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# Does sludge slow down the solar schools scheme? An assessment of administrative burdens preventing climate action in Ireland

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ABSTRACT

The installation of solar photovoltaic panels on school roofs facilitates a clean energy transition and provides opportunities for educating the younger generation about the importance of renewable energy. Grants are available in many countries to facilitate such installations. However, the administrative hassle associated with these grants can be a barrier to uptake as school principals tend to be very busy with everyday tasks. Building on research on administrative burden and sludge, we analyse the administrative procedures of the Solar for Schools programme that launched in 2023 in the Republic of Ireland. To do so we integrate insights from behavioural science about the disproportionate effect of small frictions into the energy transition and conduct one of the first "sludge audits" to inform environmental policy. We show that several procedures in the scheme are well-administered and operate smoothly, such as learning about the programme and obtaining financial approval. However, there is room for improvement. Key frictions include frustrations arising from stringent requirements and the burden of document preparation, which only an analysis through the lens of behavioural science can identify. We provide recommendations for energy policy, emphasizing how copying successful elements, centralising administrative responsibilities, simplifying application requirements, and removing inefficient restrictions may enhance policy uptake and success.

## 1. Introduction

As impacts of the climate crisis continue to be felt across the globe, methods for effective climate mitigation are increasingly being brought to the forefront of the international political landscape (Biermann, 2022). The installation of solar photovoltaic (PV) panels is one mitigation strategy that facilitates a clean energy transition and reduces greenhouse gas emissions in electricity production (Cuce et al., 2016). Educating people and particularly the younger generation is also an important contributor to tackling the climate crisis (Vinichenko et al., 2023). Installing solar PV panels on school roofs presents a unique opportunity to promote renewable energy and, at the same time, cultivate a culture of environmental stewardship and sustainability in the education sector (Mitchell et al., 2015) and expose young people to energy efficient technologies, educate them, and provide them with opportunities to ask questions and have conversations about climate change (Tucker and Izadpanahi, 2017). Moreover, installing solar panels on school roofs promotes the public sector's energy transition. Hence, many governments provide financial support to schools for such investments (Hong et al., 2014).

However, there are barriers to solar panel installation on school roofs.[1] This paper focuses on a barrier that has so far received little attention in this area: "sludge" and administrative burdens that describe the hassle associated with solar panel installations. Consider, for example, a school principal who is very motivated to improve their school's energy efficiency but is also very busy with everyday tasks. It would not be surprising if that same school principal would never manage to get a solar PV panel on the school roof if the required steps

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[1] Some of these barriers are financial (Labordena et al., 2017), others are related to the infrastructure (Ansari et al., 2013), others are related to information costs and the cultural attitudes towards change (Luthra et al., 2015). Again, other barriers to pro-environmental investments are related to psychological factors (de Vries et al., 2019).

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are not clear, too burdensome, chances of successfully receiving grants are uncertain, the paperwork is complicated, and the whole process is stressful and frustrating.

We build on work in public administration and behavioural public policy that has started to investigate hassles and other related frictions under the terms "administrative burdens" and "sludge". Our approach builds on the behavioural insight that psychological factors such as present bias and limited attention can turn seemingly small frictions into impactful barriers (Thaler, 2015). Public administration research investigates the origins and consequences of administrative burdens, defined as the subjective experience of policy implementation as onerous (Burden et al., 2012) or as the costs that people experience when they interact with government policies (Moynihan et al., 2015). This research has focused mainly on the role of administrative burden in the context of health and social benefit schemes (Halling and Bækgaard, 2023). However, only few studies have considered the role of administrative burden in the context of energy behaviour, and these studies do not systematically measure the role of burdens in a specific process (Lades et al., 2021; Mogensen and Thøgersen, 2024; Simes et al., 2023). Our paper closes this research gap. In parallel, research in behavioural public policy has begun investigating the closely related concept of "sludge", defined as "unnecessary frictions that make it harder for people to do what they want" (Sunstein, 2021). Research on sludge in the environmental sector is only beginning (Grieder et al., 2024; Lentz et al., 2026; Shreedhar et al., 2024), and we are not aware of academic work that systematically assesses sludge in the context of an energy programme or policy.[2]

Since administrative processes can differ across contexts and countries, we use an inductive approach and focus on one case study to derive more general learning from this. This case study is Phase I of the Republic of Ireland's Solar for Schools programme that launched in 2023 and aimed to reduce energy costs and carbon emissions by installing solar PV panels in the nearly 4000 schools in Ireland. The objective of our research is to conduct a "sludge audit" (Sunstein, 2022) of Ireland's Solar for Schools programme to identify potential for sludge reduction and generate insights for sludge reduction policies in other areas. To achieve this, we build on and extend a methodological approach championed by the New South Wales Behavioural Insights Unit (NSW Behavioural Insights Unit, 2024) to identify sludge, relying on journey mapping, "sludge scales", and the analysis of qualitative interviews. This approach allows us to quantify the overall "sludginess" of the scheme and to recommend the most promising areas and ways for simplification and sludge reduction. Our approach adds to the literature by presenting a novel and systematic way to analyse sludge and by applying this approach to assess a national energy policy. Therefore, this study contributes both to the evidence base on energy policy implementation by being one of the first studies to assess the role of sludge, and to the methodological literature on sludge and administrative burden measurement by proposing a novel sludge audit method.

The remainder of the paper is structured as follows. Section 2 describes the background to the case study. It presents an overview of the literature on sludge and administrative burdens and situates the case study in the policy context in Ireland. Section 3 explains the methodological approach of our sludge audit, which includes journey mapping, qualitative interviews, and objective data provided by stakeholders (e.g. data from helplines). Section 4 summarises the results of the sludge audit, showing the final behavioural journey map, the level of sludge at each step of this journey, and a more qualitative assessment of the type of sludge people experience. Section 5 discusses our methodology and presents policy recommendations. The last section concludes.

[2] However, the OECD (2024) Fixing Frictions report indicates that a sludge audit of homeowners' experiences with the application for sustainable house retrofits was conducted in the Netherlands. In the OECD report, only limited information is provided.

## 2. Background

### 2.1. Administrative burden

Administrative burdens, defined as "an individual's experience of policy implementation as onerous" (Burden et al., 2012, p. 741), can have detrimental effects on people's lives by making it harder for them to learn about, take up, or comply with government policies (Halling and Bækgaard, 2023; Herd and Moynihan, 2019; Moynihan et al., 2015). Administrative burdens can take various forms, from excessive paperwork hassles and complex or lengthy processes to stressful or frustrating interactions with bureaucracy. These burdens not only reduce policy uptake and policy implementation effectiveness, they also have distributive effects that can increase societal inequalities (Christensen et al., 2020; Halling and Bækgaard, 2023; Herd et al., 2023). For example, Christensen et al. (2020) argue that people with lower human capital (e.g., less education, fewer cognitive resources, poorer health) face greater difficulty managing burdensome procedures and, at the same time, are more likely to need public assistance. As a result, those people most needing help are least equipped to navigate administrative requirements, which they describe as a Catch 22. In recent years, there has been growing interest in administrative burdens both in academic research (Pandey, 2023) and in policy work (e.g., NSW Behavioural Insights Unit, 2024; OECD, 2024; OIRA, 2024). However, most work on administrative burden focuses on social and public services such as health, educational, and welfare programmes (Halling and Bækgaard, 2023), which is likely due to the origin of the work in the public administration literature.

