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ARTICLE



Women's empowerment through electricity access: scoping study and proposal for a framework of analysis

Tanja Winther^a, Margaret N. Matinga^b, Kirsten Ulsrud^c and Karina Standal^a

^aCentre for Development and the Environment, University of Oslo, Oslo, Norway; ^bDunamai Energy, Zomba, Malawi; ^cDepartment of Sociology and Human Geography, University of Oslo, Oslo, Norway

ABSTRACT

This article reviews the empirical literature on women's empowerment through electricity access and the methodologies that have been used. Statistical studies have looked at areas with access to the grid and measured the impact on welfare indicators and employment. Qualitatively oriented studies have looked at various types of supply and studied how electricity access in a given context has influenced women and men in everyday life, sometimes focusing on the role of the design of the systems of supply and the process of electrification. The overall results show that electricity access benefits the welfare of women as well as men, but that the impact on gender relations remains largely unclear. With the ambition to better understand the gendered nature – and impacts – of various types of electricity access, we develop a framework for analysing women's empowerment through electricity and subsequently illustrate its applications by drawing on the reviewed empirical literature.

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1. Introduction: a need for more systematised knowledge

International initiatives aim to catalyse the provision of electricity to the 1.2 billion people who currently lack such access (IEA 2015). Given that women in the rural South often live under particularly discriminating conditions, important questions emerge as to how investments in various types of electricity provision empower women and affect gender equality. Gender equality and the empowerment of women and girls are acknowledged cross-cutting goals in development cooperation (for example, Sustainable Development Goal No. 5). From supply to end use, electricity is gendered, which means that women and men have different opportunities to engage in and influence the solutions for electricity provision and different opportunities to benefit from electricity.

Previous reviews on gender and energy interventions (Kelkar and Nathan 2005; CRGGE 2006; Clancy et al. 2011) have called for a need to move away from gender-blind approaches towards addressing women and their interests in electrification policy and practice. However, an epistemological problem in such reviews is that the examined studies use different definitions of empowerment and various methodologies. This challenge, also encountered by this scoping study, highlights the need for analytical tools to help accumulate knowledge.

As this article shows, many important aspects of the gendered impacts of electrification have been covered in the academic literature. However, there are crucial areas that require much more attention and that need to be studied in new ways. For instance, while there is substantial evidence

on electricity's positive impact on women's welfare, little is known about electricity's impact on gender relations. Furthermore, many studies document whether or not electrification had a positive effect on women (and men) – and the magnitude of the effect – without accounting for how and why electricity resulted in a given set of gendered outcomes. By ignoring these relational and explanatory aspects, the majority of studies do not explain what it would take to ensure and strengthen women's empowerment through electrification, and thus have limited value to policymakers.

Informed by these and other gaps in the literature, this article proposes a framework for analysing women's empowerment through electricity access and subsequently illustrates its applications by drawing on findings from the reviewed empirical literature.¹ The framework is anchored in theoretical concepts of empowerment (Kabeer 1999), sociotechnical systems (Hughes 1983; Bijker and Law 1994) and practice theory (Bourdieu 1977; Warde 2005; Ortner 2006). We adopt an understanding of empowerment which invites attention to changes in women's and men's relative rights, decision-making power and control over various types of resources.

An underlying purpose in the present work is to begin conceptualising the gender dimension of electricity access. We focus primarily on households (that is, not public services or the commercial sector) and denote access as a household's subscription to and regular use of electricity.² The electricity may derive from various systems of supply, ranging from having a grid connection to renting solar lanterns (c.f. 'multitier framework', ESMAP 2015). There is also variation in terms of how such systems are planned and implemented and to what extent energy interventions incorporate gender goals. In energy policy and practice, gender goals tend to include increases in women's welfare while political and economic empowerment are considered as irrelevant (Skutsch 2005, 40; Clancy et al. 2007). We argue that our framework enhances a more comprehensive approach by explicitly addressing the *relationship* between potential welfare benefits and economic and political empowerment.

We assess the methodologies employed in the reviewed quantitative and qualitative studies and also examine how electricity's impacts are accounted for. These epistemological questions are important for both policy and research because the identification of knowledge gaps may be used to induce new research that could help to formulate evidence-based policies and practices and enhance women's empowerment through electrification and supplementing interventions.

The framework includes conceptual elements and methodological suggestions for how to achieve a broader and deeper understanding of the nexus between gender and electricity access. While the realm of electricity poses some particular analytical considerations, we also argue that the framework is generic and may be applicable when analysing women's empowerment through other types of interventions.

In the following section, we account for the methodology employed for this scoping study. In [Section 3](#) we develop a framework for analysing women's empowerment and in [Section 4](#) we look at how knowledge about electricity's gendered impacts has been produced in quantitative and qualitative studies. [Sections 5](#) and [6](#) then present the reviewed evidence and insights on women's empowerment through electrification. We discuss the results in [Section 7](#) while [Section 8](#) concludes and provides some recommendations.

