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Transferability of demand-side policies between countries

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ABSTRACT

The development of methods to determine the transferability of policies between countries has received limited attention in the energy policy field. Previous research has focussed on theoretical or less formal determinants of energy policy transferability, rather than providing practical analytical tools. The paper presents a practical framework for analysing the transferability of demand-side management (DSM) policies, and to identify where policies are transferable at different levels of policy transfer. The paper tests the framework to determine the transferability of different types of DSM policy across 30 countries and 36 sub-national states. The method is a contextual-based analysis that matches up countries/states that have a comparable context at the proposed three levels of policy transfer: direct copying, adaptation and inspiration. The paper utilises Multi-Criteria Decision-Making analysis with 17 DSM experts to validate the breakdown of contextual factors at different levels of policy transfer. Four groups of countries are identified where policy transfer is possible at the adaptation level and seven groups of countries/states are identified at the inspiration level. Overall, the paper argues that context is key and the level of contextual detail included in methods to analyse energy policy transferability will affect the level of policy transfer that is appropriate.

1. Introduction

Policy evaluations that show government policies to have been successful are usually followed by debates around the transferability of those policies to other countries and jurisdictions. However, surprisingly, the development of methods to formally analyse policy transfer is limited in the energy policy field, particularly in the academic literature. Instead, discussions revolve around general statements that the performance of a policy in a particular country could be replicated in the country in question.

A review of the academic literature in the field indicates that few studies have been undertaken on energy policy transferability. Two notable examples are Steinbacher (2015), who used semi-structured interviews to examine the specific case of renewable energy policy transfer between Germany and Morocco, and Dastan (2011), who used a literature review to explore the transfer of regulatory energy market reform specifically between the UK and Turkey. Beyond interviews and literature reviews, methods for determining energy policy transfer are underdeveloped. Furthermore, previous studies tend to concentrate on energy policy transfer between two specific countries rather than multiple countries, or focus on related policy areas, such climate policy (e.g. Smith, 2004) or environmental policy (e.g. Swainson and De Loe, 2011).

This paper aims to contribute to filling these methodological gaps by presenting research to develop and test a new approach for determining the transferability of energy policies. In particular, the paper focuses on demand-side management (DSM), which is much under-researched with regards to energy policy transfer. DSM refers to actions and programmes on the demand-side of energy meters that seek to manage energy consumption in order to meet various policy objectives, such as carbon emissions reduction and energy security (Warren, 2014). The paper aims to answer the following research question:

> *What factors influence the transferability of successful DSM policies between countries, and how transferable are such policies?*

The paper also proposes a second methodological approach based on a simplified form of Multi-Criteria Decision-Making (MCDM) analysis to valid the main method.

The primary argument of this paper is that statements on policy transferability should be framed in terms of the similarity of specific contextual factors, such as market structure, climate, system structure and energy demands, and should identify the specific level of policy transfer.

Section two provides a theoretical discussion of policy transferability, drawing on literature from the field of political science, before proposing a framework for determining the transferability of energy policies at different levels of policy transfer. Section three outlines the methodological approach for answering the research question, which

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revolves around the development and testing of a new hybrid quantitative-qualitative contextual-based analysis. How contextual factors are broken down at different levels of policy transfer in the proposed framework is validated using primary data from the MCDM analysis. Section four presents and discusses the results from analyses at the adaptation and inspiration levels of policy transfer. Section five provides the research conclusions and the main policy implications.

2. Theory

The paper undertook a comprehensive literature review of primarily journal papers, books, industrial and institutional reports, government documents, interviews and audiovisual material in the area of demand-side management (DSM). DSM encompasses energy efficiency (the delivery of the same services for less energy input – International Energy Agency (IEA) (2014), energy conservation (an overall reduction in energy consumption – Davito et al., 2010), demand response (the response of consumers to price changes or incentives payments – Albadi and El-Saadany, 2008), and on-site back-up generation (Eissa, 2011) and behind-the-meter storage (Warren, 2014, 2015). The literature review highlighted that research on policy transferability is not only limited in the DSM field, but in the wider energy policy field (examples include: Steinbacher, 2015 (renewable energy) and Dastan, 2011 (energy market reform)). Research on other types of transfer in the energy field, such as technology transfer and knowledge transfer, are much more extensive than policy transfer (examples include: Zhang and Gallagher, 2016 (solar photovoltaics); Talaei et al., 2014 (low carbon technologies); Liu and Liang, 2011 (carbon capture and storage); and Ockwell et al., 2008 (low carbon technologies)).

There has been much work undertaken on the lessons learned from DSM policy implementation, but this is discussion-based rather than methodological. Much of the work on policy transferability has been conducted in other disciplines. However, this literature similarly draws on theoretical discussions from political science rather than practical methodological discussions (e.g. Newmark, 2002; Dolowitz and Marsh, 1996; Rose, 1993; Rose, 1991; Radaelli, 1997; Bennett, 1991a; Bennett, 1991b). Theoretical frameworks have been produced (such as Rose, 1991), but how this translates into a practical method for determining the applicability of policy experiences between countries is not provided. This forms the research rationale for this paper – to contribute to developing methods to analyse policy transferability in the DSM (and wider energy) policy field. Section three discusses the proposed method, which aims to answer questions such as: “utility obligations have worked well in some European countries – can they be transferred to Asian countries?” or “what DSM policies could be successfully implemented in South Korea based on the experiences of other countries?” An important pre-requisite for answering such questions is an acceptance that a particular policy has been successful in the country where the experiences are being transferred from. This is discussed further in section three.

From the political science literature, Dolowitz and Marsh (1996) define policy transfer as referring “to a process in which knowledge about policies, administrative arrangements and institutions in one time and/or place is used in the development of policies, administrative arrangements and institutions in another time and/or place (p. 344). In a comprehensive review of policy transfer and diffusion, Newmark (2002) conveys how it includes lesson drawing, policy convergence, emulation and “systematically pinching ideas”. Furthermore, he cites Rose (1991), a seminal piece in the field, to highlight how governments look to other nations to find remedies to problems. In the case of energy policy, this may refer to governments examining how previously implemented policies for energy security, carbon emissions reduction or reducing energy bills (among other policy objectives) in other countries were designed, implemented and evaluated. This is also relevant at the local government level (such as sub-national states, regions, cities and provinces).

An example in relation to demand-side energy policy is the development of utility obligations across Europe as a result of the successful experiences of the UK's utility obligations since 1994. Utility obligations refer to mandatory activities that energy suppliers or distribution companies must undertake in order to meet given targets for energy or carbon savings over a given time period (usually 2–4 years). A number of European countries, such as Italy, France and Denmark, copied aspects of policy design and implementation from the UK (Eyre et al., 2009; Bundgaard et al., 2013b). This led to the European Union (EU)’s 2012 *Energy Efficiency Directive* (2012/27/EU) requiring that all member states must introduce utility obligations (or an appropriate equivalent policy) for the period 2014–2020.

Due to differences in context between countries (or sub-national states), it appears appropriate for the country/state in question to look at its past experiences with similar policies before looking at the past and current experiences of other countries/states. In both cases, it prevents “reinventing the wheel” where solutions already exist (Newmark, 2002), either internally or externally. Furthermore, the practical transferability of policies can come in various forms, from the direct copying of legislation, regulatory frameworks, policy design and implementation processes, to simply taking inspiration from successful policies in other countries/states and transferring broad ideas.