### 2.2. Sludge

A closely related concept to administrative burdens is that of sludge, which is used in behavioural public policy to refer to any excessive or unnecessary behavioural frictions that make it harder for people to do what they originally set out to do (Sunstein, 2021; Thaler, 2018). The concept of sludge is wider than that of administrative burden. Sludge is not restricted to government interactions, as the private sector relies on sludge as well to change people's behaviour (for example, a hard-to-cancel subscription plan relies on sludge to retain customers). Moreover, the concept of sludge is closely linked to "nudging" (Mills, 2023) and to behavioural economic insights highlighting that people are not perfectly rational and that small and "supposedly irrelevant factors" (Shahab and Lades, 2024; Thaler, 2015), such as frictions, can have large behavioural effects (Lades et al., 2021). Rather than nudging people towards more desirable or sustainable choices, sludge is typically to the detriment of people's preferences or best interests. Researchers have recently begun to analyse sludge in environmental policymaking (Grieder et al., 2024; Lentz et al., 2026; Shreedhar et al., 2024).

To identify sludge, Sunstein (2022) suggests using "sludge audits" which can help to identify and gauge the baseline presence of sludge and administrative burdens within a policy or a scheme (NSW Behavioural Insights Unit, 2024; OECD, 2024). These audits reveal the magnitude of sludge in a process. Sludge audits usually begin with a user mapping journey (NSW Behavioural Insights Unit, 2024; Shahab and Lades, 2024). Such user journeys map the required steps that a user must complete when interacting with a policy or a scheme. This includes decision making steps, user behaviours, forms of communication, and various other steps. Shahab and Lades (2024) recommend dividing up the journey map into certain 'required actions', where each action is associated with a specific decision or a behaviour. Auditors should separate complex processes into smaller subprocesses, allowing for more attention to detail to produce specific interventions. The second main step of a typical sludge audit is to assess the "sludginess" of each step using a variety of data sources such as qualitative interviews and objective data. Sludge audits can be used to determine if individual steps that are often perceived as small, or 'micro' behaviours, are experienced

as heavily burdensome in reality (NSW Behavioural Insights Unit, 2024).

Researchers have defined sludge as aspects of the choice architecture that can lead to different types of costs (Shahab and Lades, 2024). This allows categorising different types of sludge as leading to: *search costs* that arise when people must find information; *evaluation costs* that result from frictions that make it harder to make a decision; *implementation costs* that result from frictions that make it harder for people to implement the decisions they have previously made; and *psychological costs* that create negative experiences for people.[3] Additionally, *time* and *monetary costs* can emerge from aspects of the choice architecture (Lentz et al., 2026). Relying on cost typologies helps when running sludge audits as the relative abstract concept of sludge is translated into more identifiable cost-components. Moreover, cost typologies show how ostensibly different types of frictions across different areas are actually manifestations of a similar concept. Finally, cost typologies allow to capture the variations of user experiences with administrative frictions with both objective and subjective scales (Madsen et al., 2022). Sludge is particularly costly when a process is *infrequent* so that users do not have the opportunity to learn navigating through the administrative processes, *uncertain* so that users do not know whether their action will lead to the outcomes they expect, and *unspecific* so that expertise in this process is irrelevant for other processes (Shahab and Lades, 2024).

### 2.3. Ireland's Solar for Schools programme

The Government of Ireland is committed to a swift transition to sustainable energy. Solar PV panels on roofs are part of this agenda.[4] In 2022, solar energy production accounted for 1.1% of Ireland's overall renewable electricity, which demonstrated a 28.4% increase from the year prior (SEAI, 2024). The 2024 Climate Action Plan outlines national targets of 8 GW of installation of solar photovoltaic (PV) panels by 2030. Policies to support this include grant schemes and educational campaigns (Government of Ireland, 2023b). In November 2023, the Republic of Ireland's Department of Education launched Phase I of the Solar for Schools programme (Department of Education and Youth, 2024). The first call for applications opened for 1600 schools within 11 designated areas across Ireland, who received invitations to apply for the funding programme directly from the Department of Education.[5] Primary and secondary schools could apply for funding to install up to 6 kW (approximately 16 panels) of solar PV, saving each school around €1200-1600 per year in electricity costs.[6]

Administrative hassles related to solar PV panels on school roofs had been discussed in Ireland prior to the launch of the Solar for Schools programme. For example, the NGO Friends of the Earth Ireland highlighted in 2019 that there were extensive unnecessary frictions that made it hard for schools to apply for solar PV grants (Friends of the Earth, 2019). This analysis revealed that burdens were present throughout the scheme, but in particular in the implementation phase. Maybe due to these discussions and the early awareness of administrative barriers, there was a significant political effort to eliminate planning permission requirements for installing solar PV systems in schools (Friends of the Earth, 2022). This change has since been successfully approved (Department of Housing, Local Government and Heritage, 2022). Given the prior attention to administrative hassles, one might expect that administrative burdens and sludge should not be a significant barrier to school roof solar PV installations, and that future processes can learn from this approach.

## 3. Sludge audit methodology

This section summarises the four components of the sludge audit, detailed in subsections 3.1. to 3.4. First, we start with a behavioural journey map (subsection 3.1) of the application process to illustrate the typical steps involved in participating in Ireland's Solar for Schools programme. This journey map is both informed by and informs the semi-structured interviews discussed in subsection 3.4. The insights from these interviews also contribute to a sludge quantification, which measures the extent of sludge at each step of the application process (subsection 3.2). Finally, insights from the stakeholder interviews and sludge quantification are used to develop a more holistic evaluation of the application journey, acquired through qualitative analysis, detailed in subsection 3.4. The overall structure of this analysis is summarized in Fig. 1. We applied this methodology for another sludge audit as well in the context of Ireland's Afforestation Plan (Lentz et al., 2026).

### 3.1. Behavioural journey mapping

First, as suggested by existing literature on measuring and quantifying sludge (NSW Behavioural Insights Unit, 2024; OECD, 2024; Shahab and Lades, 2024), we start with a scoping phase to develop an initial map of the behavioural journey that leads to the successful installation of a solar PV panel on school roofs. We distinguish between several broader stages in this journey and subdivide each stage into more specific steps. We rely on "cognitive walk-through" exercises where we experience the process as if we were regular applicants (for example, creating an online profile and going through the form-filling process). We also review FAQs and guidance documents accessible online that describe the process school principals must go through from start to finish when applying for the government grant and installing the solar PV panels on their school's roofs. We then present this journey map to relevant stakeholders as the first part of the qualitative interviews (see subsection 3.4) to ask for improvements and back up the accuracy of the journey map. The final decision journey is presented in section 4.1.

### 3.2. Sludge quantification and sludge costs

Second, we quantify the extent of sludge present at each step of the behavioural journey. For this assessment, we rely on the New South Wales Behavioural Insights Unit's Sludge Scales which are part of their Sludge Finder toolkit (NSW Behavioural Insights Unit, 2024). We use this toolkit to review the applicant experience in each step of the journey map, where we assign a single rating to each step on a scale of 1 (very easy) to 5 (very difficult), using the sludge scale criteria in the sludge finder tool. These criteria are based on behavioural science and user-centred design best practices and examine different aspects of the user experience, such as language, content, design, and navigation, with suggested ratings tied to descriptive benchmarks. Sludge scales are provided for a very large number of specific behaviours. For example, instructions in emails are evaluated depending on whether the email clearly explains what the customer should do. The sludge scales suggest an assessment of "easy" if the email includes clear step-by-step

[3] The cost typology by Shahab and Lades (2024) was inspired by economic research on transaction costs and the behavioural science literature. In parallel, administrative burden theory classifies people's experiences of burdens when trying to access government services into three types of costs (Moynihan et al., 2015). People experience *learning costs*, for example when they seek information about a policy or service. They experience *compliance costs* when they have to spend time and effort to meet the requirements of a policy (for example, gathering eligibility paperwork). Finally, people experience *psychological costs* when interacting with a policy or government system causes them to feel stressed, disempowered, or stigmatised (Moynihan et al., 2015).