2. Review methodology

This independent article reviews empirical peer-reviewed studies that have addressed the gendered impacts of electrification and adhering technologies. The studies were conducted across the world but mostly in the global South, and we focus on studies from rural areas in particular because such localities have the least access to electricity. In addition to peer-reviewed publications, we have also consulted impact evaluations and central sources from the 'grey' literature produced by development organisations such as the World Bank and DFID.³

Our review strategy partly follows principles associated with ‘scoping studies’ (Arksey and O’Malley 2005) in that we initially addressed a relatively broad topic which led us to reformulate the study design as we became more familiar with the field. We decided from the beginning to map the empirical evidence and explanations for women’s empowerment through access to various types of electricity systems (‘Stage 1’, 22). We sought to cover studies from areas with grid electricity as well as areas with decentralised systems. Electricity is not an end product; hence, we also needed to search for studies on electricity’s applications such as mobile phones, which constitute one of the most important current applications of electricity’s services.

To identify relevant studies (‘Stage 2’), we visited scientific and public databases using key words such as electricity, empowerment, gender, women, men, socioeconomic, social and so forth, and benefitted from the members’ previous work and existing knowledge of the qualitative literature. The result of this mapping phase was that we initially excluded a number of academic studies (9) that did not treat gendered impacts and identified 17 academic works addressing empowerment in general (not electricity) and 15 which did treat the gender-electricity nexus. We also identified 12 works from the grey literature including reviews. After this we consulted stakeholders in the development sector (DFID, ENERGIA and so on) who provided more suggestions for central quantitative studies and impact evaluations in this field. We then continuously expanded the list of relevant studies, for example, by drawing on the lists of reference.

Across this body of literature there was considerable variation in terms of electrification project designs, sociocultural contexts and the types of outcomes investigated. A lack of conceptual clarity in the reviewed studies posed a particular challenge. Even where the outcomes under investigation were termed the same (for example, empowerment, increased employment) the measures for the outcomes were often different and sometimes unclear or even undefined. In particular, our preliminary review showed that despite the fact that gender and gender analysis relate to issues of power between women and men, many studies focus solely on women and miss out on the relational aspects.

Our ambition was to synthesise the results, but the fragmented results limited the possibility to conclusively draw causal linkages between electrification and gendered outcomes, and especially whether any specific kinds of electricity interventions have resulted in women’s empowerment. Hence, it became clear that we needed a strategy for structuring the evidence and the explanations for electricity’s gendered impacts. Therefore, we developed a framework of analysis, which components we used for charting the data (Stage 4) in Excel tables. The final selection of works (‘Stage 3’) were based on (i) their relevance to our research question including a spread on various types of access, (ii) obtaining a balance between quantitative and qualitative works as we learned that they offer complementary knowledge and (iii) their methodological transparency and strength. Hence, to some extent we have assessed the methodologies, which is commonly done in systematic reviews rather than scoping reviews (Arksey and O’Malley 2005).⁴

Based on these criteria, we identified 21 central studies for this review, of which 13 focus on areas with electricity grids, 6 focus on off-grid areas and 2 are consumption studies in which electricity and gender are a central subject. Of the 21 studies, 11 are quantitative studies, 8 are qualitatively oriented and 2 have employed mixed methods. [Appendix A](#) lists the 21 key reviewed studies, and we also draw on other studies in the analysis.

Through this iterative process, the review covers, to the best of our knowledge, the most central ethnographic and qualitative studies on the gendered impact of electrification. The selected statistical works include key, robust quantitative studies that address gender or have sex disaggregated data. Some selected studies focus solely on women and this is partly reflected in the material to be presented which sometimes lack inputs on changes in men’s situation. Unlike systematic reviews, we do not seek to examine the entire evidence base on the gendered impacts of electrification – but rather identify, examine and compile results from the selected studies (‘Stage 5’) and use this to identify knowledge gaps. In particular, we focus on how empowerment can be defined and analysed and we highlight findings and analyses that we consider under-

researched and/or in need of attention.⁵ As the framework is of value beyond structuring this review, we dedicate a substantial part of this article to account for how and why it was developed.

3. Proposing an analytical framework

We now develop a framework for analysing electricity's gendered impacts. As a first step, building on the empowerment literature, we suggest how women's empowerment can be conceptualised in the realm of electricity.

