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A NOVEL METHOD FOR FEASIBILITY TESTING URBAN SUSTAINABLE DEVELOPMENT POLICIES

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Policy making to promote more sustainable development is a complex task due in part to the large number of both stakeholders and potential policies. Policy feasibility testing provides a guide to the viability and practicality of policy implementation and forms an important part of an evidence based policy making process. An extensive literature review has identified no standardised approach to feasibility testing. This paper addresses this knowledge gap by describing a novel method using Multi-Criteria Decision Analysis (MCDA) for feasibility testing of policies aimed at increasing the sustainability of towns and villages in Ireland. Feasibility results are provided for 40 frequently cited policy interventions tested for 18 settlements in Ireland. Policies were selected in the arenas of transport, food, housing and urban form, energy, waste and water. Policies are feasibility tested through analysis of operational evidence from both quantitative and qualitative data sources. Following testing, policies are ranked in terms of feasibility. This research examines the effectiveness of local and national level policies and the importance of both local community involvement and central government regulation in policy success. The inter-settlement variation in feasibility testing scores prioritises policy selection and aims to reduce cherry-picking of policies to support the viewpoints of the decision maker. Although developed for an Irish urban context the methods described here may have applicability elsewhere.

***Key words:** feasibility testing, sustainable development, evidence based policy making, integrated assessment modelling.*

INTRODUCTION

A major challenge facing the world is the need to urgently enhance sustainability in response to the inter-related challenges of climate change, dependence on fossil fuels, food shortages and growing population (Harvey and Pilgrim, 2011). Engendering more sustainable patterns of energy use is a difficult task due to the diversity of both stakeholders and potential policies. This is further compounded by the definition of sustainable development which is vague and offers no clear policy guidance, providing stakeholders with the opportunity to cherry-pick those aspects which best suit their sectoral or policy agendas (Stupar and Nikezić, 2011). As a result the planning profession in Ireland remains unclear as to what sustainable development means and this represents a barrier to progress. There is a need for a common policy framework to provide spatially differentiated policies and planners must avoid a "one size fits all" approach to planning policy (Lazarević-Bajec, 2011; Scott, 2010). Putting the concept into practice is proving difficult in many countries and methods are evolving. The research described here aims to reduce the risk associated with decision making through development of a standardised method for feasibility testing of policies for urban areas.

Research context

This research was developed in the context of the 2008-2013 Irish economic and social climate where economic growth, new house building, and tax revenue have fallen sharply and unemployment levels have risen. The Irish policy response to recession thus far has focused almost exclusively on the banking system and austerity measures, while the immediate and important issue of global warming has been sidelined (Scott, 2012). In this economic climate there are few financial

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resources available for development of new technologies. However, significant reductions in energy use may be made through the wider adoption of existing proven technologies via better planning and behaviour change, on the assumption that if such technologies were used to their full extent there would be a large reduction in human environmental impact and fossil fuels dependency (EPA, 2007).

As described by Brković and Milaković (2011) urban areas administrators are constantly searching for policies which will sustain future development, improve settlement competitiveness at regional and national level, and provide an attractive environment to satisfy the needs of inhabitants. Robust evidence is needed to support policy implementation and further strengthen linkages between researchers and policy makers. This study employs evidence based methods to evaluate the feasibility of policies designed to increase urban sustainability. Feasibility testing determines the viability and practicality of policy implementation. Many papers discuss the benefits of feasibility testing e.g. Grimes-Casey *et al.* (2011), Hak *et al.* (2012) and Rametsteiner *et al.* (2011) but a literature review did not identify papers which describe a method for feasibility testing of sustainability policies. Many sustainability policy studies cover a narrow geographical area with little policy variability. In addition studies generally focus on one aspect of sustainability and do not permit policy evaluation across sectors (OECD, 2008). There are a number of methods for analysis of policy outcomes, such as Environmental Impact Assessment, Strategic Environmental Assessment or Sustainability Impact Assessment. These methods are either project based, or evaluate broad policy impacts, they do not test policy impact at settlement scale. In addition the majority of urban sustainability research focuses on large cities. In Ireland in 2011 cities accounted for approximately 33.3%, towns accounted for 28.7% and rural areas accounted for 38% of the national population (CSO, 2011). Here, policies for towns and villages in Ireland are analysed, as they play a key role in securing balanced regional development. For the purpose of this study small settlements have been classified as urban areas with populations of 500-1,000 persons; medium settlements 1,000-9,999 persons, and large settlements 10,000-30,000 persons. This research aims to inform policy makers of likely outcomes of policy implementation, taking account of obstacles and possible unintended effects, such as policy backfire or rebound effect (Druckman *et al.*, 2011).