Rose (1991) breaks down transferability into five categories: copying, emulation, hybridisation, synthesis and inspiration. In addition to direct copying and gaining inspiration, emulation refers to the adoption of a standard basis starting point but then allowing for adaptations to the needs of the adopter (Rose, 1991). An example of this in DSM policy is the UK's pilot testing of energy efficiency as a resource in its capacity market between 2014–2017. The UK adopted aspects of policy design from the PJM capacity market in the USA (Titus et al., 2009), but adapted the testing and implementation of energy efficiency as a capacity resource to the structure of the UK's capacity market and requirements. Hybridisation involves the merging of ideas from two different countries/states (Newmark, 2002), for example, using similar aspects of policy design and implementation but adapting the policy to a different context by using different administrative means (Rose, 1991). Synthesis is an extension of hybridisation, as it involves taking aspects of policy design and implementation from three or more different countries/states (Newmark, 2002).

This paper builds on these works by proposing a framework for policy transferability, which uses the general definition of policy transferability provided by Dolowitz and Marsh (1996) and adapts Rose (1991)’s five categories into three broader categories, as shown in figure one. Figure one provides the theoretical construction of the framework and section three provides the practical construction of the framework. (Fig. 1)

The *Policy Transferability Framework* has three broad levels of transfer: direct copying, adaptation and inspiration. ‘Direct copying’ refers to the direct translation of policies, such as design, implementation, evaluation, legislation and regulatory frameworks. ‘Adaptation’ refers to the copying of policies, but adapting them to the contextual conditions of the country/state in question through multi-arm hybridisation (merging aspects of policy design and implementation from three or more other countries/states, as per Rose (1991)’s ‘synthesis’ transfer category), focused hybridisation (merging aspects of policy design and implementation from two other countries/states, as per Rose (1991)’s ‘hybridisation’ transfer category), or emulation (copying aspects of policy design and implementation from one other country/state as a starting point but then allowing for adaptations to the contextual conditions of the country/state in question, as per Rose (1991)’s ‘emulation’ category).

Rose (1991)’s ‘synthesis’ is not used due to the definitional clash in relation to synthesis in evidence reviews or document analyses. Furthermore, Rose (1991)’s use of the word is not self-evident without explanation. ‘Inspiration’ refers to the copying of ideas from the implementation of policies in other countries/states in the past, or

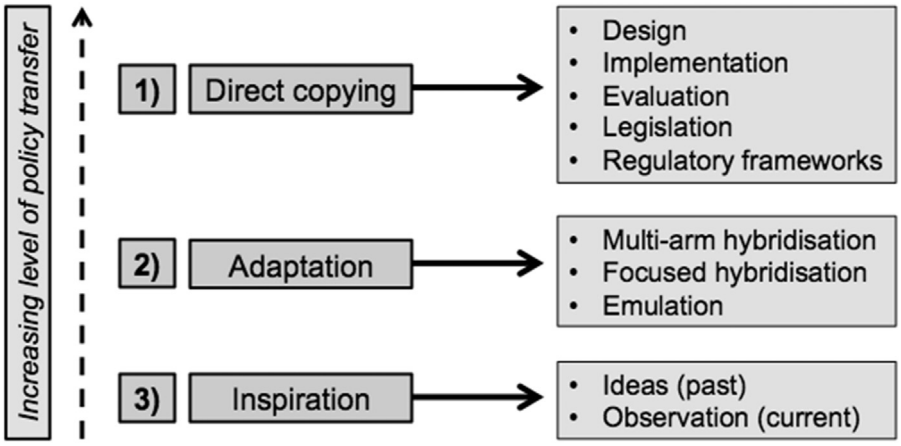

Fig. 1. *Policy Transferability Framework*: theoretical construction.

through observing the performances of policies that are currently active or currently being implemented in other countries/states. It is important to note that policy transfer also involves a country/state learning from its own previous policy experiences in a given area.

As argued previously, a crucial pre-requisite for the analysis of policy transferability is the identification of successful policies. There is no single definition for determining the success of a policy (McConnell, 2010), and this was evident from the literature review. Identified areas of focus include:

- Performance criteria (quantitative impacts – e.g. energy and carbon savings)
- Stated success (qualitative judgements of the policy evaluators)
- Stage in the policy process (success in design, implementation or post-policy evaluation)
- Underlying policy mechanisms (key factors for success and failure)

The approach outlined in section three focused on the stated success. The stated success of a policy refers to the qualitative overall judgement of the evaluator on whether or not the policy has succeeded or failed (McConnell, 2010). This includes general statements on whether collected or estimated data empirically shows a policy to have been effective or not, discussions of whether or not the policy met its original overall objectives (McConnell, 2010), and statements on how the evaluators themselves define policy success. However, the use of the proposed method in this paper is independent of how policy success is defined, as this simply forms an input to the framework.

3. Methodology

The research uses the data and results from another study, Warren (2015), as inputs into the practical construction of the proposed *Policy Transferability Framework*. The data comes from a systematic review of 690 high quality policy evaluations of twelve different types of demand-side management (DSM) policy conducted in 30 countries and 36 sub-national states. The systematic review identified successful (and unsuccessful) policies based on the stated success of policies as determined by the evaluators of those policies. Further details on the methodological process for determining policy success are outlined in Warren (2015) and are not repeated here, as the focus of this paper is to use the data to explore a different area: DSM policy transferability.

It is important to note that the primary focus of the paper is to provide a methodological approach for analysing demand-side policy transferability. As such, the inputs, such as successful DSM policies (and how they are defined) or specific data sources, can be changed and the methodological tool re-run. However, to demonstrate the use of the tool outlined in this section, the paper uses the definition of policy success from McConnell (2010), as discussed in section two, which focuses on the qualitative overall judgement of an evaluator of a particular policy based on whether or not they deem the policy to have succeeded or failed.

From the policy evaluations analysed in Warren (2015), the following broad types of DSM policy were inductively identified and examined:

- IPBDR: Incentive payment-based demand response (e.g. interruptible/curtailment programmes)
- PBDR: Price-based demand response (e.g. time-of-use programmes)
- MT: Market transformations (e.g. removal of energy efficiency barriers)
- UBM: Utility business models (e.g. decoupling policies)
- UO: Utility obligations (e.g. supplier energy efficiency obligations)
- PS: Performance standards (e.g. appliance standards)
- LB: Labelling (e.g. building labelling)
- L&S: Loans and subsidies (e.g. tax reductions)
- IR: Infrastructure rollouts (e.g. smart meter rollouts)
- R&D: Research and development programmes (large-scale programmes)
- IC: Information campaigns (e.g. energy auditing programmes)
- VP: Voluntary programmes (e.g. implementing energy management systems)

As the above DSM policies were inductively determined from a global sample of high quality policy evaluations, they were not predefined and were included based on the existing evidence base. Furthermore, Warren (2015) defines 'high quality' evaluations as those that pass a rigorous quality assessment scale, which includes six quality criteria (focussing on policy implementation, policy evaluation, peer review, conflicts of interest, institutional track record and reporting quality) and various sub-criteria.