[4] In case of doubt, there is indeed enough sun in Ireland for solar PVs to be efficient (Ryan et al., 2023).

[5] In October 2024, the Department of Education announced that 1100 of those schools received approval for solar PV installations and Phase I was deemed a success. The Solar for Schools programme was then extended to all schools nationwide (ca. 3962) for Phase II of the programme (Department of Education and Youth, 2024).

[6] Furthermore, the VAT rate for solar panel installation in schools was reduced to zero in Budget (2024); Government of Ireland (2023a).

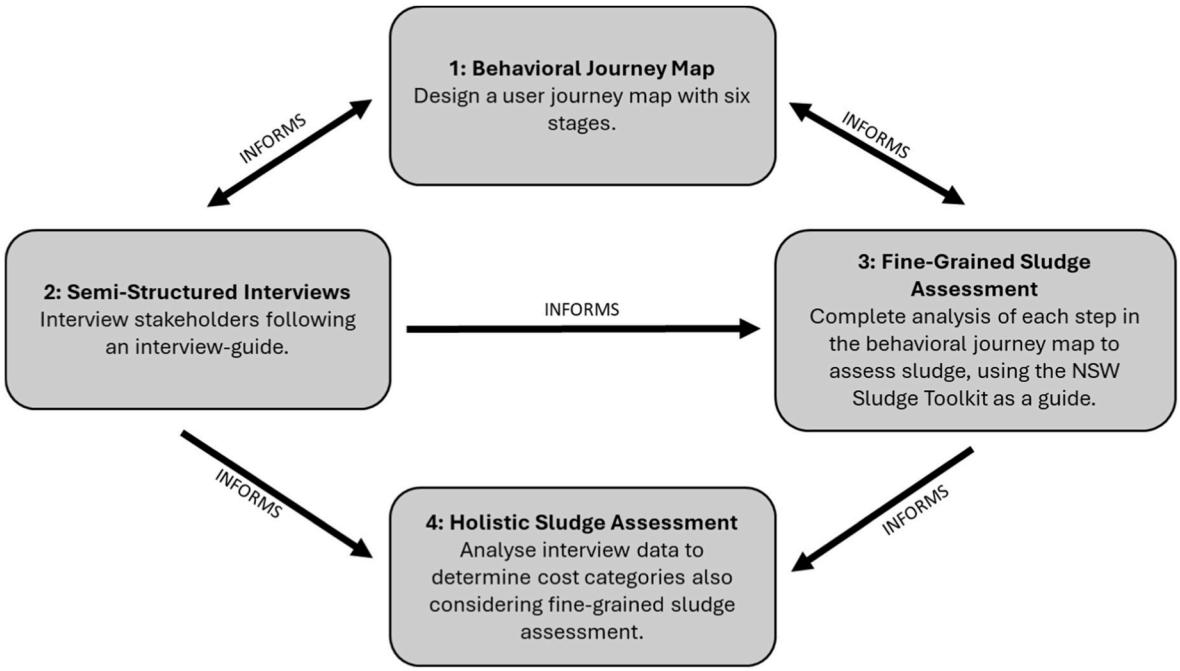


**Fig. 1.** Overview of the methodology used in the sludge audit.

instructions and includes a diagram to explain the process, of "somewhat easy" if the email includes clear step-by-step instructions but no diagram, of "somewhat difficult" if the email includes step-by-step instructions that are somewhat unclear or include more than one action, of "difficult" if the email includes listed instructions that are either unclear, hard to find, or not presented in a logical order, and "very difficult" if either there are no instructions in the email, or they are very hard to find.

To determine the sludge scores in our audits, one author drafted the ratings for each step along with accompanying justifications. The remaining authors then reviewed these scores, proposed revisions where appropriate, and discussed each contested rating until consensus was reached. While relying on the NSW sludge scales increases the objectivity of sludge audits, the resulting scores necessarily reflect the informed judgment of the auditors (in this case, the authors of this paper). Our professional background in environmental policy research implies familiarity with the Irish environmental policy context and an interest in efficient environmental policy design. However, we have no specific stake in the solar school scheme that could have biased our assessments.

Going beyond the sludge audits conducted using the NSW methodology, we categorise the sludge in each step into cost categories. We indicate whether the sludge at each step leads to time costs, search costs, evaluation costs, implementation costs, or psychological costs using the typology developed by Shahab and Lades (2024). In doing so, we build on what has thus far remained a mainly theoretical literature highlighting the potential costs dimensions of sludge (Shahab and Lades, 2024) and on the administrative burden literature, which highlights costs dimensions but uses dimensions that are mainly tailored to needs-based welfare programmes (e.g., Moynihan et al., 2015). This is presented in a sludge assessment table in the Supplementary Information section of this paper. The results of the sludge quantification are presented in section 4.2.

### 3.3. Qualitative assessment of sludge

Third, we analyse the qualitative data collected from the semi-structured interviews with stakeholders. A thematic analysis of these interviews with key stakeholders allows us to understand interviewees' subjective experiences of the sludge during the journey, and to identify common experiences and patterns relating to sludge across the user journey that are invisible when exclusively relying on the fine-grained approach (Braun and Clarke, 2006; Vaismoradi et al., 2013). This analytic method allows us to extract the predominant themes frequently highlighted in the interviews. We rely on the different cost categories (search costs, evaluation costs, implementation costs, and psychological costs) and use them as pre-specified themes for the analysis of the qualitative interviews. However, we remained open to additional themes emerging from the data. We code the interviews in NVivo 12 (Wong, 2008). The coding was conducted by one coauthor, and the results were presented to the remaining coauthors who reviewed the codes and provided feedback. To increase reliability, we discussed coding decisions and theme definitions and resolved any disagreements. Moreover, we triangulated findings from the interviews with insights from our reviews of the FAQs, guidance documents, etc. to corroborate patterns visible from the analysis of the interviews.

With the largely qualitative nature of the methodology, we include selected quotes from the interviews to demonstrate the identified themes. The quotes are selected based on their (i) representation of interview insights, (ii) succinctness, and (iii) ability to reflect the data's patterns. As established literature recommends, we use interview quotations to "illustrate findings". The selected quotes are condensed from the raw transcript data to ensure legibility and maintain interviewees' anonymity (Eldh et al., 2020). We illustrate the common themes with quotes in section 4.3.

### 3.4. Semi-structured interviews

We conduct semi-structured interviews with key stakeholders to obtain data for the three steps described above: to (i) improve the accuracy of the behavioural journey map, to (ii) obtain information for the sludge assessment of each step in the process, and to (iii) obtain an overall view on the experience key stakeholders have when interacting with the scheme. As a methodological novelty, the interview structure followed the suggestions by a guide to run interviews to identify sludge (Lades and Martin, 2024). Most other sludge audits do not rely on systematic, in-depth interviews. After introducing the research project, we establish an understanding of the stakeholder's role in the process (e.g.

whether they are a process user or a frontline staff). We then present the behavioural user journey map and invite the stakeholders to make comments and provide clarifying thoughts. Once the interview participant reviews the journey map, we ask associated questions regarding the scope of sludge in the general process, in addition to sludge present in individual stages and steps.

Recruitment for the semi-structured interviews commenced in January 2024. The interviews were conducted on Zoom and recorded with the verbal permission of the participants. Prior to participation, all interviewees had to sign consent forms to participate in the interviews. The recordings were immediately transcribed using Otter transcription software and anonymised to maintain stakeholder anonymity. The interview transcripts functioned as a key source of data for the project.