METHODS

The proposed methodological steps for feasibility testing of policies in urban areas of Ireland and results of 40 frequently cited settlement level policy initiatives are described in this section. Policy feasibility is analysed through the examination of operational evidence from both quantitative and qualitative data sources. Policies are evaluated according to a three step process. Firstly, policies are identified and described. Secondly, policies are tested through the Sustainability Evaluation Metric for Policy Recommendation (SEMPRe) developed by the research team (Fitzgerald *et al.*, 2012). SEMPRe calculates the expected percentage improvement in per capita sustainability for a settlement following policy implementation. Thirdly, 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.

Selection of policies

A literature search identified six policy arenas for settlement sustainability enhancement: transport, food, housing and urban form, energy, waste and water. These arenas were considered to encompass main environmental impacts within settlements and showed clear policy relevance. Within these arenas published cases describing implementation of relevant policies were

Table 1. Policy initiatives satisfying selection criteria

Policy arena	Policy
Transport	**National level policy initiatives**
	1. Eco-driver training
	2. Reduced speed limits
	3. National road pricing scheme
	4. Subsidised public transport
	5. Low rolling resistance tyres
	Local level policy initiatives
	6. Urban freight distribution centres
	7. Bicycle sharing system
	8. Promotion of electric vehicles
	9. Short term car rental scheme
	10. Congestion charging
	11. Bicycle lanes
	12. Financial cycling incentive
	13. Cycling facilities
	14. Integrated public transport fare system
	15. Safe school routes
	16. Commuter workplace travel plans
	17. Parking cash out
Food	**Local level policy initiatives**
	18. Communal allotments
	19. Farmers markets
Housing and urban form	**Local level policy initiatives**
	20. Smart growth programme
	21. Passively heated buildings
	22. Teleworking from home
	23. Higher urban density
	24. Green mortgages
	25. Green roofs
Energy	**National level policy initiatives**
	26. Reduction in standby energy use
	27. *Salix* and *Miscanthus* as home heating fuels
	28. Wind Energy
	29. Smart electricity meters
	30. Prepaid electricity meters
	31. Demand side management programme
	32. Mandatory home energy audits
	Local level policy initiatives
	33. Solar water heating
	34. Energy recovery from waste
	35. Radiation barriers to reduce heat losses from buildings
Waste	**National level policy initiatives**
	36. Waste prevention campaign
	37. Reduced packaging
Water	**National level policy initiatives**
	38. Low water use fixtures
	39. Water harvesting
	Local level policy initiatives
	40. Constructed wetlands for tertiary wastewater treatment

identified. Policy selection followed these criteria:

1. Policies were frequently cited and described in quantitative terms.
2. Supporting evidence on policy impacts from reliable sources was available.
3. Policies were relevant to identified urban sustainability arenas and relatively easily understood and explained.
4. Policies were suitable in the context of Irish towns and villages.

Application of these criteria resulted in a total of 40 policies being targeted for further analysis (Table 1). All impacts of sustainability enhancing policies cannot be measured quantitatively; for example, policies aimed at increasing quality of life satisfaction and biodiversity are difficult to measure. Such policies fall outside the scope of the methods adopted here. This is not an exhaustive list of all sustainability enhancing policies but a selection of frequently cited environmental policies relating to enhancing settlement sustainability.

