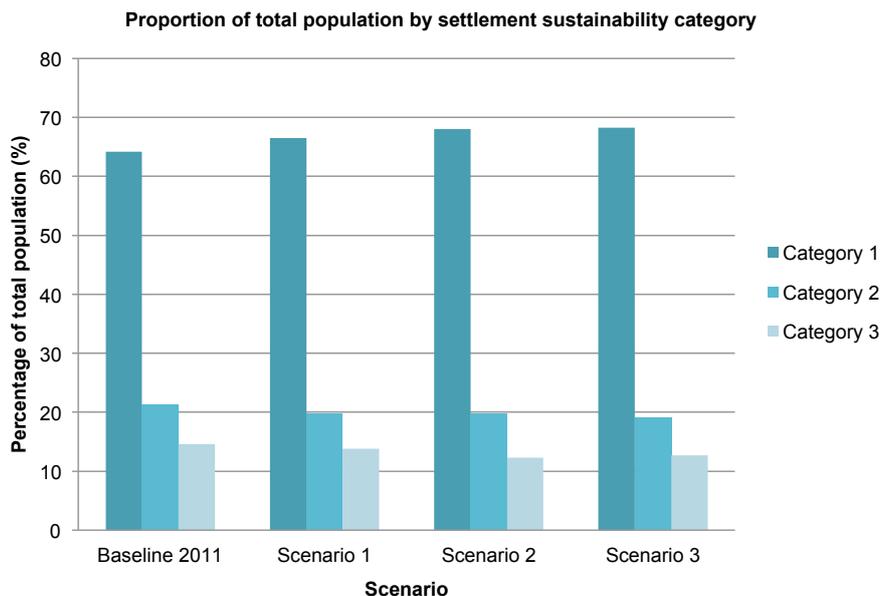


Figure 5.3. SEMPRe scenario evaluation results.

Box 5.2. Continued

From this analysis, the results suggest that all three scenarios impact positively on overall sustainability when compared with the baseline. Scenario 3 was predicted to be the most sustainable followed by scenario 2 and scenario 1 (Figure 5.3). Scenario 3 was predicted to result in the greatest improvement in sustainability. Scenario 3 allocates approximately 79% of future population growth to the most sustainable category 1 settlements, 14% to category 2 settlements and 7% to the least sustainable category 3 settlements. From this analysis, it appears that the general direction of the proposed development plan is towards accommodating future population growth in the most sustainable settlements, as measured by SEMPRE.

6 Policy Testing

SEMPRe permits testing of policies that stimulate and focus future population growth. SEMPRE can be applied to test alternative policies by quantifying projected sustainability gains associated with each. A literature review revealed a large number of potential policies. Policy selection criteria were developed in order to find the most appropriate policies for Irish urban settlements. Policies described here utilise existing proven technologies in order to reduce human impact on the environment and fossil fuel usage. This approach forms part of an evidence-based policymaking process that aims to provide evidence for policymakers, avoid duplication of research and identify research gaps.

Policy selection followed the criteria that policies were:

- described in quantitative terms;
- where possible evaluated more than once;
- supported by evidence on policy impacts that was available from reliable sources;
- relevant to aspects of urban sustainability and relatively easily understood and explained;
- suitable in an Irish context;
- capable of implementation over relatively short timescales.

Application of these criteria resulted in identification of 31 policies (Appendix 1; Table A1.1). This was the maximum number of policies that could be evaluated using these policy selection criteria and taking into consideration project time and resource constraints. This is not an exhaustive list of all sustainability-enhancing policies but a selection of different policies targeted at different end users to address and identify specific issues of settlement sustainability in an Irish context. Published cases describing implementation of relevant policies were identified and policy selection criteria were developed in order to assess the evidence base and discern the policies most applicable to Irish urban settlements. For detailed policy descriptions refer to EPA Technical Reports 1 and 2 (available online at www.epa.ie). Internationally published papers and reports provided evidence on policy impacts and instances in which a

policy had been implemented elsewhere and quantitative evidence of its effect had been published. Table A1.2 in Appendix 1 provides a list of potential policies and summarises the projected increases in sustainability associated with each policy. These projected increases in sustainability list the benefits that can be quantified through SEMPRE at this time and are not intended to list all benefits associated with each policy, some of which may be intangible, qualitative or more difficult to quantify based on current data availability.

Once the likely effects of policies have been quantified using SEMPRE, feasibility testing (O'Doherty *et al.*, 2013) is conducted to determine the viability and practicality of policy implementation.