The potential participants were selected through online research, participation in the Friends of the Earth (FoE) Ireland's Solar Schools pilot project, and identification in previous studies. The audit team contacted 201 stakeholders, including solar panel installers, primary and secondary schools in all 26 counties in the Republic of Ireland, and programme administrators. We interviewed 8 people from the three separate sectors mentioned. Of the 8 interviews conducted, 5 were school principals who participated in the process of applying for the Solar for Schools programme. That our analysis is based on this relatively low sample size is a limitation that we discuss later in section 5. The interviews were approved by University College Dublin Office of Research Ethics (reference number: LS-LR-23-208-Lades).

## 4. Results of the sludge audit

### 4.1. Summary of the journey to a school roof solar PV panel installation

Fig. 2 presents the decision journey that a typical school principal in 2024 in the Republic of Ireland must take to be able to install a grant-supported solar PV panel on their school's roof through Ireland's Solar for Schools programme. The journey distinguishes 8 main stages (from learning about the scheme to obtaining the money and grant processing). Within each stage, there are several specific steps. Most, but not all, of these steps need to be taken by the school principal. The details about the process as provided in Fig. 2 are sufficient to appreciate the following analyses. Hence, the detailed description of Fig. 2 is provided in the Supplementary Information.

### 4.2. Quantitative sludge assessment

The quantitative sludge assessment relies on the NSW sludge scales to measure how much sludge is present at each step in the journey. We assess the sludge at each step on a scale from 1 to 5, referring to "very low," "low," "medium," "high," and "very high," respectively. We also assess the type of sludge in each step differentiating between search costs, evaluation costs, implementation costs, psychological costs, and time costs (Shahab and Lades, 2024). Table SI1 in the Supplementary Information presents this sludge quantification in detail. The remainder of this subsection, including Fig. 3, summarises this analysis stage by stage. Table 1 summarises the results also illustrating the types of costs in each stage.

#### 4.2.1. Sludge at stage 1: learning about the scheme

In the initial stage, the schools face *very low search costs* in learning about the scheme because the Department of Education contacts the schools directly with invitation emails to submit an expression of interest. The invitation emails include links to the relevant guidance documentation on the Department of Education website, making information about the programme and application process easily accessible. The registration link for the SEAI M&R system is provided in the emails as well. Likewise, *very low implementations costs* are present in the Expression of Interest application form provided on the School Hub because there are very few questions, with most using a drop-down

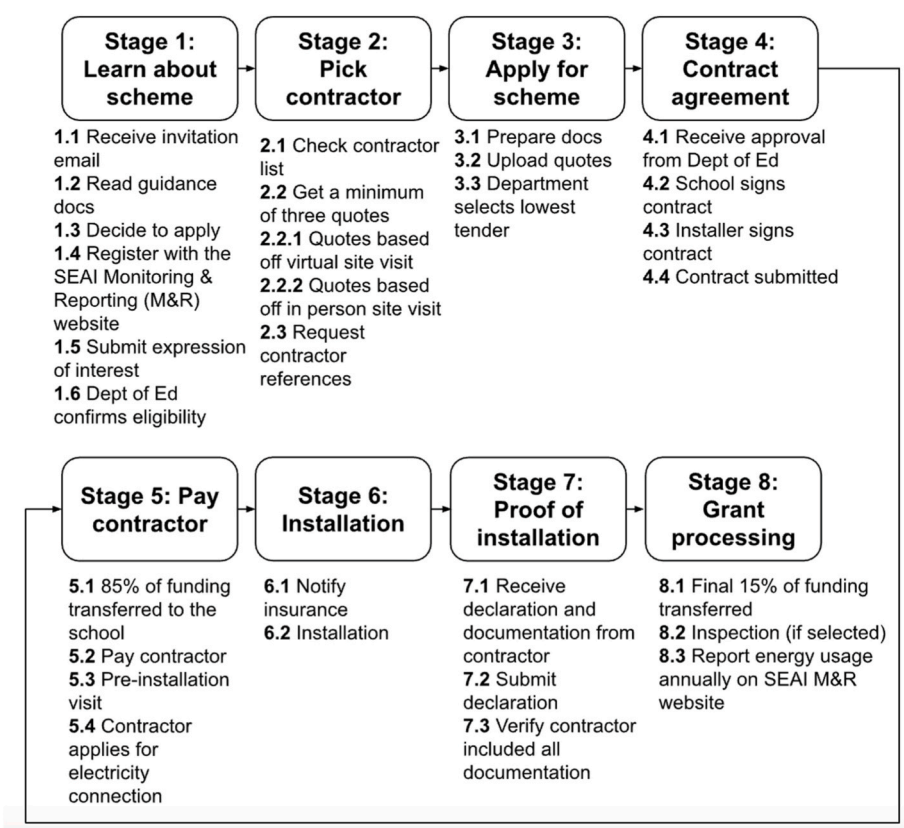


**Fig. 2.** Journey map of applicants participating in Ireland's Solar for Schools programme Phase I, as of September 2024.

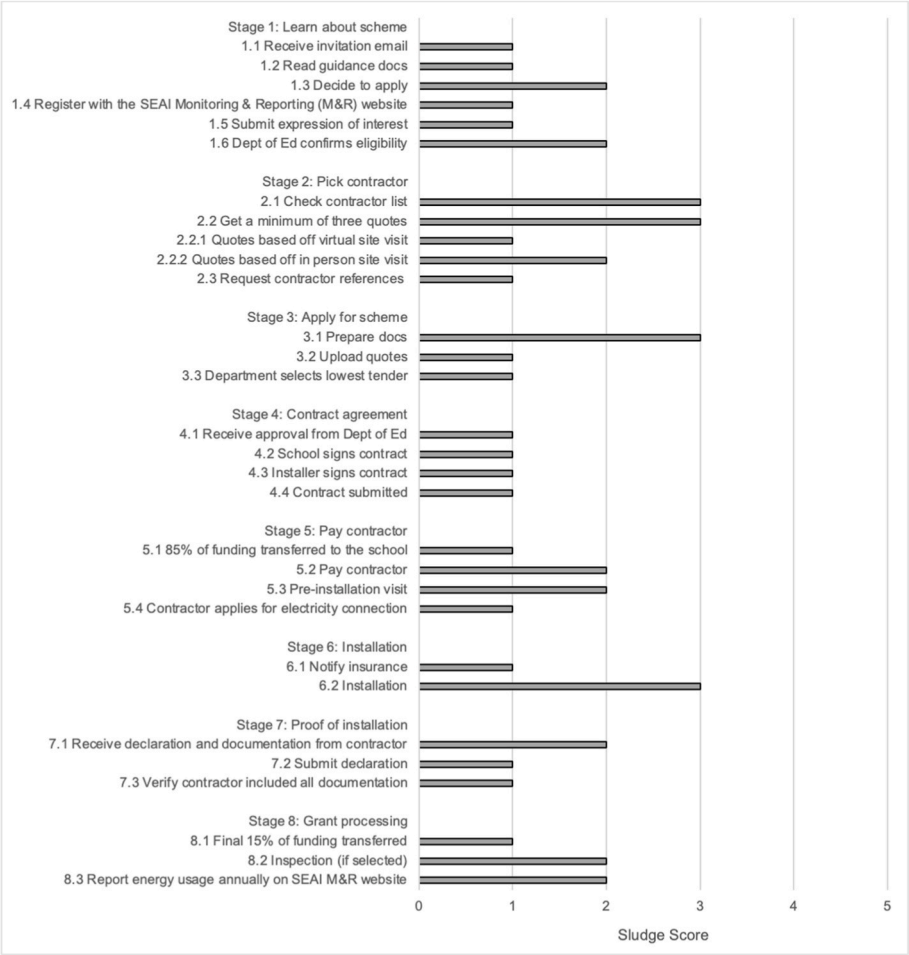


**Fig. 3.** Step-by-step sludge quantification with 1 (="very low"), 2 (="low"), 3 (="medium"), 4 (="high"), and 5 (="very high") of Ireland's Solar for Schools programme as of September 2024.