The same data source provides a list of the countries/states that have experienced success with each of these types of DSM policy, as summarised in figure two (note, the acronyms for the policies are used). (Fig. 2)

Following the identification of successful DSM policies by country/state, the second methodological stage was to use the literature review and the systematic review to identify the main contextual factors that affect policy transferability. From the list of contextual factors, the most important factors need to be determined and data needs to be obtained for all countries (and sub-national states) that are to be included in the analysis in order to ensure the accuracy of the results. The reviews highlighted that the contextual factors shown in table one are the most important for affecting the transferability of demand-side (and wider energy) policies between countries/states. Factors in grey were included in the analysis and those that are in white were not included. (Table 1)

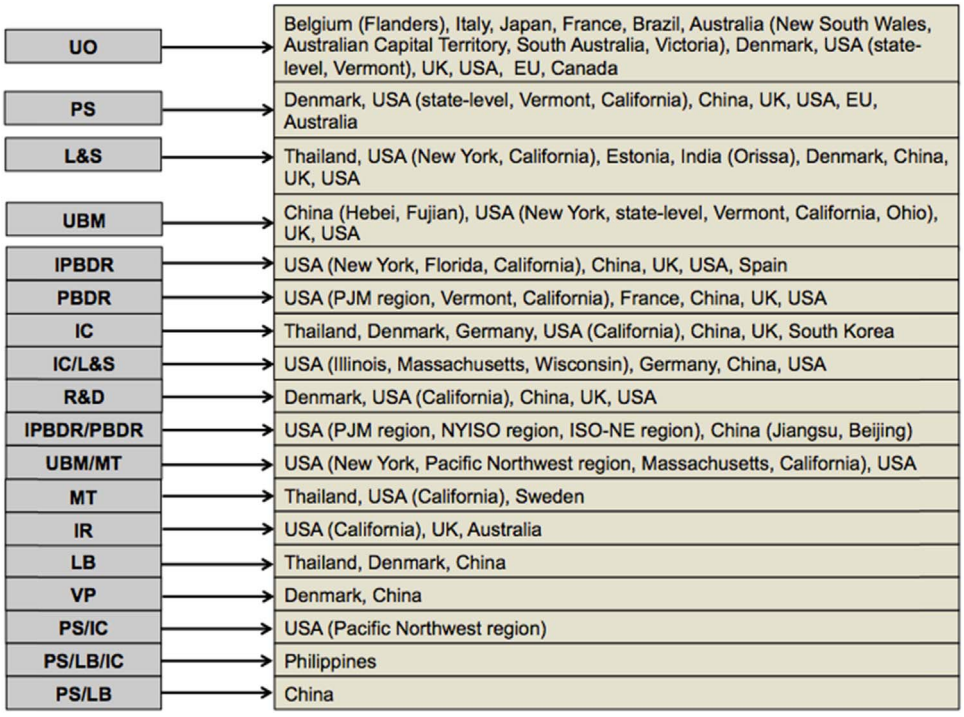

Fig. 2. Successful demand-side policies by country/state.

The reliability of determining policy transferability increases as more factors on context are analysed. However, due to data availability, only the twelve sub-factors shaded in grey were included in the final analysis. The reviews highlighted that the most important contextual factor for DSM policy is market structure. As most of the evaluations included in the systematic review sample examined electricity-focussed DSM policies, the electricity market structure was included and the heat (or gas) market structure was excluded. At a sub-factor level, it is clear that the degree of liberalisation of the electricity markets is crucial. In the analysis, this translates into utility structure, generation structure, transmission structure and distribution structure in terms of whether or not the structures are fully-competitive (F-C), partially-privatised (P-P) or state-owned (S-O). The reviews identified two other sub-factors that could affect policy transferability – the presence of regulatory frameworks to allow DSM to participate in balancing, reserve or capacity markets, and the submission of resource plans (including the role of DSM) by utilities to regulators.

In addition to market structure, climate, system structure and energy demands were also included in the analysis. Data on regulatory structure and cultural familiarity could not be obtained for all 30 countries and 36 sub-national states included in the research, so were excluded. Furthermore, a key challenge is how to categorise information on these factors, and this is an area that requires further methodological development. Data for market structure, climate, system structure and energy demands could be obtained for either the full sample of countries/states or the full sample of 30 countries but excluding the 36 sub-national states. For system structure, the analysis focussed on the electricity system structure for the same reasons as for the electricity market structure stated previously. Thus, the heat (or gas) system structure was excluded. Projected electricity system structures and projected heat system structures were also excluded due to the research focus on policy transferability.

For climate, the historical average summer and winter temperatures were included. A sensitivity analysis was conducted to assess the sensitivity of the results to projected average summer and winter temperatures, as data for these factors could be obtained from the same source. The sub-factors had minimal impact on the results and thus were excluded from the final analysis. For energy demands, current electricity consumption and current heat consumption were included. Although heat consumption was not crucial to incorporate due to the evaluations primarily focussing on electricity, there were a number of evaluations that analysed policies that impacted both electricity and heat (gas) consumption. Thus, the sub-factor was incorporated into the analysis to account for this. As with climate, projected electricity consumption and projected heat consumption were excluded for the same reasons. Table two summarises the data sources used, which are based on the most up-to-date data at the time of the analysis. Table 2)

For generation, data for each country/state included in the research were initially obtained from the International Energy Agency (IEA)'s *Energy Policies of IEA Countries Reviews*, and where data were not available for certain countries/states, the US Energy Information Administration (EIA)'s *Country Statistics* and *State Statistics* were used. In both cases, data were from 2005 to 2014 depending on the latest country reports that were available at the time of the analysis.

For transmission and distribution, the same data sources were used. The data showed that the difference between the degree of liberalisation for transmission and distribution in the countries/states examined was minimal, so the two are included together as one sub-factor. For utility structure, the same data sources were also used. At the time of the analysis, data on utility restructuring for US states were only available from the EIA for 2010. Utilities are classified as either 'vertical' or 'horizontal'. Vertically integrated utilities own the supply, transmission, and distribution aspects of one energy resource (electricity, gas, or water), whereas horizontal utilities own more than one energy resource (electricity, gas, or water) but for one aspect of the energy system (supply, transmission, or distribution) (Joskow, 2008; Walsh and Todeva, n.d.).

For DSM in balancing, reserve or capacity markets, data were obtained from government websites and from Warren (2015). For the submission of utility resource plans to regulators, the research used the IEA DSM Programme database, particularly the Task XXII report on utility obligations, which was prepared by the Regulatory Assistance Project (RAP) (2012).

For climate, data from the World Bank's *Climate Change Knowledge Portal* were downloaded. Summer and winter temperatures (in °C) were obtained for each country, which were averages over the

Table 1
Key contextual factors that influence the transferability of demand-side (and wider energy) policies.