Quantified policy impacts

An existing database of over 300 economic, social and environmental attributes of 79 Irish settlements, located in three regional clusters in central and western Ireland provided a baseline against which the effects of new policies could be modelled (Moles *et al.*, 2008). This database was previously used to identify key links between attributes of urban settlements and their per capita sustainability, through the calculation of a Sustainable Development Index (SDI), based on the aggregation of 40 indicators for each of 79 settlements. Using this database SEMPRe was employed to quantify the percentage increase in per capita sustainability for a settlement, which might be expected following policy implementation, using published analyses and direct Irish experience (Fitzgerald *et al.*, 2012). This feasibility testing method incorporates data from SEMPRe to determine the feasibility of proposed policy implementation.

Policy feasibility testing

Policies found to have positive impacts on the SDI were subjected to feasibility testing, based on criteria adapted from those provided by Ledbury *et al.* (2006). 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 which 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, while others are more suited to local level implementation. In addition key agencies responsible for policy implementation are identified. For illustration purposes feasibility test information for an energy policy is shown in Table 2.

Following quantified policy impact via SEMPRe and gathering of feasibility test information MCDA is then employed for policy prioritisation. MCDA provides a framework for assessing policies across differing criteria, and such methods have been successfully applied to environmental problems in the past (Alvarez-Guerra *et al.*, 2009; Kiker *et al.*, 2005). The criteria chosen for use within feasibility testing were: timeline for policy implementation, cost of policy implementation and improvement in per capita sustainability. For the three criteria, the expected consequence for implementation of each policy was assigned a numerical score on a scale of 0-10, with more desirable outcomes given higher scores (see Table 3).

A weighting of 1 was attributed to timescale for policy implementation and cost of policy implementation. A weighting of 2 was assigned to improvement in per capita sustainability. The use of sustainability impact as a factor in feasibility testing is self-evident, as the purpose of the test was to evaluate the feasibility of policies which would impact upon sustainability. The use of cost

Table 2. Feasibility test information for an energy policy

Policy: Energy recovery from waste
Policy description and aims: Energy can be recovered from waste through Anaerobic Digestion (AD) of organic wastes. A carbon neutral form of energy is produced in the form of biogas which can be used to develop heat or electricity (Singh *et al.*, 2010). The use of residues as a fuel source does not impinge on food production. In addition to the energy production benefits, AD reduces the quantity of waste sent to landfill which will help in meeting Ireland's obligations under the Waste Framework Directive and Landfill Directives, and the digestate can be used as a fertiliser.
Lessons learned: It has been demonstrated in countries such as Sweden, Germany and Switzerland that greater efficiencies can be achieved through upgrading biogas to biomethane which can be injected into the national gas grid or used as a transport fuel (Browne *et al.*, 2011). A relatively large initial capital investment is needed to construct anaerobic digesters; the cost is a function of plant size, feedstock and technology. In the case of plants producing electricity from combined heat and power the cost per unit energy decreases with increasing plant size up to 1000 KW equivalent, above this few benefits are gained through increasing plant size (Walla and Schneeberger, 2008).
Likely effectiveness in achieving objectives: Assessments of waste to energy technologies conclude that they are an economical process for renewable energy production. There is an abundance of feedstocks in Ireland, for example, slaughterhouse, agricultural and municipal wastes or wet biomass (Singh *et al.*, 2010). In excess of 40 million tonnes of agricultural slurry is land spread in Ireland each year, resulting in eutrophication, air pollution and toxicity in water bodies (Browne *et al.*, 2011).
Implementation: Already in Ireland many large sewerage treatment plants include AD and the biogas is used within the plant for combined heat and power. In an analysis of the cost of biogas production in Ireland Browne *et al.* (2011) found that biogas production from the organic fraction of municipal solid waste was the most cost effective at €0.3/m^3 followed by slaughter house waste at €0.54/m^3. A more attractive feed in tariff rate would further incentivise investment in AD. Public resistance to anaerobic digesters may also be an issue in Ireland similar to the resistance to incinerators in recent years; therefore involving the local community is important. Biomethane has the potential to be a cost effective natural gas substitute, however due to reduced energy prices there is an incentive for greater use – the rebound effect. Using a variety of different methods Haas and Biermayr (2000) and Sorell *et al.* (2009) estimate the rebound effect for space heating is likely to be less than 30%.
Policy summary: Capturing this resource would be a considerable step in addressing Ireland's renewable energy targets, reducing the country's dependency on energy imports. In other European countries AD has been found to be economically viable and provide benefits such as low cost hot water and electricity to local communities. Larger AD plants are more efficient than smaller plants.
Policy champions: Department of the Environment, Community and Local Government, Teagasc – Irish Agriculture and Food Development Authority, Sustainable Energy Authority of Ireland, Environmental Protection Agency.