3.1. Defining women's empowerment

We consider *women's empowerment as a process towards gender equality, understood as women's and men's equal rights, access to and control over resources and power to influence matters that concern or affect them*. The definition conceives empowerment in relational terms which requires analysis of women's situation as compared to that of men's (for example, Butler 1990; Friedman 1992; who focuses on empowerment of marginalised groups). Our definition is heavily influenced by Kabeer (1999, 2001) and her framework for *measuring* empowerment, in which access to resources and agency constitute two central pillars. In addition we bring in the notion of rights (see Section 3.2).

We follow Kabeer in that there are three types of resources: human, social and material. The focus on agency is also important. Kabeer (2001, 19) captures agency as people's degree of influence over issues that concern them. Agency and choice are at the core of her definition of empowerment, which she conceives as 'the expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them' (1999, 437). Such 'strategic life choices' (or 'first-order choices') concern decisions of major significance in a person's life such as who to marry, choice of livelihood and freedom of movement (2001, 19). Kabeer (1999, 437) also acknowledges the relevance of 'second-order choices', which may affect a person's well-being, but she contends that such choices do not form part of the definition of empowerment because they are not equally as relevant to the exercise of power as first-order choices.

On the point of agency our framework departs from Kabeer's definition in two ways. First of all, in the realm of energy and electricity, which are implicated in everyday life in subtle but profound ways, it seems important not to exclude the possibility that increased influence in everyday decision-making may imply empowerment. Secondly, rather than highlighting 'choice', we choose to focus on people's degree of ability to influence decisions that concern or affect them, partly because people may not necessarily be conscious or concerned with issues that affect them (Yamin 2009). Also, the emphasis on 'choice' gives associations to theories of social change in which individual agency is considered to play a major role (Shove 2010).⁶ Social practice theory (Bourdieu 1977) adds important insights in this regard, showing that decisions tend to be socially negotiated by individuals who are differently positioned within existing social practices and sociomaterial structures (for example, Warde 2005; Wilhite 2008b; Winther 2012). Practice theory has particular merits in analysing gendered impacts of electrification due to the repetitive and habitual character of everyday energy use and the way structures such as gender ideologies, norms and power relations and the material organisation shape what people do with energy (Shove 2003; Wilhite 2008a, 2008b; Winther 2008).

Typical household practices which involve energy use include household chores such as cooking, cleaning, maintenance, ironing and caretaking; consumption of information and entertainment; communication; and income generating activities. Both energy and the converting equipment and appliances such as phones and television sets are required to render the practices meaningful, which is why the study of electricity's impact necessarily also concerns people's acquisitions and uses of appliances and phones. Each energy practice is guided by conventions and norms (Ward 2005), and they tend to be gendered in that women and men are recruited in different ways, perform different roles, have different responsibilities and positions, and pursue

distinct identities. When electricity and the option to use new appliances becomes available, it can be seen as a moment when everyday practices move out of the habitual realm (*doxa*) and enter a phase with increased consciousness when individuals with varying degrees of negotiating power promote their interests and pursue specific identities. As the practice gradually re-enters the habitual realm, the guiding conventions, distribution of responsibilities, access to resources and women's and men's agency might be different from what was the case before electricity's arrival.

3.2. The framework part I: analysing women's empowerment

Rights, resources and agency constitute the central pillars in our definition of empowerment and we now look at how these dimensions may be analysed and measured. In addition, we bring analytical attention to potential negative effects on women's empowerment as well as women's agency in the realm of the intervention (in our case the provision of electricity access). Table 1 summarises the discussion that follows.

We denote empowerment's first dimension *overarching issues* and this includes women's and men's rights according to juridical and customary law and practice (Danielsen 2012), gender norms, and women's and men's social positions. These overarching issues tend to heavily influence the second dimension, which is the *gendered access to and control over resources*. This is a broad category divided into material, social and human resources. *Material resources* include money, property including appliances, and other physical assets. Access to material resources such as income does not necessarily mean control over such assets (for example, Standal and Winther 2016). Similarly, when people start using electric light, this constitutes increased access to material resources particularly to women who tend to spend more time at home than men (Matinga 2010, 186; Winther 2008, 17; Annecke 2005, 36; Standal 2008). However, without accumulation and control over material assets, this shift does not denote material endowments. We therefore separate between *material opportunities* such as income on the one hand and long-term control over finances and assets, also referred to as *material endowments*, on the other (World Bank 2011, 4, 55).⁷

Social resources are important for sustaining a good living, and the associated notion of social capital includes the 'ability of actors to secure benefits by virtue of membership in social networks or other social structures' (Portes 1998, 6). Social resources may increase through access to using light, television and mobile phones.