**Table 1**
Summary of the sludge quantification for each stage distinguishing different types of costs of Ireland's Solar for Schools programme as of September 2024.

| Stage | Search Costs | Evaluation Costs | Implementation Costs | Psychological Costs | Time Costs | Peak Score |
|---|---|---|---|---|---|---|
| 1. Learn | O | OO | O | | OO | 2 |
| 2. Contractor | OOO | | O | OOO | OO | 3 |
| 3. Apply | | | OOO | O | | 3 |
| 4. Agreement | | | O | | O | 1 |
| 5. Pay | | | OO | | OO | 2 |
| 6. Installation | | | O | | OOO | 3 |
| 7. Proof | | | OO | | O | 2 |
| 8. Processing | | | OO | O | OO | 2 |

Note: O = "very low", OO = "low", OOO = "medium", OOOO = "high", OOOOO = "very high".

response format. Eligible schools also likely already report to the SEAI M&R system, making the potential additional burden in this step very minimal. *Low evaluation costs* arise in the decision step of this stage, as there is very little risk and high reward for a school to apply for this programme. Lastly, schools can face *low time costs* as there is a passive waiting period after submitting the expression of interest form when the Department of Education is assessing their eligibility.

#### 4.2.2. Sludge at stage 2: picking a contractor

In the second stage of the programme, *medium search costs* arise as applicant schools must accumulate potential contractor quotes, requiring the school principal to check the SEAI Non-Domestic Micro-Generator Company list and contact contractors in their region. While there are approximately 500 SEAI-approved companies across Ireland, school principals may have issues finding available and interested contractors, as schools will be searching at the same time and the capacity for smaller, local installers may be limited. Likewise, installers may prioritise applications for larger installations over the approved 6 kW of solar PV approved in this scheme. *Medium psychological costs* emerge in this stage as principals are likely to experience a knowledge gap when researching solar PV panel installation, causing frustration, confusion and stress. These psychological costs also arise as principals have different administrative capacities to dedicate their time to contacting and finding three contractor quotes. Likewise, school authorities are likely to experience *low implementation costs* when organising site assessments necessary for installers to prepare their installation quotes. These visits to examine the suitability of the school's facilities and electrical system can create *low time costs* for the school authorities if it is

in person. While the visit takes less than one day to complete, the school representative must be present at the time of visit. There is a chance for disappointment in this stage if a school is deemed unsuitable for solar PV panel installation, largely due to poor roof conditions or structure (*very low psychological costs*). Despite this, in the contractor references step, schools are likely to face *very low search costs*, as installers are used to these requests and can easily provide relevant references.

#### 4.2.3. Sludge at stage 3: applying for the scheme

In stage 3, principals face *medium implementation costs* as they coordinate the necessary documents for the application, which requires the installer complying with the required format and language. While installers and principals are likely used to the paperwork for government funding applications, issues emerge with the language around VAT exclusion in the tenders. To reduce frictions for school principals, the Department provides links to the programme guidance documents in the initial invitation email. For example, the Programme Overview and Guidance document includes a glossary of technical terms that aims to make the information comprehensive and accessible but might be off-putting (Department of Education and Youth, 2023). The language in the document might be perceived as technical and could potentially be daunting to a principal considering applying for the programme. On the other hand, the guidance document is straightforward in defining the outline of the scheme, particularly when paired with the Schools Application Checklist (Department of Education and Youth, 2023). There is also a twenty-one page document on the Technical Frequently Asked Questions (FAQs) for Schools, with a portion dedicated to panel installation. This document uses a format that reduces sludge for the user to make it easier to read, including paragraph chunking (short, concise paragraphs), white space (not overwhelming block text), and bolding to emphasise certain information. The document uses hyperlinks to allow the user to access relevant information from other forms.

Nevertheless, *very low implementation costs* emerge in the document submission and contract agreement steps. Schools must submit their three contractor quotes for the department to choose the lowest. There are no major frictions in this application process. For example, in the initial expression of interest application form, the Department uses drop down and autofill options, and there are only a handful of forms for the school principals to complete. While this should reduce sludge for the principals, issues emerged with the VAT exclusive language in contractor documents. It can happen that documentation needs to be re-submitted due to the VAT exclusive language. The School Hub website is easy for principals to navigate to submit the tender quotes. Lastly, *very low psychological costs* arise as the lowest tender quote is selected by the Department, reducing concerns of frustration, stress or stigma would not be present.

#### 4.2.4. Sludge at stage 4: contract agreement

In the fourth stage, the Department of Education selects a tender and sends approval for contract agreement to the school authority with the selected installer. *Very low time costs* are present while the Department of Education reviews the submitted quotes and sends their approval for one tender to the applicant school. In the contract signing and submission steps, *very low implementation costs* are present as this is a familiar process for all actors involved, as principals and installers have likely interacted in similar grant schemes.

#### 4.2.5. Sludge at stage 5: paying the contractor

In Phase I, once a contract is agreed upon, the Department of Education sends 85% of the funding to the school to pay the installer, which is a passive waiting period (*very low time costs)*. In Phase II, the school receives 10% of the grant to pay as a deposit to the installer. *Low implementation costs* arise when the school pays the contractor because principals are used to this process. The payment can be completed over the phone, online, or in-person. As in stage 3, the principals face *low time costs* during the pre-installation visit with the installer, which takes around one day. *Very low implementation costs* emerge in the final step of this stage, where the installer applies for electricity connection. The contractor is very familiar with this process.

#### 4.2.6. Sludge at stage 6: installation

In stage 6, *very low implementation costs* arise as the school notifies their insurance of the structural changes to the facilities. The principal is used to this process. During installation, *low implementation costs* are present, as the installer completes this step in 1-2 days, depending on their work capacity. However, *medium time costs* arise for schools as the demand for solar PV installation may cause uncertain waiting times for the installation date to be scheduled, with some schools waiting a few weeks.

#### 4.2.7. Sludge at stage 7: proof of installation

In the next stage*, low implementation costs* are present as the school coordinates the declaration of installation paperwork with the installer. While the installer is familiar with this process, it is possible that forms need to be completed again and corrected to fit Department of Education requirements. *Very low implementation costs* arise when the declaration documents are submitted, and principal verifies that all required forms are included. Likewise, there are *very low time costs* as the installer can complete these forms easily. In Phase II, the school authority receives 75% of the funding once the declaration paperwork is submitted. This step creates *very low time costs* as the funding transfer does not take too long.

#### 4.2.8. Sludge at stage 8: grant processing

In the final stage, the Department of Education processes the payment of the final 15% of the grant to the school immediately in Phase I, creating *very low time costs*. In Phase II, the final 15% of the funding is transferred 30 calendar days after the declaration documentation is submitted to the Department of Education. If selected for an inspection or audit, *very low psychological costs* may emerge, a principal may feel stress or concern over the inspection of the site. *Low implementation costs* occur because the school is thereafter required to annually report their energy usage on the M&R site, which it is likely already participating in. Lastly, in Phase II, the school must report performance feedback 12 months after installation, which creates *very low implementation costs* for the principals.