Table 3. Policy feasibility scores

Timescale	Score
<1 year	10
1-2 years	8
2-3 years	6
3-4 years	4
>5 years	2

Cost	Score
Low	10
Medium	5
High	1

Improvement in per capita sustainability (%)	Score
>4	10
3-4	8
2-3	6
1-2	4
<1	2

and timescale as the two other factors in feasibility testing was influenced by the need to prioritise policies which could be introduced quickly at low cost. Rametsteiner *et al.* (2011) supports the use of cost as a factor in respect of feasibility testing of sustainability policy and the importance of timescale in sustainability policy implementation is widely recognised (Bond and Morrison-Saunders, 2011). It is acknowledged that there is an inherent subjectivity in establishing weighting and scoring systems. It is believed that the criteria and their weighting adopted here are appropriate within a contemporary Irish urban context as they address areas of concern or greatest relevance in policy implementation. A different ranking system might be adopted depending on the needs of decision makers in other jurisdictions.

RESULTS

The scores for each criterion identified for policy feasibility scores (timescale, cost and improvement in per capita sustainability) were weighted, aggregated and expressed as a percentage of a maximum value of 100 (Table 4). The improvement in per capita sustainability shown in Table 4 represent averages for applicable Irish settlements.

All 40 policies are applicable in larger settlements, 36 policies are applicable in medium sized settlements while 26 policies are applicable in small settlements. With regard to implementation level, 19 policies are more suited to national level implementation, 14 require both national and local level implementation and 7 are more suited to local level implementation.

DISCUSSION AND CONCLUSION

This research addresses the important policy issue described by Daly and O'Gallachoir (2011): that quantification of the impact of policies is essential for policy makers to compare different policy measures, to ensure the most effective and feasible policy is implemented, and to assess how individual policies combine to contribute to overall targets. The methods presented here do not advocate the purely positivist approach whereby empirical evidence alone informs policy. It is acknowledged that public and political support is crucial and knowledge and

