



Drivers and barriers for municipal retrofitting activities – Evidence from a large-scale survey of German local authorities



Friedemann Polzin^{a,*}, Colin Nolden^b, Paschen von Flotow^c

^a Utrecht University School of Economics (U.S.E.), Sustainable Finance Lab (SFL), Kriekenpitplein 21-22, 3584 EC Utrecht, The Netherlands

^b University of Bristol Law School, 8-10 Berkeley Square, Bristol, BS8 1HH, United Kingdom

^c Sustainable Business Institute (SBI), Zehnthofstr. 1, 65375 Oestrich-Winkel, Germany

ARTICLE INFO

Keywords:

Energy efficiency
Retrofitting
Local authorities
LED
Lighting

ABSTRACT

Local authorities are key actors for implementing innovative energy efficiency technologies (retrofitting) to reduce end-use energy demand and consequently reduce negative effects of high energy use such as climate change and public budget deficits. This paper reports the results of a large-scale survey of German municipalities by assessing drivers and barriers for deploying LED street lighting as an example of innovative retrofits. The results indicate that competencies and capacities, transparency of the underlying technology base, and a clear proposition of savings are crucial drivers for municipal retrofitting engagement. Most significant barriers include lack of experience, the tendency to wait for future improvements of innovative energy efficiency technologies, and existing contracts with energy suppliers, manufacturers, or other conventional retrofitting contractors. Investments in municipal competency building (both regarding technologies and procurement) as well as diffusing standard tendering criteria and (public) monitoring of their effectiveness are highly recommended to accelerate the municipal modernization process.

1. Introduction

Reducing energy demand by implementing novel energy efficiency technologies represents one solution to combatting climate change while also reducing energy costs, fossil-fuel dependency and related issues such as energy insecurity and fuel poverty [22,23,41,51,53]. Municipalities play a central role implementing measures that reduce end-use energy demand (EUED) and deliver more efficient energy services as they are often the proprietors of aging infrastructure [21,42,51,54].

Many modernization (retrofitting) activities are driven by the need to increase energy and cost effectiveness, to tackle climate change, to reduce budgetary deficits, to maintain adequate levels of public services or to comply with increasing regulation [48,51,52]. Qualitative, case-study based research points towards technological factors (e.g. quality, durability and missing standards), economic factors (high upfront costs, transaction costs and uncertain future energy costs), competency factors (for procurement and management of retrofits) and institutional factors (such as public infrastructure maintenance backlog) hindering retrofitting activities [36,42,51,52,60].

Quantitative analysis of drivers and barriers for retrofitting, on the other hand, have been lacking [42,49,51,52]. Statistically backed

recommendations for local authority administrations and national policy makers are required to enhance and accelerate retrofitting activities in municipalities (see for example [38]). Based on a review of recent studies published, our research question reads as follows: *Which factors enable or prevent local authorities (municipalities) from modernising energy infrastructures?*

We analyse the case of LED (light-emitting diodes) street lighting in Germany. Street lighting in Germany, as in many other countries, represents a major cost factor, accounting for almost one third of municipal electricity budgets [11,7]. With municipal debt in Germany amounting to 152.71bn EUR in 2016 or 13.4m EUR per local authority [13,14], LED streetlights, with energy efficiency gains of up to 90% compared to conventional light bulbs, provide an innovative and cost-effective retrofitting option [16,3,7]. Modernising public street lighting appliances allows municipalities to reduce end-use energy demand and costs and to alleviate budget constraints [10].

The remainder of this paper is structured as follows: The next section (Section 2) contains a literature review. Section 3 develops the hypotheses based on theoretical insights. Section 4 introduces the methodology. Section 5 reviews the results of the quantitative survey analysis. Section 6 discusses our findings and concludes this paper by deriving policy implications.

* Corresponding author.

E-mail address: f.polzin@uu.nl (F. Polzin).

2. Literature review

Financing, operating and maintaining public sector properties is a global challenge [18,44,9]. At the same time, local authorities and cities in particular find themselves increasingly at the heart of global energy and climate change action [21]. Although maintenance backlogs and aging infrastructure may place increasing strains on limited resources, retrofitting and energy performance improvements provide windows of opportunities to procure innovative retrofits and services given the relatively large municipal responsibility to minimise costs while guaranteeing investment and climate action [36,40,55,6].

However, modernization activities using innovative EUED technologies ('retrofitting') require significant upfront investments and enhanced capacities to evaluate different types of LED, integrate LED into the existing infrastructure and set up intelligent lighting systems. Our qualitative research [42] on municipal retrofitting governance suggests that designing the content of tenders to include cost transparency and open-book accounting is an important determinant for competition among organisational (governance) structures¹ which often determine retrofitting investment and capacities. Depending on the local situation, especially in the absence of appropriate skills and institutions, outsourcing using Energy Service Companies (ESCOs) may help accelerate the retrofitting process [42]. Our quantitative research [43] suggests that the cost of outsourcing may be higher if in-house competencies and capacities as well as existing partnerships are sufficient to engage in innovative retrofitting activities [43]. Both papers indicate that market transparency and municipal capacities play an important role in accelerating retrofitting activities by allowing municipal representatives to make rational choices among modes of governance most suitable for their specific retrofitting priorities [42,43].