Human resources include common welfare indicators such as knowledge and education, health, safety and psychological power as well as reduction in time spent on physically demanding and repetitive tasks (that is, drudgery). We consider reduced drudgery as a sign of a person's increased human resources and empowerment if the previous practice were detrimental to people's health, restricted them from having enough time for rest and leisure and/or if the time saved led to new choices.⁸

The third dimension, *agency*, is crucial and heavily informed by overarching issues (dimension 1) such as social norms, as these often constrain women's ability to speak and act to the same extent as men in various realms. Women's degree of agency also impacts their access to resources of various kinds (dimension 2). For reasons accounted for above, our framework includes two general modalities of agency: *influence over life decisions* (including political power) and *influence over everyday decisions*.

We also include *negative impacts of the intervention on any of the three dimensions of women's empowerment*. Negative impacts are sometimes treated in qualitative studies but barely mentioned in quantitative studies and impact evaluations (Winther 2015, 9–10). Negative impacts could also have been integrated in each of the empowerment dimensions, but we think identifying this as a separate category of analysis helps bring attention to the issue, which results are likely to be unexpected because they are not included in intervention designs.

The three dimensions of empowerment and the potential negative impacts constitute the criteria for measuring the impact of an intervention hence they need examination before and

after intervention. The overall assessment of women's empowerment must be qualified by weighing the relative changes in each of the three empowerment dimensions caused by the intervention while comparing the changing situations of women and men.⁹ Because they concern structural and enduring aspects, we argue that signs of changes in the following aspects should have the greatest bearing on the overall assessment: overarching issues, material endowments and/or influence on life choices.

Finally, we include *agency in the domain of the intervention*. This type of agency cannot be captured by measuring changes before and after intervention, hence it is of a different and more qualitative and conditional order than empowerment's three general dimensions. For the type of intervention under study (electricity access), we include two intervention-specific modalities of agency; women's ability to influence decisions on electricity at the household level and women's agency within the intervention as such (programme/project/system of supply). We argue that women's agency in the realm of the intervention needs examination partly because it is important in itself (cf. equal rights to resources and participation). Also, the gendered composition and decision-making patterns of interventions may also impact wider groups of women and men in the community and thus be a key aspect for analysing pathways to empowerment, qualified through examination of changes in dimensions 1–3. Agency in the domain of the intervention may therefore also be considered as one of the conditional factors for electricity's gendered impacts as discussed later.

Our framework is illustrated in Table 1 and will inform our review of the empirical literature. The table also includes suggestions to specifications that may enhance operationalisation and development of indicators, though this is beyond the scope of this article.

3.3. The framework part II: understanding how and why empowerment occurs: bringing in conditional factors

As noted, the purpose of the framework goes beyond examining the evidence on empowerment. We also analyse how and why the impacts come about. Informed by the general theory and the literature review, we propose looking at four types of factors that may influence electricity's impact on women's empowerment.

- (1) *The material and sociocultural context* comprises the existing social structures and practices in which gender relations – and gender inequality – are founded and reproduced. As generally noted, sociocultural aspects are crucial for understanding how any development intervention affects women's empowerment (for example, Elson 1995; Rogers 1980). The three empowerment dimensions all concern various aspects of the material and socio-cultural context. Electricity systems and the ways they function are also adapted to and shaped by the material and sociocultural context in which they become embedded (Wilhite 2008b; Winther 2008; Ulsrud 2015).
- (2) *The sociotechnical design, ownership and management of the system of supply* influence the kind of electricity access that is provided, and hence to what extent the electricity services suit the needs of various types of users such as women, men, poor, rich, people living in different geographical locations (Ulsrud 2015, 54). The design of the system also influences which groups are able to subscribe to electricity and pay the required fees for using it. This invites attention to details in the sociotechnical design and functioning of the electricity systems, which consists of interwoven technologies, actors and institutions (Hughes 1983; Bijker and Law 1994; Rohrer 2001; Ulsrud et al. 2011). Included here is also the ownership and management structure as well as the price and quality of the services provided. As acknowledged in the multitier framework (ESMAP 2015), the duration, quality and reliability of supply as well as people's affordability to use electricity constitute important elements of the notion of electricity access.

Table 1. A framework for analysing women's empowerment through electricity access.

Dimension	Subdimensions	Specifications	Conditional factors
Empowerment 1 <i>Overarching issues</i>	Women and men's rights	Women and men's respective rights according to juridical and customary law and practice.	1. The material and socio-cultural context 2. The socio-technical design of the system of supply (intervention) 3. The gendered organisation of supply and process of implementation 4. The role of policies, regulations and international actors
	Gender ideologies and norms	How women and men are expected to be and behave, their roles and responsibilities	
	Social positions	How women and men of various ages and classes are valued	
	Material short-term opportunities	Access to and control over assets in the short term such as food, income, using light and appliances	
	Material long-term endowments	Access to and control over investments, savings, long-term financial security, ownership and accumulation of assets. Includes economic empowerment	
Empowerment 2 <i>Resources</i>	Social resources	Access to communication and social networks, social inclusion	
	Human resources	Access to information, education, knowledge, degree of drudgery (time use), comfort and convenience, health, safety. Includes psychological power	
		A person or group's ability to influence decisions which they conceive as significant in their lives. Includes political power	
Empowerment 3 <i>Agency</i>	Influence over life decisions	Ability to influence decision-making in everyday life which in sum affects a person's or group's autonomy and power to influence matters that affect or concern them	
	Influence over everyday decisions		
Negative events	Negative effects of intervention	Signs of deterioration in any of the above dimensions	
Agency in the realm of the intervention (electricity)	Influence over decisions regarding household electricity access	Ability to influence decisions regarding the household's subscription, installation, use and payment of electricity and acquisition and use of appliances	
	Involvement in and influence over system of supply	Involvement in and ability to influence electricity supply (governing, planning, sociotechnical design, implementation, management and operation)	