Contextual Factor	Contextual Sub-Factor	Included?
Market structure	Electricity market structure	Included
	Heat market structure	Excluded
	Utility structure	Included
	Transmission structure	Included
	Distribution structure	Included
	Generation structure	Included
	Demand-side in balancing/capacity markets	Included
	Submission of resource plans to regulators	Included
System structure	Current electricity system structure	Included
	Current heat system structure	Excluded
	Projected electricity system structure	Excluded
	Projected heat system structure	Excluded
Climate	Current summer climate	Included
	Current winter climate	Included
	Projected summer climate	Excluded
	Projected winter climate	Excluded
Energy demands	Current electricity consumption	Included
	Current heat consumption	Included
	Projected electricity consumption	Excluded
	Projected heat consumption	Excluded
Regulatory structure	Regulatory frameworks	Excluded
	Current legislation	Excluded
	Political system	Excluded
	Current political situation	Excluded
	Government structure	Excluded
Cultural familiarity	Consumer familiarity with demand-side activities	Excluded
	Degree of environmentalism	Excluded
	History of demand-side policy implementation	Excluded

Table 2
Data sources for the analysis of policy transferability.

Contextual Factor	Contextual Sub-Factor	Data Source
Electricity market structure	Generation (F-C, P-P, S-O)	IEA (2005–2014), EIA (2005–2014)
	Transmission and distribution (F-C, P-P, S-O)	IEA (2005–2014), EIA (2005–2014)
	DSM in balancing markets (YES/NO)	Government and utility websites, systematic review
	Utility structure (VERTICAL/ HORIZONTAL)	IEA (2005–2014), EIA (2005–2014)
	Submission of resource plans (YES/NO)	IEA DSM Programme (2012)
Climate	Summer average temperature (°C)	World Bank (1990–2009)
	Winter average temperature (°C)	World Bank (1990–2009)
Energy demands	Electricity consumption (GWh)	IEA (2011a,b)
	Heat consumption (TJ)	IEA (2011a,b)
Electricity system structure	Fossil fuels (% of mix)	IEA (2011a,b); EIA (2011)
	Nuclear (% of mix)	IEA (2011a,b); EIA (2011)
	Hydro (% of mix)	IEA (2011a,b); EIA (2011)
	Other renewables (% of mix)	IEA (2011a,b); EIA (2011)

1990–2009 period (as given by the World Bank). At a state-level, the capital cities of states were used as the points for extracting relevant data from the same source. To obtain data for the European Union (EU), which was included as a country in the research (despite being neither a country nor a state), Met Office data were used, as this was not available from the World Bank. Data for countries/states within Europe were obtained from the World Bank, as per the other countries/states.

For energy demands, data for electricity consumption (in GWh) and heat consumption (in TJ) were extracted from the IEA's *Country Statistics*. Heat consumption primarily refers to gas consumption, though the IEA's figures also include other sources such as district heating and the utilisation of waste heat. Data in GWh and TJ were used due to the level of analysis of the research to examine DSM policies at a national (or state) level rather than at the individual consumer level (consumption per capita). 2011 data were used, as these were the most up-to-date data when the analysis was conducted.

For electricity system structure, data were extracted from the same data sources as for generation, transmission and distribution: the IEA's *Country Statistics* and where data were not available, the EIA's *Country Statistics*.

The data were stored and analysed in a spreadsheet-based policy transferability tool. For the sensitivity analysis, each contextual sub-factor was varied using a filtering function whilst keeping all of the other sub-factors at their baseline settings for each country/state. For example, for transmission and distribution, only those countries/states with fully-competitive (F-C) transmission and distribution market structures would be included, but all other variations of all of the other sub-factors could be included (e.g. countries/states with F-C, P-P or S-O generation market structures). It is important to note that the data showed that the difference between the degree of liberalisation for transmission and distribution in the 30 countries and 36 sub-national states was minimal, so the two were included together as one sub-factor. The sensitivity analysis identified that market structure was the most important factor, thus validating the findings from the literature review and the systematic review. This was followed by climate, and then energy consumption and electricity system structure.

The findings from the sensitivity analysis were mapped out onto the *Policy Transferability Framework* to convey how it can be used in practice to analyse the transferability of demand-side policies. Figure three provides the practical construction of the framework. (Fig. 3)

As table one shows, regulatory structure and cultural familiarity are important factors affecting policy transferability between countries/states. However, as data could not be obtained for these factors, analysis at the policy transfer level of 'direct copying' could not be conducted. At the level of 'adaptation', data could be obtained for all relevant contextual factors at this level (market structure, climate, system structure and energy demands) for all of the countries in the sample, but data for all of the sub-national states for system structure and energy demands could not be obtained. Thus, sub-national states were excluded from this part of the analysis. In contrast, at the level of 'inspiration', data for all 30 countries and 36 states could be obtained for market structure and climate.

The results discussed in section four identify groups of countries/states with similar contextual factors. The premise of this paper is that there is a higher probability of successfully transferring policies within the groups than between the groups at certain levels of policy transfer. A flowchart summarising the proposed methodological approach is presented in figure four. Further details on the process for analysis are discussed in section four. (Fig. 4)

To validate the breakdown of the contextual factors at different levels of policy transfer, as determined from the literature review and the systematic review, a simplified form of (unweighted) Multi-Criteria Decision-Making (MCDM) analysis was undertaken with 17 DSM experts. The experts were based in the UK or USA and represented government, academia and industry. The 45-min sessions involved first asking the experts to list the key factors that they judged to affect the degree of transferability of DSM policies between countries/states, and

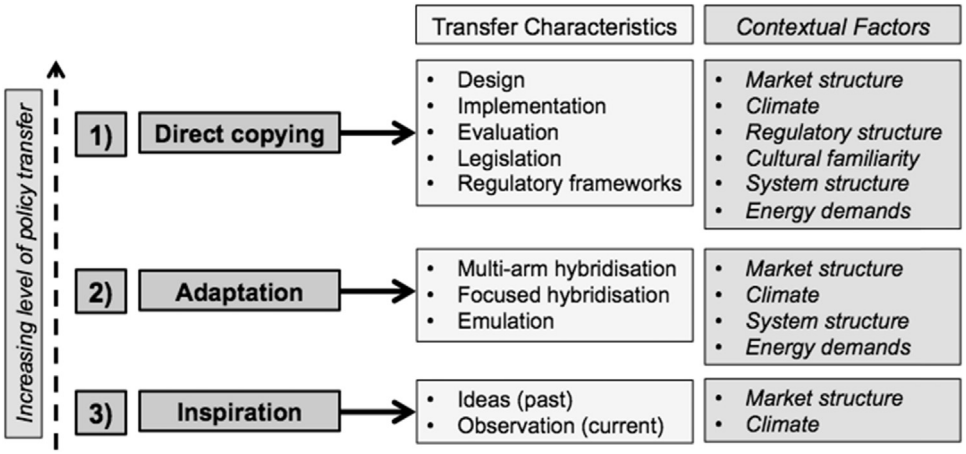

Fig. 3. *Policy Transferability Framework*: practical construction.

then asking them to rank the factors by importance. All factors were inductively determined and experts were not shown the factors presented in table one and figure three.

The factors and rankings were then aggregated to identify the most important factors overall in the sample. Those factors with higher rankings represented factors that were crucial at higher levels of policy transfer, such as 'direct copying', and those with lower rankings represented factors that could be included at lower levels of policy transfer, such as 'inspiration'.