Policy feasibility is analysed through the examination of operational evidence from both quantitative and qualitative data sources. Multi-Criteria Decision Analysis (MCDA) is employed to prioritise alternatives for the decision maker by transforming a complex problem into a single criterion problem and ranking alternatives according to their feasibility. Firstly, a clear description of the policy objectives is provided. Secondly, an assessment is made of the likelihood of the policy, when implemented, meeting its objectives, based on effects achieved elsewhere and key issues that may influence implementation. Thirdly, the possibility of unintended consequences such as rebound and backfire effects are considered. Fourthly, a plan of action designed to assist decision makers with policy implementation is produced. Policy cost-effectiveness, a timeline for implementation, uptake rates and applicability in an Irish context were estimated on the basis of previous experience elsewhere. The scale of policy implementation is examined, as some policies are more suited to national-level implementation by a government or another national body, while others are more suited to local-level implementation by a community organisation or local authority. In addition, key agencies responsible for policy implementation are identified. For full feasibility descriptions of all policies, please refer to EPA Technical Reports 1 and 2.

Box 6.1. Worked example of policy testing

To demonstrate testing policy impact through SEMPRe, policy no. 1, *Eco-driver training*, is modelled in the settlement Ballincollig. Eco-driver training seeks to change driver behaviour in order to reduce fuel consumption. It has been found that techniques such as frequent engine servicing, maintaining correct tyre pressures, reducing vehicle weight, less aggressive braking and acceleration, and more efficient use of gears can improve fuel economy. Where eco-driver training has been implemented it has resulted in a 10% reduction in transport CO₂ emissions and a 3% reduction in traffic congestion. As a first step, the new indicator value due to candidate policy is input into SEMPRe. Figure 6.1 shows an exploded view of the relevant parts of worksheet no. 3, *SEMPRe interface*.

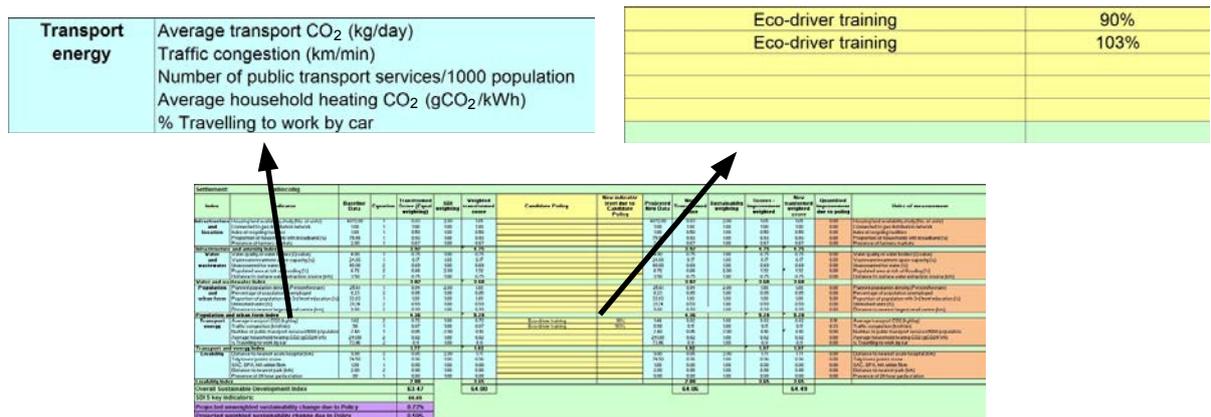


Figure 6.1. Testing policy effects.

SEMPRe automatically recalculates the baseline data, reapplies the normalising equations to the new data to give a new transformed score and calculates the effect of the policy on overall settlement sustainability. An additional output of SEMPRe is quantified sustainability outputs in units of the indicators. A strength of SEMPRe is that it facilitates the modelling of a policy that impacts on multiple indicators simultaneously and provides quantified improvements (Figure 6.2).