### 4.3. Qualitative assessment of sludge in Ireland's Solar for Schools programme

This section highlights the most noteworthy results that emerged from the thematic analysis of the semi-structured interviews. These results are organised by cost category and additionally we include themes that emerged from the exploratory aspects of the thematic analysis. Table 2 presents a summary of these results.

#### 4.3.1. Search costs

Search costs arise when aspects of the choice architecture make it more difficult for people to find relevant information. They often arise when it is hard for potential beneficiaries to become aware of schemes such as grant offerings. However, the Department of Education reduced the initial search costs associated with the solar scheme as it directly contacted schools in the eligible counties through email (stage 1). The emails included information sheets, contact information for the SEAI helpline and the application link which reduced search costs for schools. For schools less involved in national schemes, the invitation emails make it easier for the principal to learn about and express interest in applying.

> *"I would have heard about it in the media. And then obviously, I got the link, and I would have probably responded almost immediately at that point."* (School Principal)

While search costs emerge when the schools must find three tender

**Table 2**
Summary of the qualitative assessment of Ireland's Solar for Schools programme as of September 2024.

| Cost Category | Key Qualitative Findings | Illustrative Evidence or Context |
|---|---|---|
| Seach Costs | Low initial burden due to proactive outreach, but manual verification is required. | The Department of Education reduced costs by emailing schools directly with links and checklists. However, principals noted significant work in verifying if contractors were on the SEAI-approved list. |
| Evaluation Costs | Technical knowledge gaps and overwhelming documentation. | Principals felt they had to blindly trust experts due to a lack of technical expertise. Some described the number and length of documents as something no principal would realistically read in full. |
| Implementation Costs | Contractor scarcity and the burden of quote collection. | While the application was called simple, finding three quotes was difficult as many local contractors were too busy or uninterested in the 6 kW projects. |
| Psychological Costs | Frustration and disappointment regarding policy rigidities. | Frustration arose from the VAT Trap, requiring principals to reach out to contractors repeatedly (up to three times) to correct quote language. Disappointment was high regarding the 6 kW cap, which prevented larger schools from installing more panels. |
| Time Investment | High time scarcity for school staff. | Principals reported spending 8 to 10 h on the application process before installation even began, time they felt they did not have. |
| Communication | Inconsistent feedback from the Department. | Some principals reported one-way communication or silence, where they had to call the Department themselves to discover errors in their applications. |

quotes from contractors on the SEAI Non-Domestic Micro-Generator Company list, the burden is not excessive. Issues with finding a contractor arise when a school is more isolated from solar PV panel installation companies or demand is too high for a local installer, where capacity may be limited. Likewise, the Department of Education reduces this burden by using the SEAI's resources to make the information easily accessible. Despite this, one principal noted the amount of work involved with confirming whether an installer is registered on the SEAI list.

> *"There's a significant amount of work from the point of view of checking that contractors are on the SEAI list."* (School Principal)

> *"And effectively, at the request of the Department of Education, who don't have a call centre. SEAI provides call centre support to schools for the application process … [They] would have a significant experience from a call centre point of view of dealing with applicants, supporting people through the process, etc."* (Scheme Admin)

#### 4.3.2. Evaluation costs

While the Solar for Schools programme does not lead to substantial evaluation costs for schools applying to the programme, some difficulties with decision making are present. Because not all school principals have the technical expertise and knowledge in solar PV panel installation, for them it is more difficult to evaluate whether investing in solar panel installation on a school roof is a sensible choice than for energy experts.

**Length and complexity of documents:** The Department of Education provides several documents to inform the school principal on the expectations and requirements of the programme. These information sheets are provided in the invitation email to the school. However, one stakeholder expressed concern about the provision of multiple documents to inform school principals.

> *"It would save, they have reams and reams of documents. Okay. I guarantee you that no principal is going to read, even attempt that."* (School Principal)

> *"Other people will have an issue with understanding what a particular documentary requirement is, or basically like, what am I putting in here? Is it meant to include VAT, you know, just really basic administrative queries that are in there."* (Scheme Admin)

**Lack of knowledge and need to trust expertise:** The principals' lack of expertise and knowledge in solar PV panel installation was mentioned repeatedly by the interviewees. This makes it difficult for school administrators to evaluate whether the cost estimates are fair. School administrators must gain this knowledge quickly and put trust in the experts they talk to. One stakeholder expressed concern over having to blindly trust that everyone they work with is being honest about the panel installation process, tender quotes, and advantage of the panels for school electricity savings. Another stakeholder stated that they trusted the installers to complete the work and engage with their school due to their experience with these kinds of installations.

> *"It's the time and as well as that I don't have expertise in this area. So, I am trusting that the people I'm speaking with are being honest and upfront about everything they're telling me. And I suppose the only way I have, checking that is that they're registered on the SEAI website, which I obviously did."* (School Principal)

#### 4.3.3. Implementation costs

When schools apply to the Solar for Schools programme, they incur implementation costs across different stages of the application process, whether in the document preparation step or when seeking contractor quotes.

**Difficulty to find quotes:** Finding a contractor (stage 2) may be time-consuming as it involves gathering three quotes from contractors on the SEAI's list of approved contractors and selecting one; although schools are used to this process as they likely undertake a similar process when tendering for other common school services (catering, electricity, etc.). One principal shared that they struggled to find three quotes for contractors in their county, resulting in a quote being derived from Northern Ireland. They stated that there was an obvious price discrepancy between the two local contractors and the one NI installer. Another principal said it was not difficult to find contractor quotes, even as they limited their quote requests to local installers.

> *"I was surprised that I asked a number of local contractors to tender for the work and they weren't interested. They clearly have too much work on. My lowest quotation is coming in from a Northern Ireland company. Very strange."* (School Principal)

> "No, we got three or four in very quickly. And then one came back and re-tendered, saying that there was such a volume gone through, they were able to offer a cheaper rate." (School Principal)

While the volume of paperwork for the schools is still considerable (eligibility assessment at step 1.4, tender for contractor at step 4.2, insurance notice at step 6.1, contract for works at step 4.4, declaration of works at step 7.2, and annual energy usage report at step 8.3), the scheme has improved since the FoE Ireland's 2019 pilot project. Despite some issues with the VAT exclusion language in the forms, two of the school principals shared that the application form is straightforward and easy to complete in a timely manner.

*"I didn't need help with the process, I assume that I'm following the steps quite clearly. They're well outlined. To be fair, and the documentation from the Department outlines it step by step, their checklist is quite helpful."* (School Principal)

*"It was simple. It was easy to fill in, really."* (School Principal)

#### 4.3.4. Psychological costs

When administrative frictions cause feelings of stress, worry, or frustration for school principals in the Solar for Schools programme, they are experiencing psychological costs (Herd and Moynihan, 2019; Shahab and Lades, 2024). The common negative emotion that the interviewed stakeholders mentioned was a feeling of frustration throughout many steps of the scheme.

**Need to reach out repeatedly:** As mentioned previously, our interview participants referred to the frustrating experience of having to contact contractors multiple times due to changes of the VAT exclusion policy. There have been issues with the 0% VAT declaration on solar panels for schools, resulting in schools and contractors having to redo application forms and re-submitting them numerous times. School principals also reported on contractors being frustrated with the issue themselves.