4. Results

A spreadsheet-based transferability tool was developed in order to undertake the analysis. Using a filtering function, every combination of the contextual factors was run in order to identify groups of countries/states with specific combinations of contextual factors. The ten main contextual combinations are shown in table three. (Table 3)

Two transferability analyses were conducted – one at the level of 'adaptation' (including the 30 countries but excluding the 36 sub-national states) and one at the level of'inspiration' (including all 30 countries and 36 sub-national states). As four contextual factors were included in the former (market structure, climate, system structure and energy demands), 112 filtering runs were needed to cover every possible combination of contextual factors. In the 'inspiration' analysis, as just two contextual factors were included (market structure and climate), fewer filtering runs were required (32) to cover every possible combination of contextual factors.

Four groups of countries were identified in the 'adaptation' analysis, as shown in table four. (Table 4)

The groups listed above are only those where at least one country in the group has implemented at least one DSM policy successfully from the data and results of Warren (2015). Thus, other groups of countries were identified but there were no documented successful policies (in high quality policy evaluations) to transfer. All 30 countries appeared during the 112 sets of filtering runs, which helped to verify that the tool was set up correctly. The exclusion of the regulatory and cultural contextual factors explains why certain groups of countries are produced that are culturally, economically or politically different (such as groups 2 and 4). Thus, it is important to reiterate that at this level of policy transfer, ideas on policy design, implementation, evaluation,

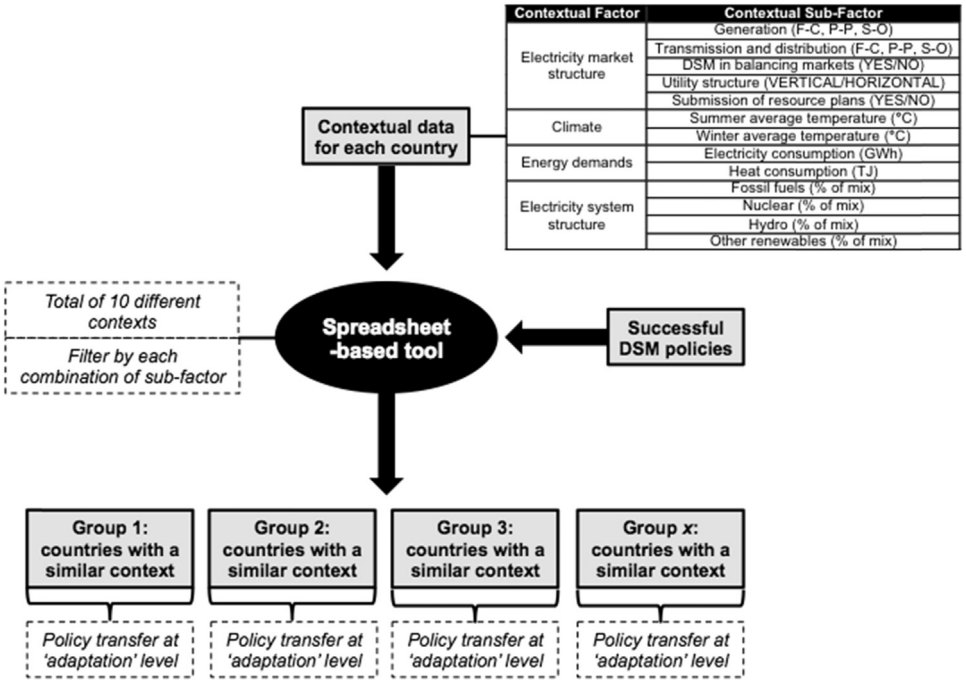

Fig. 4. *Policy Transferability Framework*: methodological approach.

Table 3
The ten different contexts used in the transferability analysis.

Context	Definition	Details
Mild Summer Climate	10.1–20.0 °C	Characteristic of temperate regions
Mild Winter Climate	≥10.0–30.0 °C	Characteristic of temperate, arid and tropical regions
Hot Summer Climate	20.1–30.0 °C	Characteristic of arid, tropical and continental regions
Cold Winter Climate	< 10.0 °C	Characteristic of polar, temperate and continental regions
High Renewables	≥20% renewables	Influence of EU 2020 targets; applies to 'Other Renewables'
Low Renewables	< 20% renewables	Influence of EU 2020 targets; applies to 'Other Renewables'
High Electricity Consumption	≥599,915 GWh	Average electricity consumption in sample
Low Electricity Consumption	< 599,915 GWh	Average electricity consumption in sample
High Heat Consumption	≥430,448 TJ	Average heat consumption in sample
Low Heat Consumption	< 430,448 TJ	Average heat consumption in sample

legislation and regulatory frameworks are taken from one or more countries but then adapted to the local conditions of the country in question.

Seven groups of countries and states were identified in the 'inspiration' analysis, as shown in table five. (Table 5)

As expected, including less contextual detail increases the number of countries/states where potential policy transferability is possible, but at a lower level of transfer. 'Inspiration' refers to gaining inspiration from other countries/states rather than directly copying policies or transferring specific aspects such as policy design, implementation, evaluation, legislation or regulatory frameworks.

Tables four and five also highlight non-transferability, as countries/states excluded from any of the groups in either of the two analyses show limited potential for transferability with the countries/states shown in the groups. One of the useful applications of the research findings in this regard is the identification of which countries/states governments should focus their limited resources on observing (for a given level of policy transfer).

Table 4
Policy transfer between countries at the 'adaptation' level.

Group 1	Successful DSM Policies		Key	DSM Policy
Japan	UO		IPBDR	Incentive payment-based demand response
USA	IPBDR; PBDR; UO; PS; L&S; UBM; R&D; UBM/MT; IC/L&S		PBDR	Price-based demand response
USA (state-level)	IPBDR; PBDR; UO; PS; L&S; UBM; R&D; UBM/MT; IC/L&S		MT	Market transformations
			IR	Infrastructure rollouts
Group 2	**Successful DSM Policies**		UO	Utility obligations
Australia	IR; PS		LB	Labelling
Philippines	PS/LB/IC		PS	Performance standards
			L&S	Loans and subsidies
Group 3	**Successful DSM Policies**		UBM	Utility business models
Belgium			R&D	Research & development
Germany	IC; IC/L&S		IC	Information campaigns
New Zealand			VP	Voluntary programmes
Sweden	MT		/	Policy package
UK	IPBDR; PBDR; IR; UO; PS; L&S; UBM; R&D; IC			
Group 4	**Successful DSM Policies**			
Croatia				
South Korea	IC			

The paper focuses the discussion on the results of the 'adaptation' analysis, as it is a higher level of policy transfer and may prove more useful to policy makers and researchers than the results of the 'inspiration' analysis.

For group one, the results show that a large number of the DSM policies included in the research could be transferred from the USA to Japan: incentive payment-based demand response (IPBDR – e.g. interruptible/curtailment programmes), price-based demand response (PBDR – e.g. critical peak pricing tariffs), performance standards (PS – e.g. appliance standards), loans and subsidies (L&S – e.g. grants), utility business models (UBM – e.g. decoupling policies), research and development programmes (R&D – large-scale), and the policy packages of UBM/MT (utility business models with market transformations – e.g. decoupling policies with programmes to reduce energy efficiency market barriers) and IC/L&S (information campaigns with loans and subsidies – e.g. consumer awareness campaigns with low-interest loans). As both countries have experienced success with utility obligations, the main policy implication from the results is to continue the policy.