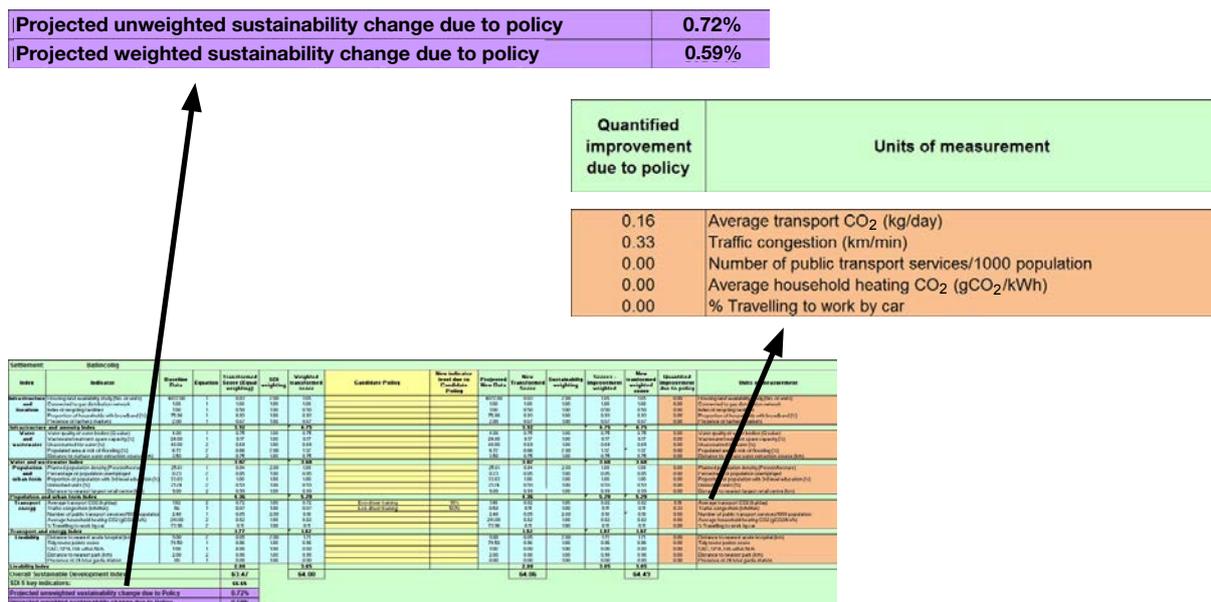


Figure 6.2. SEMPRe interface outputs.

7 Discussion and Conclusions

This method adds to our knowledge of the extent to which Irish settlements are sustainable and provides a possible standardised, transparent, quantitative, evidence-based evaluation of policy targets and potential champions, thus assisting planners in making policy decisions. In addition, it provides a systematic framework of Irish sustainable development policymaking, and assists national and local governments in identifying the most feasible sustainability strategy to assist in meeting national and international environmental targets and informing core strategies. In its current guise, the method is used for sustainability assessment of small, medium-sized and large towns, but if modified it could be used for sustainability assessment in smaller villages or rural areas.

The principal application of the method was to develop a practical, indicator-based methodology for the assessment of the sustainability of alternative core strategy and development plan strategies that can easily be used by practising planners in the preparation of the SEA environmental reports. The method provides an essential evidence base for sustainability assessment that enables modelling of population growth scenarios to ensure that population growth is in the most appropriate areas. An advantage of the method is that it permits evaluation of snapshots of sustainability at different times to monitor progress towards greater sustainable development. Policymakers and the general public may observe the rate of decoupling of economic growth from environmental degradation and progress towards sustainable development over time. This approach to

sustainability review and policy identification has also been taken with cognisance of data availability and applicability to Irish settlements.

The method presented here represents an important step for Ireland on the ladder to more sustainable urban development. It will enhance sustainability, especially where the selected indicators take full cognisance of the environmental setting of the LAP. It is acknowledged that results are sensitive to weightings that are associated with subjective judgements; the method is intentionally conservative and provides weighted and unweighted results. Sustainable development policy is dynamic in nature and requires long timescales for successful implementation. A strength of this research is that the initiatives described here aim to provide a method for sustainability gains to be increased beyond those already identified by following the requirements of the SEA Directive, the Floods Directive, the Habitats Directive, the Birds Directive (EC, 2009), the Water Framework Directive (EC, 2000), and other directives. The methods have been developed based on their ability to provide a tangible means of examining what sustainable development means in practice, through provision of a comprehensive overview of sustainability. This method provides a purpose-specific evaluation of what and who should be targeted in terms of policy development, providing a means whereby policymakers may select policies with greater certainty of the likely outcome. Balanced interpretation of the results may lead to prioritisation of more appropriate actions, which may increase settlement sustainability.