- (3) *The gendered organisation of supply and process of implementation.* The process of electrification is a crucial moment in time. During the planning and implementation process, major decisions are taken concerning the sociotechnical design, investments in equipment and recruitment strategies. Electricity infrastructures are costly, enduring and often physically heavy, and the decisions that are taken when they are being shaped have long-term consequences in terms of how supply works for various types users, who are able to subscribe and how it empowers the users (Winther 2008, 69–71; Clancy et al. 2007). Implementation processes may be gender neutral or gender sensitive, hence they influence recruitment strategies and who becomes involved in the supply of electricity. Systems of supply are always gendered and the degree to which women and men are involved may impact solutions and impacts.
- (4) *The role of policy, regulations and international actors* influence the shaping of electricity systems and thereby their gendered access and impacts. Electricity policies and regulations provide crucial framework conditions for supply, for example, by regulating the price. Also more general policies such as social support schemes and ensuring women's representation in decision-making bodies may impact electricity supply and its gendered effects. Finally, international actors and initiatives (for example, SE4ALL, SDGs) and bilateral partners often contribute to shaping electricity policies, investments, provision and use.

The overall framework (Table 1) can be used for analysing women's empowerment and the underlying conditions of electricity's gendered impact. The material and sociocultural context (factor type 1) always comes into play because this constitutes the entry point for electrification upon which the empowerment dimensions rests. The remaining three types of conditional factors are also likely to influence women's empowerment through electrification, and in contrast to the sociocultural context, they are issues that can be influenced directly by policies and programmes. The framework may also be used for analysing the empowerment of other groups than 'women' (for example, marginalised ethnic groups, subgroups of women) and for examining the impacts of other types of interventions beyond the provision of electricity access.

We now shortly describe the methodologies used in the literature before employing the framework for reviewing the empirical evidence.

4. Methodologies used in the literature for studying the impact of electricity access on women's empowerment

4.1. Quantitative research

The reviewed statistical studies draw on large data sets that derive either from existing population censuses or energy surveys conducted in the recent past, and they often employ modelling for estimating electricity's impact.¹⁰ The central purpose of these studies is to quantify the impact of having electricity access. They all focus on geographic areas with a connection to the grid, treating such access in binary terms: either people have a subscription or they do not. They set out to test hypotheses with predefined dependent variables on which the magnitude of electricity's impact is measured. The use of standardised questions and large samples in such studies enhance comparison and statistical aggregation of the data (Patton 2001, 227).¹¹

Thematically, most of these studies looked at singular indicators of electricity's gendered impact on welfare indicators (subdimension 2d). For example, they examine to what extent household access to electricity reduces the time women (and men) spend on drudgery or enhances children's enrolment in school. Others focus on material resources (subdimensions 2a/b) either electricity's impact on women's employment (on Nicaragua, Grogan and Sadanand 2013; on South Africa, Dinkelman 2011; and on India, Van de Walle et al. 2015; on India) and/or shifts in fuel use.

Electricity's impact on gender norms and fertility rates, hence overarching issues (dimension 1), has also been studied (Hoque 1988; Jensen and Oster 2009; La Ferrara, Chong, and Duryea 2012).

Most of these studies are 'causal' in that they systematically control for other factors that may explain the observed differences between households with and without electricity (IEG 2008; Jensen and Oster 2009; Dinkelman 2011; Khandker et al. 2014; Grogan and Sadanand 2013; Van de Walle et al. 2015). Others only show a correlation between electrification and selected variables (for example, Heltberg 2004).¹² Positioned in-between are studies that construct strata in their samples (for example, based on income and education) to provide accounts of how electricity impacted each of these groups (UNDP/ESMAP 2004; World Bank 2009).