*"I had to get the contractor that had filled in that form to resubmit another form. And then I had to go back to him on a third occasion, because his quotation didn't state exclusive of VAT. And the department wanted that. So, he was quite frustrated and annoyed. As was my secretary, who ended up having to make contact with this contractor on three separate occasions."* (School Principal)

*"There was a small degree of frustration. It wasn't mentally health damaging or anything. A good rant helps that … It was okay, I suppose, really. But it was just irritating more than anything. Just mildly irritating. I think my fundamental frustration is: make it expandable."* (School Principal)

**Disappointment:** As hinted at above, one of the biggest themes across the stakeholder interviews is the disappointment in not being able to expand the number of solar panels being installed on the school roofs. If a school wanted to expand using the same electrical system or same installation visit, the school would no longer be eligible for the grant, as it is capped at 6 kW of solar PV panels. An installer discussed the equipment redundancy associated with the 6 kW string inverter used in these installations, as most of the schools are better suited for a 10 kW hybrid inverter that would allow for system expansion in the future.

*"Yeah, so in a lot of these schools, we're buying six-kilowatt three phase string inverter[s]. I haven't bought a six-kilowatt three phase string inverter ever, because I never recommend them. Because I'll always buy a 10-kilowatt hybrid inverter because they're more adaptable."* (Installer)

*"So, if you have a school with one pupil in it, you get a six-kilowatt system. If you have a school with 1000 pupils, you get a six-kilowatt system. That's it. End of [story]. There's no, 'Can I talk to your superior?' No, no, absolutely not. And that's not like sludge, it's more like concrete."* (School Principal)

#### 4.3.5. Additional themes

**Time investment:** One additional issue that came up in the interviews is that the school needs to invest time and effort into applying for the scheme (reading about the scheme in stage 1, selecting a contractor in stage 2, filling out an application in stage 4, etc.). Schools in Ireland are under-resourced, and administrative staff already face high time scarcity. As such, long-term benefits of installing solar PV may be deprioritised against issues requiring immediate attention. One stakeholder stated that they had issues with dedicating additional time and resources to organising site visits with contractors, reading guidance documents, and redoing the application forms. This can also be understood as implementation costs as the stakeholders had made the decision to invest and experienced frictions in the process of implementing this decision. One stakeholder reported that they spent around 8-10 h on this application process at the time of interviewing, even before the solar panels were installed on their school.

*"Meeting with these contractors, spending time with them, showing them the roof of the school where their solar panels will most likely go. All of that, that all takes time. And it's time that you really don't have."* (School Principal)

*"No, again, I just think the department needs to take stock of the workload of principals, and whether it's fair to expect them to do this additional work."* (School Principal)

**Communication:** Poor communication from the Department of Education was mentioned by school principals as an issue particularly when there is already a knowledge gap in the technical process. A few of the stakeholders, including school principals and an installer, reported that communication has been poor from the department. While another stakeholder stated that the department has communicated efficiently and effectively in the process. One principal reported that they were not informed of issues with their application documentation, and they had to seek out information on its status.

*"One way communication. You have to ring up and ask. When you submitted the application form, no one came back to you to say, 'Sorry, there's mistakes in your application form, A, B and C.' Silence. So, I ring up. 'Oh, there's a mistake in application form number one.' So, you don't hear anything again, and the contractor rings, 'Did you hear anything from them?' Say no. I'd ring them and [they'd] say, "Oh, there was a problem with number two as well.' You didn't tell me that!"* (School Principal)

## 5. Discussion

The literature has not yet developed a gold standard for sludge audits, although attempts are underway spearheaded by the OECD following on their Fixing Frictions report (OECD, 2024). Our sludge audit methodology combines the detailed approach suggested the New South Wales Government Team's method (NSW Behavioural Insights Unit, 2024) with a qualitative thematic analysis of semi-structured interviews and the identification of cost categories. We followed a three-phase process, including a behavioural journey map, a sludge audit assessment of each individual step in line with the NSW approach, and the qualitative assessment of the semi-structured interviews. This three-step approach can quantify and qualify sludge at each step which is essential for giving policy advice. Our paper presents one of the first sludge audits aimed at identifying sludge and administrative frictions as a barrier to achieving climate action targets, and we hope that more sludge audits will be conducted in the future to improve environmental policy design. Below we discuss the limitations of our study with a view to suggest future research directions and to enhance the quality of future sludge audits that could be conducted to analyse other energy policy schemes and beyond. Afterwards, we present five recommendations for policy and future research. These recommendations can be applied to the Irish Solar for Schools Programme but are also of wider relevance.

### 5.1. Limitations and future work

The main data sources for our analyses are semi-structured interviews, cognitive walk-throughs where we went through the relevant documents ourselves, and materials about the solar school scheme that are publicly available. As such, some of the data is subjective, either from the perspective of the interview participants or from our own perspective. This is a limitation (some would argue a feature) of any sludge audit and qualitative work. To reduce the subjectivity as much as

possible and provide a structure that disciplines the interviews and our analysis, we used a pre-determined systematic interview guide, relied on the journey map to organise the interviews, and analysed the data using pre-determined cost categories as well as the detailed NSW Sludge Scales which are designed to reduce subjectivity in the sludge assessments. Future work might want to generate more guidelines and support documents to help auditors come up not only with the level of sludge as in the NSW sludge scales, but also with objective ways to assess the type of sludge in a process.

A limitation of our analysis is the relative low number of five school principals who indicated willingness to speak with us about the solar school programme. The limited sample size constrains the extent to which the interview findings can be generalised to all schools participating in the Solar School Programme. Accordingly, the results should be interpreted as illustrative rather than definitive, and caution is required when extrapolating beyond the cases examined. Nevertheless, a degree of data saturation was reached, as similar themes and perspectives repeatedly emerged across interviews. Future sludge audits could examine a larger and more diverse sample of participants to assess whether the patterns identified here hold across different institutional contexts.

One can also interpret the limited willingness of school principals to participate in our study as a finding in its own right. While this interpretation is necessarily speculative, low participation rates may reflect the substantial time constraints faced by principals, who frequently assume teaching responsibilities in the absence of staff and therefore have limited availability for interviews or engagement in time-intensive application processes. In addition, reluctance to participate may stem from apprehension about disclosing negative experiences with government institutions, given schools' dependence on government funding. Finally, school principals may prefer not thinking about the solar schools process once it is done, which is itself an indication of the low-sludge character of this programme. In our experience, in other programmes that are not run as efficiently people (supposedly powered by frustration) are very willing to talk about sludge and administrative frictions.

### 5.2. Policy recommendations

The findings of this study emphasise the importance of assessing administrative frictions in the design and implementation of energy policies and programmes. This subsection outlines policy recommendations that arise directly from this assessment. Acknowledging the limitations of the study discussed above and to further strengthen these recommendations, future research should quantify the outcomes and expected benefits of their implementation using objective data, for example through randomised controlled trials or repeated sludge audits. When evaluating sludge reductions within environmental policy, it will be essential to consider not only effects on engagement and participation (also using data on take-up rates, shares of successful applications, timeline to completion, etc.), but also implications for equity and for Ireland's broader national climate policy objectives.

#### 5.2.1. Copy what works well

As the sludge audit of the Solar for Schools application process found limited frictions in the process, it is important to acknowledge the components of the process that work well. In the initial stage of the process, the Department of Education minimises search costs for school principals by sending invitation emails to the application, which include references to relevant guidance documentation. Likewise, the Department of Education fosters a partnership with the SEAI in the early stages of the programme, where principals have the opportunity to use the SEAI Help Desk for any inquiries about solar PV installation. This minimises search costs, evaluation costs, and psychological costs for principals with queries who may lack the expertise or knowledge of solar panel. The Department of Education also developed the School Hub application programme to minimise additional frictions for school principals. The School Hub is straightforward to navigate and contains questions and formatting that reduce administrative burdens.