The literature review also highlighted Japan's success with performance standards, particularly through its *Top Runner* programme, which aims to improve the energy efficiency of products on the market. 'Top Runners' (the most energy efficient products on the market during the standard-setting process) set the standards (Kimura, 2010). However, as no high-quality evaluations of the programme were identified in the systematic review, the findings would not be captured in the policy transferability tool. Overall, due to differences in culture and regulatory structure between the USA and Japan, policy transfer at the level of 'direct copying' should not be undertaken. However, taking aspects of DSM policy design, implementation and regulation in the USA and adapting them to the local conditions in Japan is more appropriate.

It is also apparent that what has been introduced widely at a state-level in the USA could be introduced at the national level and vice versa. In the research, 'state-level' for the USA refers to high quality evaluations of similar policies implemented independently across a large number of states (though not at the national-level), and where evaluations did not specifically identify particular states that were under examination (only the number of states that had implemented the policy). It is clear from the systematic review that it is more appropriate for certain DSM policies to be implemented at certain levels, particularly in the USA where states have greater power than their equivalents in other countries. For example, policies for performance standards (PS), labelling (LB) and market transformations (MT) would be more appropriate at a national level than at a state-level in order to ensure that there is standardisation in the manufacturing processes, compliance procedures and the development of markets across the country. Furthermore, tax incentives would arguably be more appropriate at the national level for administrative and accounting reasons.

In contrast, as the evidence shows, introducing alternative utility business models (UBM) such as decoupling policies, providing subsidies for energy efficiency technologies (L&S), undertaking information campaigns (IC) and utility obligations (UO) are likely to be implemented more effectively (practically and in terms of resources) at a state-level in the USA than at the national level. For example, half of all US states have now successfully implemented decoupling policies (a type of UBM) independently of each other (Natural Resources Defense Council (NRDC), 2013). Due to differing local circumstances and contexts (such as the willingness and structure of utilities, and the willingness and awareness of consumers), introduction at a state-level is arguably more appropriate, as it allows state governments, public commissions and utilities to more effectively adapt the regulations to the local circumstances of utilities and consumers.

Table 5
Policy transfer between countries/states at the 'inspiration' level.

Group 1	Successful DSM Policies
Canada (BC)	
France	PBDR; UO
China	IPBDR; PBDR; LB; PS; L&S; R&D; IC; VP; IC/L&S; PS/LB
China (Jiangsu)	IPBDR/PBDR
Group 2	**Successful DSM Policies**
Canada (Ontario)	
China (Beijing)	IPBDR/PBDR
China (Fujian)	UBM
China (Hebei)	UBM
China (Hefei)	
China (Shandong)	
China (Shanghai)	
China (Sichuan)	
Australia (ACT)	UO
Group 3	**Successful DSM Policies**
USA (Vermont)	PBDR; UO; PS; UBM
Ireland	
Group 4	**Successful DSM Policies**
USA (Wisconsin)	IC/L&S
Croatia	
Pakistan	
South Korea	IC
Group 5	**Successful DSM Policies**
USA	IPBDR; PBDR; UO; PS; L&S; UBM; R&D; UBM/MT; IC/L&S
USA (ISO-NE region)	IPBDR/PBDR
USA (Maine)	
USA (New Hampshire)	
USA (PJM region)	PBDR; IPBDR/PBDR
Belgium	
Belgium (Flanders)	UO
Denmark	UO; LB; PS; L&S; R&D; IC; VP
European Union (EU)	UO; PS
Germany	IC; IC/L&S
Sweden	MT
UK	IPBDR; PBDR; IR; UO; PS; L&S; UBM; R&D; IC
Group 6	**Successful DSM Policies**
USA (Connecticut)	
USA (Illinois)	IC/L&S
USA (Massachusetts)	UBM/MT; IC/L&S
USA (Michigan)	
USA (New York)	IPBDR; L&S; UBM/MT
USA (NYISO region)	IPBDR/PBDR
USA (Ohio)	UBM
USA (Oregon)	
USA (Pacific Northwest)	UBM/MT; PS/IC
USA (Texas)	
Spain	IPBDR
Japan	UO
Australia (SA)	UO
Australia (Victoria)	UO
Group 7	**Successful DSM Policies**
USA (California)	IPBDR; PBDR; MT; IR; PS; L&S; UBM; R&D; IC; UBM/MT
Netherlands	

The same argument applies to loans and subsidies (L & S) and information campaigns (IC), particularly in relation to consumer engagement. For example, a marketing campaign that comes from a familiar, local source inside a community is likely to have a bigger impact than a large national institution or national utility (e.g. Wüstenhagen et al., 2007 – in relation to renewable energy). For utility obligations, the historical experiences of state governments and public utilities commissions have been effective at setting energy efficiency targets for utilities, which are met by the utilities investing in energy efficiency measures in their customer base (costs can usually be recovered through consumer energy bills). Unlike countries in Europe, where national level utility obligations are arguably more appropriate, state-level obligations should continue in the USA.

There are some policies that appear to work well at a regional (multi-state) level in the USA. For example, the evidence shows that by giving the Independent System Operators (ISOs) the authority (through supporting regulation and legislation) to develop incentive payment-based demand response (IPBDR) and price-based demand response (PBDR) (as is currently done), the contribution of the demand-side can play a greater role in balancing, reserve or capacity markets. ISOs, such as PJM, ISO-NE, MISO, NYISO and CAISO operate across US states at a regional level. This draws parallels to voluntary agreements, particularly those related to peak load reductions, as the contracts are drawn up by the ISOs directly with large consumers. Other types of DSM policy, such as infrastructure rollouts (IR), (large-scale) research and development programmes (R & D) and some types of voluntary programmes (VP), appear to transcend levels in terms of implementation and performance, and the evaluations in the systematic review gave examples of where they have been successfully introduced at both national- and state-level.

For group two, three policies are transferable between Australia and the Philippines: infrastructure rollouts (IR), performance standards (PS) and the policy package of PS/LB/IC (performance standards with labelling and information campaigns). Here, policies refer to the national level and the two countries share contextual factors that are similar enough for potential policy transfer at the level of 'adaptation'. As argued in relation to the example of the USA and Japan, the culture and regulatory structure of Australia and the Philippines are different, so policy transfer at the level of 'direct copying' is inappropriate. From the data and results in Warren (2015), both countries have experienced success with performance standards (PS), but the addition of labelling (LB) and information campaigns (IC) in the Philippines (to highlight the improved energy efficiency performance of products) has increased their impact on consumers. The main policy implication is that this policy package (PS/LB/IC) should be considered in Australia. Similarly, Australia's experiences with advanced meters could be transferred to the Philippines.