The statistical studies examine the impact of electricity by comparing households with and without access at a given moment in time, though some offer a longitudinal perspective (Dinkelman 2011; World Bank 2009). These studies rarely account for the use of observational data, but sometimes imply that they also make use of observations (for example, UNDP/ESMAP 2004, 61). The authors often discuss and suggest, rather than document, some of the mechanisms through which the effects might have occurred. However, as noted by IEG (2008, 46) for studies on electricity's impact on education, there is often a lack of analytical focus on the causal chain from electricity to impact. This implies that the channels for electricity's impact remain unknown. The lack of explanatory power may be linked with a limited selection of indicators, and also the selection of models affects the relevance and validity of the results.

4.2. Qualitative research

The qualitatively oriented research tends to present case studies on electrification in a given context in order to understand the different interests, power relations and mechanisms at work, and the social processes that suffuse electricity interventions. The purpose of these studies is often to understand how and why various groups start using electricity in specific ways and the social impact of such shifts.

One type of qualitative study includes fairly rapid assessments, interviews and/or focus group discussions with a limited number stakeholders and/or end users (for example, Sovacool et al. 2013). A second type is based on in-depth interviews and ethnographies drawing on long-term fieldwork, informed by anthropology and human geography (Wilhite 2008a; Winther 2008; Matinga 2010; Standal 2008). A third type is the use of mixed methods, in which quantitative and qualitative methods are employed in combination, typically a survey covering a sample of 100–200 respondents and semi-structured interviews and observations (for example, Annecke 2005).¹³ We also include one historical study based on document analysis (Matly 2005). The reviewed studies cover areas with both grid electrification and decentralised systems of supply. The latter comes in a variety of forms ranging from village-scale mini-grids to solar home systems (SHS) and portable systems such as lanterns. Some of the studies cover all the elements in our framework.

Qualitative studies rarely document school enrolment and study time, which may be due to a lack of longitudinal and statistical data on children's school performance as well as a lack of minutiae documentation of daily time use on various practices. Because of the limited number of respondents in most qualitative research, the results pose challenges to generalisation on aspects that require counting of instances (that is, lack of representative results). Various case studies have looked at similar topics, providing a potential for accumulating knowledge, as we attempt to do in the present, but we did not come across comparative case studies in the realm of electricity and gender.¹⁴

5. Evidence deriving from quantitative studies

We now employ the framework to review the literature. We examine to what extent and how empowerment's various dimensions have been treated, starting with statistical studies and

followed by qualitative studies (Section 6). We thereby also demonstrate the framework's practical application.¹⁵ The results are illustrated in Appendix A and details from the quantitative studies are given in Appendices B and C.

5.1. Overarching issues

Meaningful use of electricity implies the use of light and appliances such as mobile phones and TV sets. Access to watching television has had a positive impact on gender norms and how girls are valued compared to boys (Hoque 1988; La Ferrara, Chong, and Duryea 2012; Jensen and Oster 2009, 1091). The assumed mechanism is that women have gained knowledge (subdimension 3d) about family planning through television and learned about and adopted alternative gender norms, which reduced their likelihood of having many children (La Ferrara, Chong, and Duryea 2012; Jensen and Oster 2009). In one of these studies, the interpretation was substantiated through assessment of changes in norms; women with access to cable television were less inclined to agree that it is acceptable for a husband to beat his wife and tended to have a lower preference for having sons rather than daughters (Jensen and Oster 2009).

5.2. Material resources

Three studies have documented electricity's impact on women's employment and arrive at different conclusions. In rural South Africa, it was found that electricity induced 9 per cent increase in women's employment rate over a period of 5 years, when other factors were controlled for (Dinkelman 2011, 3080). At the same time, the uptake of electric stoves increased, and women, who were often head of households, reduced the time spent on drudgery. The author attributes women's increased participation in the labour market to grid electrification through reduced drudgery and the facilitation of microenterprises.

Also in Nicaragua, the arrival of electricity spurred women's participation in the labour market. One study found that women became 23 per cent more likely to be employed due to household electrification, other factors controlled for, while there were no such effects for men (Grogan and Sadanand 2013, 261). The Nicaraguan study also documents that access significantly increased the amount of time people spent on salaried work, which rose by more than four hours per day for both women and men (256).

In one of the studies from rural India,¹⁶ Van de Walle et al. (2015, 31–2) measured the amount of time women and men spent on various types of work. In contrast to the two previously mentioned studies, they found that women's time use on regular wage work did not increase as a result of electrification. The authors suggest that women's wage work might actually have decreased, though this is not a statistically significant finding. In contrast, men significantly increased their annual wage work and reduced their time on casual work while women increased the amount of time spent on casual work. It may seem that electricity here triggered men to pursue formal work, reducing their casual work which in part was taken over by women.