#### 5.2.2. Centralise administrative responsibilities

Our sludge audit revealed that selecting a contractor can be a burdensome task for school principals. Principals mentioned that limited time, expertise, and resources prevent them from finding appropriate contractors. The process could be optimised by shifting the responsibility of finding contractor quotes from the school principals to local authorities who could oversee procurement through a centralised system covering all eligible schools within their area. This would reduce the burden currently on the school principals and increase contractor interest by enabling them to bid for multiple schools at once. This approach of shifting administrative responsibilities from individual actors to a central institution which can develop administrative expertise when repeatedly completing the tasks is realistic. For example, in the UK local authorities manage the process for all schools within their catchment as part of their own Solar for Schools programme.

#### 5.2.3. Simplify application requirements

While the programme application process is not excessively burdensome, stakeholders identified frictions within the early stages of the process, during the document preparation. Specifically, issues occurred with the VAT exclusive language in the application forms, with several stakeholders expressing frustration with the need to have their contractor re-sign forms and re-submit the forms numerous times. Both school principals and solar contractors would benefit from additional clarity in the application forms regarding requirements in their tender reporting. In the instance of excessive paperwork, school principals can be deterred, especially for those with limited time and capacity, from participating in similar programmes in the future.

#### 5.2.4. Remove inefficient restrictions

Interview participants identified frictions related to the Solar for Schools programme's limit of 6 kW in each solar PV system. While an installation of 6 kW in solar PV allows school authorities to *save* on electricity costs, many principals are inclined to have the ability to install additional panels, funded by the community or the school itself. If the school is able to install these additional panels while the contractors are already on site, it saves the school on installation costs in the long run. Likewise, solar installers would be more incentivised to install projects for schools installing larger systems. Consequently, policymakers may wish to consider introducing greater flexibility in system size limits rather than maintaining a strict cap on installations above 6 kW to provide greater motivation for both schools and contractors to participate in the programme. This ultimately helps schools reduce their operational costs and impact on the environment.

While interview participants frequently highlighted the 6 kW cap as a source of inefficiency, it is also important to recognise the potential policy rationale for such a restriction. Programme designers may introduce system size limits in order to distribute available funding across a larger number of schools, ensure administrative simplicity, or manage potential grid integration challenges associated with rapid deployment of distributed generation. A standardised system size can also simplify procurement processes and reduce programme oversight requirements for government agencies. However, our findings suggest that rigid system size caps may unintentionally introduce inefficiencies and additional costs. In particular, installers indicated that many schools could accommodate larger systems without additional installation complexity, and that the use of 6 kW inverters can limit opportunities for cost-effective system expansion in the future. This may require schools to undertake additional installations later, increasing total programme costs and administrative effort. A more flexible policy approach, such as allowing schools to install larger systems with partial self-financing or permitting modular expansion, could maintain equity objectives while reducing long-term inefficiencies.

#### 5.2.5. Apply this model to other schemes

As the delivery of Phase I of the Solar for Schools programme can be deemed as successful, it is important to acknowledge the collaboration between the Department of Education and the SEAI as a key contributor to this success. The SEAI is an organisation with expertise in existing solar PV grant programmes that maintains the resources and knowledge, including from applied behavioural science, to administer energy grant applications. The expertise provided by the SEAI is necessary for the Department of Education to manage applications. This successful model for administering energy grant applications could be utilized in other schemes to streamline the application process and guarantee vital expertise is available to applicants.

While this study focused on Ireland's Solar for Schools programme, the findings have broader implications for the design of renewable energy support schemes internationally. Many governments are expanding distributed renewable energy through grant programmes targeting households, schools, and public buildings (Ryan et al., 2023). These programmes often focus on financial incentives and technical standards but devote less attention to the administrative processes that determine whether eligible participants actually apply. Our findings suggest three key lessons for programme design globally.

First, administrative simplicity is critical for programmes targeting actors whose primary responsibilities lie outside the energy sector, such as school principals, local authorities, or community organisations. Even relatively small administrative requirements can discourage participation when potential applicants have limited time or technical expertise.

Second, behavioural insights can complement traditional energy policy analysis by identifying small procedural frictions that accumulate throughout the application and implementation process. Behavioural insights about human decision-making biases such as present bias, overoptimism, or inattention can explain why small procedural frictions can have large behavioural effects (Lades et al., 2021; Sunstein, 2021). Conducting structured sludge audits during programme design or evaluation with these behavioural insights in mind may help policymakers identify and remove these barriers before they suppress programme uptake.

Third, programme rules that prioritise administrative standardisation, such as rigid technology specifications or system size caps, may unintentionally create inefficiencies for installers and participants. Allowing greater flexibility, while maintaining oversight and equity goals, can improve programme effectiveness without necessarily increasing public expenditure.

Together, these findings suggest that achieving rapid deployment of distributed renewable energy will require not only financial incentives but also careful attention to administrative design. Integrating behavioural insights, such as those presented in this study, into policy development could help governments worldwide design programmes that are easier for citizens and organisations to navigate, thereby accelerating the energy transition.

## 6. Conclusions

This research conducted a systematic sludge audit of the Solar Schools programme in Ireland to identify administrative burdens that may impede the clean energy transition. The study relied on behavioural journey mapping, sludge quantification using the NSW Sludge Scales, and thematic analysis of semi-structured interviews with key stakeholders, including school principals and installers. By categorising these burdens into search, evaluation, implementation, psychological, and time costs, the audit provided a comprehensive view of the "sludginess" of the scheme and highlighted specific areas where administrative complexity could be reduced to enhance policy success. The sludge audit of the Irish Solar for Schools programme revealed valuable insights. We showed that some procedures are well administered and that much of the programme is designed in an efficient way. For example, key steps such as learning about the programme, understanding the documents, and obtaining financial approval are relatively straightforward and free of significant friction. These are aspects that other processes might want to copy. The sludge audit also revealed room for further improvement. In line with the literature, we showed that even small administrative frictions can lead to delays and lower uptake of programmes when people are busy and time-constrained as is the case for school principals (Bearson and Sunstein, 2023; Lades et al., 2021). Addressing even low frictions can thus progress engagement and success within programmes.

There are at least three aspects of the programme that create friction for school principals and contractors. First, frustrations can arise from the need to find three contractor quotes. The selection of a contractor arose as one of the most time-intensive stages, as it necessitates obtaining three quotations from contractors listed on the Sustainable Energy Authority of Ireland's (SEAI's) contractor registry. Second, the document preparation step can be particularly burdensome for many principals, as they lack familiarity with the required forms and associated obligations. In particular, the VAT exclusive language in the contractor quote documentation emerged as the primary source for frustration for principals and contractors. Lastly, while not particularly an administrative friction, a primary theme identified among the stakeholder interviews was the issues associated with the panel installation limit of 6 kW (approximately 16 panels) of solar PV for each school. If schools were allowed to install additional panels, it would reduce installation costs for future panel installations, as these could be minimized if the panels were integrated into the initial installation. More broadly, this study demonstrates how sludge audits, as a tool within behavioural public administration, can provide valuable insights for the design and evaluation of renewable energy programmes. Integrating behavioural insights into programme design may therefore help improve uptake and accelerate distributed renewable energy deployment globally.

## Declaration of generative AI and AI-assisted technologies in the writing process

We did not use any AI during the preparation of this manuscript.

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## CRediT authorship contribution statement

**Leonhard K. Lades:** Conceptualization, Funding acquisition, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Patricia Lentz:** Data curation, Formal analysis, Project administration, Writing – original draft, Writing – review & editing. **Lucie Martin:** Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Cara Augustenborg:** Conceptualization, Funding acquisition, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.enpol.2026.115268.

## Data availability

The authors do not have permission to share data.

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