For group three, the transferability potential at the level of 'adaptation' is greatest. The group consists of Belgium, Germany, New Zealand, Sweden and the UK. The UK, Sweden and Germany have experienced success with various DSM policies. From the high quality policy evaluations in the systematic review, the UK has experienced success with nine broad types of DSM policy: incentive payment-based demand response (IPBDR), price-based demand response (PBDR), infrastructure rollouts (IR), utility obligations (UO), performance standards (PS), loans and subsidies (L & S), (alternative) utility business models (UBM), (large-scale) research and development programmes (R & D) and information campaigns (IC). Germany has experienced success with two policies: information campaigns (IC) and the IC/L & S (information campaigns with loans and subsidies) policy package. Sweden has experienced success with market transformations (MT). Belgium and New Zealand have not experienced success with DSM policies as documented in high quality policy evaluations, but their contextual factors are similar enough to the other countries in the group at the level of 'adaptation' to warrant potential policy transferability. Furthermore, the UK could learn from Sweden's experiences with market transformations (MT) and Germany's experiences with the IC/L & S (information campaigns with loans and subsidies) policy package, and all of the countries in the group could learn from the UK's successful experiences with the diverse range of DSM policies listed in table four.

For group four, only one successful policy (documented in a high quality policy evaluation) is produced, which is South Korea's successful experiences with information campaigns (IC). There is potential for the policy to be transferred to Croatia at the policy transfer level of 'adaptation'. It is also possible that the transferability potential is greater if contextual data and high-quality policy evaluations for a number of Croatia's neighbouring countries in the Balkan region could be obtained. This is an area for further research. The practical construction of the *Policy Transferability Framework* (figure three) is designed as a spreadsheet-based tool where data can easily be added for new countries/states and the filtering process re-applied. Furthermore, if data on regulatory structure and cultural familiarity can be obtained, the policy transfer level of 'direct copying' can be analysed, which is an important area for further research.

In summary, the number of new countries where various DSM

policies can be transferred at the level of 'adaptation' is listed below (ranked 1–4). OF refers to the current overall frequency of the policy in the group and PP refers to a policy package.

- 1. *Performance standards:* to 6 new countries (OF = 4)
- 2. *Incentive payment-based demand response*: to 5 new countries (OF = 3)
- 2. *Price-based demand response:* to 5 new countries (OF = 3)
- 2. *Loans and subsidies:* to 5 new countries (OF = 3)
- 2. *Utility business models:* to 5 new countries (OF = 3)
- 2. *Research and development programmes*: to 5 new countries (OF = 3)
- 2. *Information Campaigns/Loans & Subsidies PP*: to 5 new countries (OF = 3)
- 2. *Infrastructure rollouts:* to 5 new countries (OF = 2)
- 3. *Utility obligations:* to 4 new countries/states (OF = 4)
- 3. *Information campaigns:* to 4 new countries (OF = 3)
- 3. *Market transformations:* to 4 new countries (OF = 1)
- 4. Utility business models/Market transformations PP: to 1 new country (OF = 2)
- 4. Performance standards/Labelling/Information campaigns PP: to 1 new country (OF = 1)

The Multi-Criteria Decision-Making (MCDM) analysis with 17 DSM experts validated the importance of the six contextual factors identified in the literature review and the systematic review, as shown in table six. The table provides an overall aggregated (unweighted) ranking across the interviews and also provides the combined frequency of discussion of the sub-factors contained within each of the six factor categories (see table one for a list of sub-factors). As such, the frequency can extend beyond 17 as the frequency of each sub-factor (e.g. electricity market structure) is aggregated into their relevant factor categories (e.g. market structure, as per table one) to provide richer detail beyond the broader transferability categories listed in table six. (Table 6)

As discussed in section three, experts were asked to list the factors that they judged to be important in affecting the transferability of DSM policies between countries and then to rank them. Factors were determined inductively and the experts were not provided with a pre-defined list of factors. In table six, 'Overall aggregated ranking' refers to the overall ranking once the individual rankings from each of the 17 experts are aggregated, and 'Frequency discussed' refers to the total number of times a particular factor category was identified across the sample of 17 experts. To demonstrate the latter, if an expert stated that the electricity market structure and the inclusion of the demand-side in balancing/capacity markets are important considerations, the frequency of discussion for 'market structure' for that interview is two, as both are sub-factors of the market structure factor category.

The factors also matched the breakdown of the three levels of policy transfer with the exception of climate, which, despite being identified as one of the six most important contextual factors, was ranked joint-fifth out of those factors, which is in contrast to the findings from the literature review and the systematic review, which place a greater emphasis on its influence. To explore the importance of climate in more depth, further research should adopt a third, different methodological approach, such as in-depth country case analyses (to explore the relationship between energy policy and climate) or surveys. Despite this, the MCDM analysis has identified the necessity of market structure, regulatory structure and cultural familiarity as crucial components of the 'direct copying' level of policy transfer. This level was not analysed in this research due to data availability, particularly on cultural familiarity (which represents the importance of behavioural factors), as discussed in section three.

It is also important to note that the MCDM analysis included experts from just two out of the 30 countries examined. This was primarily due to practical reasons and resource constraints when organising interviews. As a result, this provides further justification for future research to valid the findings of the tool using a third, different methodological approach.

Table 6
Validation of the *Policy Transferability Framework* tool using MCDM analysis.

Factor discussed	Overall aggregated ranking	Frequency discussed
Market structure	1	29
Regulatory structure	2	20
Cultural familiarity	3	8
Energy system	4	7
Climate	5	3
Energy demands	5	3

5. Conclusion and policy implications

The development of methods to determine the transferability of policies between countries has received limited attention in the energy policy field. Previous research has focussed on theoretical and more qualitative discussions of energy policy transferability, rather than providing practical frameworks and tools to determine applicability. This paper aimed to contribute to filling this methodological gap by developing and testing a proposed method, the *Policy Transferability Framework*, in the field of demand-side management (DSM) policy in order to answer the following research question: *What factors influence the transferability of successful DSM policies between countries, and how transferable are such policies?*

The research used the data and results from another study (Warren, 2015) that identified successful DSM policies in 30 countries and 36 sub-national states from a systematic review of 690 high quality DSM policy evaluations. From a literature review, this paper identified key categories of contextual factors that influence the transferability of DSM (and wider energy) policies between countries/states: market structure, climate, regulatory structure, cultural familiarity, system structure and energy demands. The literature review particularly highlighted the importance of market structure and this was validated using the spreadsheet-based policy transferability tool that was developed for the analyses.

The premise of the *Policy Transferability Framework* is that the more detail that is included on the specific context of countries/states, the higher the level of policy transfer that is possible between similar countries/states. The three proposed levels are: 'direct copying' (required data: market structure, climate, system structure, energy demands, regulatory structure and cultural familiarity), 'adaptation' (required data: market structure, climate, system structure and energy demands), and 'inspiration' (required data: market structure and climate). Due to the lack of required data available for all countries/states in the analyses on regulatory structure and cultural familiarity, the paper focused on the policy transfer levels of 'adaptation' and 'inspiration'.

The 'adaptation' analysis produced four groups of countries (excluding sub-national states) where various DSM policies could be transferred at this level, and the 'inspiration' analysis produced seven groups of countries (including sub-national states) where policies could be transferred at this level. Twelve broad types of DSM policy were included in the analyses. The specific results for both analyses ('adaptation' and 'inspiration') are summarised in tables four and five in section four respectively. The results provide an efficient avenue for policy makers and researchers to focus their constrained resources in identifying specific countries/states and successful DSM policy experiences that are applicable to their country/state of focus, and at what level of policy transfer such experiences are appropriate to consider.