A historical study from the US (Lewis 2015) provides some insights into the relationship between electrification, women's work and employment. This study on the impacts of electrification in the US between 1930 and 1960 found no evidence that the uptake of modern technologies through electrification led to an immediate increase in women's employment rate at the time when they were introduced. However, when comparing women born in 1920 and 1950, the study observed that differences in *childhood access to modern home technologies* could account for almost 25 per cent of the rise in women's employment in the period (542). The author suggests that this observed postponed effect of having access to modern appliances partly explains the paradox of the 'household revolution' in which time-saving appliances were taken in use without having immediate effects on time-use patterns (cf. Cowan 1983): 'It took several decades for the full impact of these new technologies to be felt' (Lewis 2015, 542). Although there are important

contextual differences involved, Lewis argues that this finding may imply that the benefit of electrification projects in the South may be underestimated.

Despite the general emphasis on poverty reduction in development, this review did not find statistical studies that provide gender disaggregated data on electricity's impact on income and expenditure.

5.3. Human resources

Almost all the reviewed studies cover various aspects of electricity's impact on women's access to human resources and find a positive effect.

5.3.1. Reduced time spent on drudgery

Both women and men tend to reduce the time spent on drudgery and household chores due to electrification and some studies look at such time use in combination with uptake of modern stoves such as kerosene stoves and low pressure gas (LPG).

In a study from rural India (Khandker et al. 2014) which accounts for causality, women and men saved a relatively modest amount of time collecting fuel due to electrification (3.3 h each per month). Because women here initially spent twice as much (ca 12 h per month) as men on this activity, we conclude that men gained relatively more than women from this shift. In Nicaragua, men initially spent twice as much time collecting fuel than women, and here electricity caused a dramatic reduction in men's time use (65 min per day), and slightly less but still considerable reduction in women's time-use collecting fuel (45 min per day), other factors accounted for (Grogan and Sadanand 2013).

On the effects of electrification on fuel use for cooking, firewood went down by 3.9 per cent as the main fuel for cooking in South Africa, while the use of electricity for cooking increased by 5.6 per cent (Dinkelman 2011). In this case, the shift in cooking technology was a documented explanation for the reduction in drudgery, whereas in the Nicaraguan case mentioned earlier, the authors suggest that the reduced time used to collect fuel might be linked to a growing uptake of gas stoves (Grogan and Sadanand 2013). Another robust study from India found that electricity access increased the likelihood of owning a kerosene stove by 13 per cent and that such items were kept by 56 per cent of those with electricity access (Van de Walle et al. 2015, 30–31).

In studies that only treat single difference (for example, ESMAP 2002),¹⁷ the results should be carefully interpreted, but sometimes people's different affluence is considered. A study on women's time use in India (UNDP/ESMAP 2004) found that when having electricity access, women generally spent 40 min less per day cooking and collecting firewood compared to households without access. The time use was further reduced if the household also owned a television set. This trend was the same for all levels of income (six income groups). The authors suggest that the benefits from electricity in some respects may be more important as a condition for living than one's socioeconomic status: 'women from households with electricity in the lowest-income group seem to have an easier and more balanced life than those from the highest-income group in households without electricity' (60).

5.3.2. More years in school and more study time

The second type of human resources treated by quantitative studies relates to children's education. Electricity's positive effect on children's school enrolment and time spent studying¹⁸ has been documented in statistically robust studies (World Bank 2009; World Bank 2013; Khandker et al. 2014; IEG 2008, 46, 127, 129). While we draw on the data for highlighting gender differences, several of these studies have been more preoccupied with showing the variation between rich and poor households.

In Bangladesh, a statistically robust study found that both girls and boys completed about 4 years of schooling and wanted to examine electricity's impact in this respect (World Bank 2009).

For all income groups, electricity access had a greater positive impact on girls' completed schooling years than boys' completed schooling years. Girls from poor families gained almost as much as rich girls while the result for boys was less for both economic groups, and particularly low for boys from poor families. The same tendency occurred with respect to children's study time. If the family lived in an electrified village but did not have access, girls completed approximately the same duration of schooling as those living in nonelectrified villages, whereas boys only completed less (3.64 years). Thus, girls gained particularly from household access and boys seemed to be more at risk of dropping out of school when there was electricity in the village but not at home.

In rural India, where girls' school enrolment generally lags behind boys, electricity access has contributed to closing the gender gap. A statistically robust study found that girls' enrolment increased by 14 per cent when the household got access to electricity, while the effect on boy's enrolment was insignificant (World Bank 2013, 29). The authors suggest that girls' increased schooling through electrification was linked to a reallocation of their home duties from daytime to the evenings when electricity (that is, electric light) is available. Thereby, electricity reduced the opportunity cost (lost labour) to parents of sending their daughters to school (World Bank 2013), which is an issue that has also been noted by Schultz (1993) (found in World Bank 2013, 7). This concurs with another study also from India which analysed the impact of cable television and showed 12 per cent significant increase in the enrolment in school of young girls – aged 6–12 years – due to cable television (Jensen and Oster 2009, 1083). This study also shows that electricity access may positively affect girl's education through access to entertainment and information by changing attitudes towards gender discriminating norms.