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Abbreviations

DECLG	Department of the Environment, Community and Local Government
EPA	Environmental Protection Agency
EU	European Union
EUSDS	European Union Sustainable Development Strategy
NSS	National Spatial Strategy
RPG	Regional planning guidelines
SDI	Sustainable development index
SEA	Strategic Environmental Assessment
SEMPRe	Sustainability Evaluation Metric for Policy Recommendation
SPA	Strategic Planning Area

Appendix 1

Table A1.1. Policies that passed policy selection criteria

Policy no.	Policy description	Appropriate settlements
1	Driver training in economical driving techniques (eco-driver training)	S, M, L
2	Strict speed limit enforcement and speed limit reduction	S, M, L
3	National road pricing scheme	S, M, L
4	Support for public transport	M, L
5	Low rolling resistance tyres	S, M, L
6	Urban freight distribution centre	L
7	Bicycle sharing system	L
8	Charging points for electric vehicles	M, L
9	Short term car rental scheme	L
10	Provision of bicycle lanes	M, L
11	Payment for cycling to work	M, L
12	Parking and showering facilities for cyclists	M, L
13	Integrated public transport fare system	S, M, L
14	Safe school routes	M, L
15	Commuter workplace travel plans	M, L
16	Parking cash out	M, L
17	Farmers markets	M, L
18	Smart growth programme	M, L
19	Passively heated buildings	S, M, L
20	Higher urban density	L
21	Green mortgages	S, M, L
22	Green roofs	S, M, L
23	Use of energy crops as home heating fuels	S, M, L
24	Smart electricity meters	S, M, L
25	Mandatory home energy audits	S, M, L
26	Solar water heating	S, M, L
27	Energy recovery from waste through anaerobic digestion	S, M, L
28	Use of metallic foils as radiation barriers to reduce heat losses from buildings	S, M, L
29	Low water use fixtures	S, M, L
30	Water harvesting	S, M, L
31	Constructed wetlands for tertiary wastewater treatment	S, M, L

S, small; M, medium; L, large.

Table A1.2. Projected policy sustainability increases

Policy no.	Policy effects
1	10% Decrease in transport CO ₂ emissions
2	10% Decrease in transport CO ₂ emissions
3	14% Decrease in transport CO ₂ emissions, 12% decrease in % travelling to work by car
4	4% Decrease in transport CO ₂ emissions
5	3% Decrease in transport CO ₂ emissions
6	5% Reduction in transport CO ₂ emissions
7	16% Decrease in transport CO ₂ emissions, 16% decrease in % travelling to work by car
8	5.3% Decrease in transport CO ₂ emissions
9	2% Decrease in transport CO ₂ emissions
10	9% Decrease in transport CO ₂ emissions
11	5.4% Decrease in transport CO ₂ emissions
12	1.3% Decrease in transport CO ₂ emissions, 2% Increase in no. of public transport services/1000 persons
13	9% Increase in % public transport Use
14	4% Decrease in transport CO ₂ emissions, 3.5% Increase in no. of Public transport Services/1000 persons
15	15% Decrease in transport CO ₂ emissions, 15% decrease in % travelling to work by car
16	4% Decrease in transport CO ₂ emissions, 4% decrease in % travelling to work by car 10% Increase in No. of Public transport Services/1000 persons
17	20% Decrease in transport CO ₂ emissions
18	14% Decrease in transport CO ₂ emissions, 14% decrease in % travelling to work by car
19	20% Decrease in household heating CO ₂ emissions
20	33% Decrease in transport CO ₂ emissions, 33% decrease in household heating CO ₂ emissions 22% Decrease in % travelling to work by car
21	16% Decrease in transport CO ₂ emissions
22	3% Increase in urban wastewater treatment status, 8% Decrease in household heating CO ₂ emissions
23	22% Decrease in household heating CO ₂ emissions
24	10% Decrease in household heating CO ₂ emissions
25	15% Decrease in household heating CO ₂ emissions
26	10% Decrease in household heating CO ₂ emissions
27	2% Decrease in household heating CO ₂ emissions, 5% decrease in transport CO ₂ emissions
28	3.4% Decrease in household heating CO ₂ emissions
29	28% Increase in urban wastewater treatment status
30	6% Increase in urban wastewater treatment status
31	60% Increase in urban wastewater treatment status