The role of intermediaries is particularly relevant in this context as they raise awareness and lower transaction costs for non-hierarchical (as opposed to in-house/hierarchical) options [36,42,43]. The number of drivers increasing municipal engagement with retrofitting in general is increasing rapidly. These include the emergence of public procurement frameworks that reduce the transaction costs for both the public sector and contractors in the UK [35,36], innovative business models mimicking 20-year power purchase agreements such as MEETS (Measured Energy Efficiency Transaction Structures) in the US [35] and the increasing drive towards making energy efficiency projects 'investor ready' internationally, such as the Investor Confidence Project² [35,36].

Despite innovations in the retrofitting/energy efficiency service market there are still many barriers to overcome, mostly linked to high transaction costs arising out of uncertain returns on investment and payback periods linked to a lack of verified information on quality, energy savings and longevity of new retrofits (such as LED) [25,51,52]. Below, drivers and barriers for retrofitting in the municipal context are discussed.

3. Hypotheses

This section provides an overview of the hypotheses regarding drivers and barriers for retrofitting derived from the literature.

3.1. Drivers for retrofitting (using EUEDs–LED)

First, enhanced competencies, such as those described above, stimulate the procurement of innovative (green) goods and services to improve energy performance [35,36]. These competencies were previously not necessary because more efficient energy technologies in the

¹ In this context modes of governance refers to how transactions are organised through governance structures where in-house refers to complete control over the procurement and retrofitting process and long-term performance contracts refer to outsourcing [42,59].

² see <http://www.eepperformance.org/>.

lighting industry evolved slowly ([16,47,7]; for an extended review see [15]). In the case of local authorities, staff only needed to replace the lightbulbs without changing the adjacent infrastructure. Hence, local authority competencies regarding tendering and implementation of retrofitting are crucial [42].

H1a: Higher municipal competencies (technical knowledge) increase engagement in retrofitting activities.

Second, potential savings result from the application of innovative EUEDs (in this case LEDs yield 90% efficiency gains and associated energy and cost reductions compared to conventional lighting depending on drivers and other components) [3,7]. Hence, we hypothesize that this is one important incentive for engaging in retrofitting activities [42,52]. This is supported by research on consumers [34]. In addition, these savings need to be verified to plan and implement retrofitting measures [40].

H1b: The larger the potential saving (anticipated savings / financial return), the greater the interest in retrofitting.

H1c: Measurement and verification of these savings drive engagement in retrofitting activities

LEDs as innovative technologies are still more expensive than conventional lighting technologies which leads to a longer payback period for retrofits [16]. Public support programs represent a driver for the implementation of novel EUEDs [8], energy efficiency investments [52] and low-carbon innovation in general [41].

H1d: Subsidies/support schemes constitute a driver for retrofitting activities.

To further support the planning and implementation process, previous research has highlighted the importance of consultants (facilitators) in filling the knowledge gap that municipalities face regarding retrofitting activities and specific innovative technologies [31,36]. Our quantitative study on the topic found that consultants discourage outsourcing of retrofitting activities while maintaining their role as drivers for in-house municipal initiatives [43].

H1e: Engagement of a consultant increases the likelihood of retrofitting the public lighting infrastructure

Our final hypothesis builds on the fact that behaviour plays a significant role in saving energy. Previous research has found that decision makers do not necessarily act rationally when it comes to assessing costs and benefits [26,51,52]. Despite the expectation that investment opportunities in energy with a reasonable payback time will be realized, political will and support remain important drivers for retrofitting activities [42,46].

H1f: Political will and support determine a municipality's engagement in retrofitting.

3.2. Barriers to retrofitting (using LED)

Major factors limiting municipal engagement with innovative EUED are linked to their technological nature, such as their diversity and widespread application, small scale and low visibility [52,60]. From the procurement literature [37,49,52,55], we derive that potential users require enhanced knowledge to evaluate, plan and implement innovative EUEDs [55]. Also, the management of retrofitting processes requires enhanced capabilities i.e. for neutral and cost-transparent tenders as well as measurement and verification (M&V) once the technology has been installed [18,40,55].

H2a: Missing personnel capacities limit engagement in retrofitting activities.

A central barrier to the adoption of new technologies in the

Download English Version:

<https://daneshyari.com/en/article/8111466>

Download Persian Version:

<https://daneshyari.com/article/8111466>

[Daneshyari.com](https://daneshyari.com)