Table 4. Multi-criteria analysis of policies

Rank	Policy	Type of implementation National level = N Local level = L	Settlement applicability Small = S Medium = M Large= L	Timescale	Cost	Per capita sustainability increase	Level of feasibility (%)
1	Wind energy	N, L	S, M, L	6	5	10	78
2	Energy recovery from waste	N, L	S, M, L	8	5	8	73
3	Mandatory home energy audits	N	S, M, L	10	10	4	70
4	*Salix* and *Miscanthus* as home heating fuel	N, L	S, M, L	8	5	6	63
5	Low water use fixtures	N	S, M, L	8	5	6	63
6	Wetlands for wastewater treatment	L	S, M, L	8	5	6	63
7	Eco-driver training	N	S, M, L	10	10	2	60
8	Farmers markets	L	M, L	10	10	2	60
9	Urban distribution centres	N, L	M, L	10	10	2	60
10	Heat loss barriers	N	S, M, L	10	10	2	60
11	Reduction in standby energy use	N	S, M, L	10	10	2	60
12	Low rolling resistance tyres	N	S, M, L	8	10	2	55
13	Demand side management	N	S, M, L	8	10	2	55
14	Teleworking from home	L	S, M, L	8	5	4	53
15	Green mortgages	N	S, M, L	4	5	6	53
16	Communal allotments	L	S, M, L	4	5	6	53
17	Passively heated buildings	N	S, M, L	6	10	2	50
18	Safe school routes	N, L	S, M, L	6	5	4	48
19	Bicycle sharing scheme	L	L	6	5	4	48
20	Bicycle lanes	N, L	L	6	5	4	48
21	Subsidised public transport	N	M, L	10	5	2	48
22	Financial cycling incentive	N, L	M, L	10	5	2	48
23	Cycling facilities	N, L	M, L	10	5	2	48
24	Waste prevention campaign	N	S, M, L	10	5	2	48
25	Parking cash out	N, L	M, L	8	5	2	43
26	Short term car rental scheme	N, L	L	8	5	2	43
27	Reduced speed limits	N	S, M, L	8	5	2	43
28	Integrated public transport fare system	N, L	M, L	8	5	2	43
29	Smart electricity meters	N	S, M, L	8	5	2	43
30	Prepaid electricity meters	N	S, M, L	8	5	2	43
31	Solar water heating	N	S, M, L	8	5	2	43
32	Reduced packaging	N	S, M, L	8	5	2	43
33	Water harvesting	L	S, M, L	8	5	2	43
34	Green roofs	N, L	S, M, L	8	5	2	43
35	Congestion charging	N, L	L	4	5	4	43
36	Electric vehicles	N	S, M, L	6	5	2	38
37	Commuter travel plans	L	M, L	4	5	2	33
38	Smart growth programme	N, L	M, L	4	5	2	33
39	Higher urban density	N	M, L	2	1	4	28
40	National road pricing scheme	N	S, M, L	6	1	2	28

creativity are valuable in the policymaking process. Additionally it is recognised that the assumption that a policy may be transferrable from one urban area to another is only valid within a detailed understanding of the policy context and knowledge of the local area (Macário and Marques, 2008).

New insights emerge as to which policies are most effective in increasing sustainability in Irish towns. Of the policies investigated, those aimed at promoting indigenous forms of energy and increasing energy efficiency such as wind energy and energy recovery from waste, rank highest. This finding is supported by Jollands *et al.* (2010). On average, water, waste and food policies also scored relatively high whilst housing and urban form and transport policies scored lower. With regard to implementation; the highest ranking policies require a mixture of local and national level implementation, and local level policies score higher than national level policies. The importance of local level community buy-in has been highlighted by Lucas *et al.* (2008). The methods developed here may be used both by communities to construct bottom-up sustainability strategies and by central government to promote top-down sustainability strategies.

Due to the rebound effect (Druckman *et al.*, 2011), only a proportion of expected sustainability improvements from policy implementation are achieved in practice. This research attempts to take rebound effects into consideration in policy evaluation through the use of quantitative data based on previous experiences. A key determinant in the success of this method is the quality and quantity of data available: while for an increasing number of policies quantitative data have been published, there exists a need for further quantitative evaluation of policy impacts. As these are published, the range of policies which can be feasibility tested will increase, as will the rigour of results.

Through integrated evaluation of timescale, cost and improvement in per capita sustainability associated with sustainability policies this method provides a template for a novel method for feasibility testing urban area sustainable development policies. The method described here goes beyond MCDA and creates a new purpose-built framework for feasibility testing which incorporates both quantitative and qualitative data within a single method allowing selection of both top-down and bottom-up policies most appropriate for different types of settlement, thereby increasing the likelihood of implementation success. The feasibility testing method gathers a large amount of scattered evidence describing impacts of policy when implemented elsewhere. This approach restricts the opportunities for those against policy change to argue that it is too risky to be the 'first jumper', or that simply it is impractical to implement such a policy. Although the research is developed in the context of the 2008-2013 Irish economic and social climate, there are no barriers to its implementation elsewhere, with indicators and weighting customised to local conditions.

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