Appendix 2

Table A2.1. Glossary of Census 2011 terms

Theme	Variable	Description
Theme 6 table 1	T6_1_TH	Total (households)
Theme 6 table 5	T6_5_OCH	Oil (central heating)
Theme 6 table 5	T6_5_NGCH	Natural gas (central heating)
Theme 6 table 5	T6_5_ECH	Electricity (central heating)
Theme 6 table 5	T6_5_CCH	Coal (central heating)
Theme 6 table 5	T6_5_PCH	Peat (central heating)
Theme 6 table 5	T6_5_LPGCH	Liquid petroleum gas (central heating)
Theme 6 table 5	T6_5_T	Total (central heating)
Theme 8 table 1	T8_1_ULGUPJT	Unemployed having lost or given up previous job
Theme 8 table 1	T8_1_TT	Total persons aged 15 years and over
Theme 10 table 4	T10_4_ODNDT	Ordinary bachelor degree or national diploma (total)
Theme 10 table 4	T10_4_HDPQT	Honours bachelors degree, professional qualification (or both)
Theme 10 table 4	T10_4_PDT	Postgraduate diploma or degree (total)
Theme 10 table 4	T10_4_DT	Doctorate (PhD) or higher (total)
Theme 10 table 4	T10_4_TT	Total persons aged 15 years and over
Theme 11 table 1	T11_1_F	Means of travel to work, school or college on foot
Theme 11 table 1	T11_1_BI	Means of travel to work, school or college by bicycle
Theme 11 table 1	T11_1_CD	Means of travel to work, school or college car driver
Theme 11 table 1	T11_1_CP	Means of travel to work, school or college car passenger
Theme 11 table 1	T11_1_T	Total aged 5 years and over travelling to work, school or college
Theme 11 table 3	T11_3_D1	Total commuting under 15 minutes to work, school or college
Theme 11 table 3	T11_3_D2	Total commuting 15–30 minutes to work, school or college
Theme 11 table 3	T11_3_D3	Total commuting 30–45 minutes to work, school or college
Theme 11 table 3	T11_3_D4	Total commuting 45–60 minutes to work, school or college
Theme 11 table 3	T11_3_D5	Total commuting 60–90 minutes to work, school or college
Theme 11 table 3	T11_3_D6	Total commuting more than 90 minutes to work, school or college
Theme 11 table 3	T11_3_T	Total
Theme 15 table 3	T15_3_B	Number of households with broadband internet access
Theme 15 table 3	T15_3_T	Number of households total

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOL

Tá an Gníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaoil a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaoil a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gclóíonn leis na córais sin.

Eolas: Soláthraimid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírthe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.

Tacaíocht: Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaoil atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaoil inbhuanaithe.

Ár bhFreagrachtaí

Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaoil:

- saoráidí dramhaíola (*m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistriúcháin dramhaíola*);
- gníomhaíochtaí tionsclaíoch ar scála mór (*m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta*);
- an diantalmhaíocht (*m.sh. muca, éanlaith*);
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe (*OGM*);
- foinsí radaíochta ianúcháin (*m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíoch*);
- áiseanna móra stórála peitрил;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce poiblí, a mhaoirsiú.
 - Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhírú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúcháin.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídóinn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaoil.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uisce idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéal uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaoil

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil (*m.sh. tuairisciú tréimhsiúil ar staid Chomhshaoil na hÉireann agus Tuarascálacha ar Tháscairí*).

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainnithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeraíde, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaoil in Éirinn (*m.sh. mórphleananna forbartha*).

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéal radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as tairmí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaoil ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaoil (*m.sh. Timpeall an Tí, léarscáileanna radóin*).
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosaint agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- An Oifig um Cosaint Raideolaíoch
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair inné agus le comhairle a chur ar an mBord.

Technical Guidance Manual; Report No. 178b

Sustainability Evaluation Metric for Policy Recommendation



Authors: Bernadette O'Regan, Travis O'Doherty, Brian G. Fitzgerald, and Richard Moles

There is now clear recognition that in future, urban communities (both Local Authorities and voluntary) must play a more active role in promoting sustainable development so as to meet national and EU environmental targets, especially in relation to greenhouse gas emissions. Governments must provide leadership, but communities have crucial knowledge on land areas in which new policies may be implemented. This report explains a method and decision support tool designed to aid Local Authorities and communities in prioritising policies which benefit the environment and are appropriate for their circumstances.

Identifying pressures

79 urban communities studied were found to have relatively low Sustainable Development Index values, with smaller settlements (population <1000) showing lowest values. Dublin was excluded from the study.

Informing policy

Communities require guidance on both the potential and appropriate policies to enhance their sustainability. Policy makers need to be reassured that implementation of appropriate policies is likely to have the intended outcomes. Some policies are more easily implemented in the short term and with limited cost, but others often with greater impact take longer and are more expensive. Communities differ in population, location and economic base: prioritising policies must take account of both community attributes and available resources.

Developing solutions

This research developed a decision support tool to enhance community sustainability which is both academically robust (all predicted policy impacts are supported by published studies) and accessible for planners and policy makers in voluntary communities. The tool is structured around a set of indicators which may be altered to suit local circumstances. The tool calculates the likely impact of introducing a new policy, taking rebound effects into account, and identifies policies required to meet set targets. The tool was trialled over six months with Cork County Council planners and adopted in the preparation of a new County Development Plan. The tool was found to be user friendly and valuable in providing evidence for more sustainable policy decisions. It is freely available to all communities and can be downloaded at goo.gl/MtMnKz