Although the paper contributes to filling a much methodologically under-developed area, there remain research gaps that further work should seek to fill. Firstly, obtaining data on regulatory structure and

cultural familiarity would allow the policy transfer level of 'direct copying' to be tested. Where the data do not exist, efforts should be made to fill these data gaps (for example, through regulatory reviews and national consumer surveys). Similarly, the number of countries and sub-national states that are included in the tool could be increased by seeking relevant contextual data from additional countries/states. Secondly, the application of the *Policy Transferability Framework* to other aspects of energy policy, such as supply-side management or renewable energy policy, should be tested using the same methodological process. Thirdly, alternative methods for analysing energy policy transferability should be developed to allow the cross-comparison and validation of the results. Despite this, this research developed and utilised a simplified form of Multi-Criteria Decision-Making (MCDM) analysis with 17 DSM experts to validate the framework's breakdown of contextual factors for different levels of policy transfer.

Overall, the paper argues that context is key and the level of contextual detail included in methods to analyse energy policy transferability will affect the level of policy transfer that is appropriate. As such, the policy implications of the research revolve around government officials and policy researchers using the *Policy Transferability Framework* to determine what countries/states to emulate and at what levels of policy transfer for given DSM policies. Under the time and resource constraints of governments, the methodological approach enables officials to target countries, as well as to acknowledge where successful experiences in some countries/states may not be transferable at certain levels of policy transfer due to contextual factors being too dissimilar.

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References

Albadi, El-Saadany, 2008. A summary of demand response in electricity markets. Electr. Power Syst. Res. 78, 1989–1996.
Bennett, C.J., 1991a. How states utilize foreign evidence. J. Public Policy 11, 31–54.
Bennett, C.J., 1991b. What is policy convergence and what cause it? Br. J. Political Sci. 21, 215–233.
Bundgaard, S.S., Togeby, M., Dyhr-Mikkelsen, K., Sommer, T., Kajaerbye, V.H., Larsen, A.E. (2013b) "Spending to save: evaluation of the energy efficiency obligation in Denmark", In: Proceedings of the ECEEE Summer Study 2013, European Council for an Energy-Efficient Economy (ECEEE).
Dastan, S.A., 2011. Analysing success of regulatory policy transfers: evidence from Turkish energy markets. Energy Policy 39 (12), 8116–8124.
Davito, B., Tai, H., Uhlaner, R. (2010), *T*he Smart Grid and the Promise of Demand-Side Management, Report, McKinsey and Co.
Dolowitz, D., Marsh, D., 1996. Who learns from whom: a review of the policy transfer literature. Political Stud. XLIV, 343–357.
Eissa, M.M., 2011. Demand side management program evaluation based on industrial and commercial field data. Energy Policy 39, 5961–5969.
Eyre, N., Pavan, M., Bodineau, L. (2009) Energy company obligations to save energy in Italy, the UK and France: what have we learnt?, In: Proceedings of the ECEEE Summer Study, European Council for an Energy-Efficient Economy (ECEEE).
IEA DSM Programme (2012) Best practices in designing and implementing energy efficiency obligation schemes, Research report prepared by the Regulatory Assistance Project (RAP), Task XXII of the IEA DSM Programme, June 2012.
International Energy Agency (IEA), 2011a. Country Statistics, can be downloaded from: ⟨http://www.iea.org/statistics/⟩.
International Energy Agency (IEA), 2011b. Energy Policies of IEA Countries Reviews, can be downloaded from: ⟨http://www.iea.org/publications/countryreviews/⟩.
International Energy Agency (IEA), 2014. Energy efficiency, website article can be downloaded from: ⟨http://www.iea.org/topics/energyefficiency/⟩.
Joskow, P.L., 2008. Lessons learned from electricity market liberalisation. Energy J. 10, 9–42.
Kimura, O. (2010) Japanese Top Runner approach for energy efficiency standards, SERC Discussion Paper, SERC09035, Central Research Institute of Electric Power Industry.
Liu, H., Liang, X., 2011. Strategy for promoting low-carbon technology transfer to developing countries: the case of CCS. Energy Policy 39 (6), 3106–3116.
McConnell, A., 2010. Policy success, policy failure and grey areas in-between. J. Public Policy 30, 345–362.
Natural Resources Defense Council (NRDC), 2013. Decoupling Across the United States, Map, August 2013, can be downloaded from: ⟨http://www.nrdc.org/energy/decoupling⟩.
Newmark, A.J., 2002. An integrated approach to policy transfer and diffusion. Rev. Policy Res. 19 (2), 153.
Ockwell, D.G., Watson, J., MacKerron, G., Pal, P., Yamin, F., 2008. Key policy considerations for facilitating low carbon technology transfer to developing countries. Energy Policy 36 (11), 4104–4115.
Radaelli, C.M., 1997. Policy transfer in the European Union: institutional isomorphism as a source of legitimacy, *ECSA* – In: Proceedings of the Fifth Biennial International Conference, 29th May – 1st June 1997, Seattle, USA.
Rose, R., 1991. What is lesson-drawing. J. Public Policy 11, 3–30.
Rose, R., 1993. Lesson Drawing in Public Policy: a Guide to Learning Across Time and Space. Chatham House.
Smith, A., 2004. Policy transfer in the development of UK climate policy. Policy Polit. 32 (1), 79–93.
Steinbacher, K., 2015. Drawing lessons when objectives differ? Assessing renewable energy policy transfer from Germany to Morocco. Polit. Gov. 3 (2), 34–50.
Swainson, R., De Loe, R.C., 2011. The importance of context in relation to policy transfer: a case study of environmental water allocation in Australia. Environ. Policy Gov. 21 (1), 58–69.
Talaei, A., Ahadi, M.S., Maghsoudy, S., 2014. Climate friendly technology transfer in the energy sector: a case study of Iran. Energy Policy 64, 349–363.
Titus, E., Michals, J., Hurley, D., Osann, E.R., Waite, S., 2009. Energy efficiency as a resource in the PJM Capacity Market, In: Proceedings of the International Energy Program Evaluation Conference 2009.
US Energy Information Administration (EIA), 2011. Country Reports, can be downloaded from: ⟨http://www.eia.gov/countries/⟩.
Walsh, P.R., Todeva, E., year not stated. Vertical and horizontal integration in the utilities sector: the case of RWE, unpublished paper, University of Surrey, UK.
Warren, P., 2014. A review of demand-side management policy in the UK. Renew. Sustain. Energy Rev. 29, 941–951.
Warren, P., 2015. Demand-side Management Policy: Mechanisms for Success and Failure (Ph.D. Thesis). University College London (UCL), UK.
World Bank (2014) Climate Change Knowledge Portal, 1990-2009 averaged data from the Climate Research Unit, University of East Anglia.
Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: an introduction to the concept. Energy Policy 35 (5), 2683–2691.
Zhang, F., Gallagher, K.S., 2016. Innovation and technology transfer through global value chains: evidence from China's PV industry. Energy Policy 94, 191–203.