Drawing on a more limited sample, Daka and Ballet (2011) studied the relationship between the time children read and the time they spent doing housework. Electricity had a positive impact on girls' and boys' study time, and the authors argue (with some difficulties¹⁹) that girls living in households without a male bread winner benefitted particularly. The study suggests that in most cases, increased time use on homework did not reduce the total time spent on household chores. Rather, electric light enhanced the girls' own rescheduling of tasks (study in the evening) and also the mothers' ability to help their daughters do homework in the evening.

6. Evidence deriving from qualitative studies

Qualitative case studies on electricity's gendered impacts often focus on accounting for the observed effects. In the following, we provide a joint presentation of observed effects (that is, empowerment dimensions) and conditional factors that have come into play.

6.1. Overarching issues

Several studies have looked at the links between electrification and discriminating gender norms and practices, some of which persisted and hindered women from benefitting from electrification to the same extent as men (Winther 2008; Upadhayay 2009; Winther 2014; Standal and Winther 2016). In these cases, material aspects, such as limited investment in appliances, and sociocultural aspects (factor type 1) constituted barriers to women's general empowerment and implied that overarching issues were left unchanged. However, some studies have documented that electrification resulted in changing gender norms and relations, most of which treated the effects of interventions in which women played an active role (factor type 3, see discussion later).

6.2. Access to and control over resources

6.2.1. Material resources

Qualitative studies have mainly focused on the informal sector and found that women use electricity to increase their income either by establishing and running shops such as in South

Africa (Annecke 2005; Matinga 2010), by producing income from home (Winther 2008; Standal 2008; World Bank 2012, 50) and/or by using electricity to process and sell food. Women in Mali reportedly increased their income by 44 USD per year by using electrified tools for income-generating activities such as rice hulling and Shea nut grinding (Sovacool et al. 2013, 44).

In two Indian cases, electricity did not affect women's income (Winther 2014; Standal and Winther 2016, 38), while in Zanzibar, women's income from various home activities was too modest to make a substantial difference to their finances.²⁰ In Afghanistan, some women received salaries (material opportunities) through their jobs as responsible for maintaining and repairing the SHS in their village. However, they had limited power to decide on the spending of their incomes (Standal 2008, 64–65)²¹ hence, their material endowments did not increase. The Afghan case exemplifies that women's increased economic opportunities do not necessarily lead to their increased control of these resources and that agency (dimension 3) hence influence over decision-making is a crucial element for assessing empowerment.

Some studies have looked at the gendered access to electricity and how subsidy schemes (factor type 4) affected the connection rate of single woman households. One study (World Bank 2012) found that the introduction of a financing mechanism in Lao PDR which subsidised poor and 'female-headed' households (that is, single women households) increased the connection rate among female-headed households from 63 per cent to 90 per cent. In South Africa, a blanket subsidy for connections led to a high level of connections even among poor households and a 'basic' level of consumption provided about 50 kWh of free electricity per month per household (Matinga 2010). Hence, in both Lao and South Africa, women gained increased access to electricity through financing mechanisms. As we account for later, without such supplementing interventions, the literature suggests that it is men rather than women who tend to decide on and be responsible for subscriptions to the grid.

6.2.2. *Social resources*

Access to electricity's services radically changes the way people socialise within the household and beyond. Through reduced drudgery and the arrival of electric light, television and mobile phones, women find more time to socialise and relax (Annecke 2005). Women and men tend to congregate in households with televisions sets to watch television, radically changing socialising patterns in the evenings (UNDP/ESMAP 2004; Winther 2008, 174–182, Matinga 2010; Standal and Winther 2016). In South Africa, television watching was most common among young people (women and men) who jointly watched programmes even if they had televisions sets in their own homes (Matinga 2010, 79). People appear to sleep later after electrification, potentially reducing resting time, and also increasing the time spent watching television, as was found for the Philippines and Lao PDR (IEG 2008).²² In Zanzibar, women's concern for watching television (and pursuing income-generating activities through seaweed farming) was an important driver when they reduced the number of meals (cooked with firewood) after electricity's arrival in the village (Winther 2008).

Light has improved women's mobility outdoors, which is otherwise often restricted to them, and increased the sense of security around homesteads. Mobile phones²³ have been used by women to strengthen their communication with the outside world, including their natal families (Tenhunen 2014, 41; Winther 2014; Standal and Winther 2016) and thereby contributed to their increased agency and security. In West Bengal, women used mobile phones to call for support from their natal households in difficult times such as periods of food insecurity or when being mistreated by their husbands, and also enabled faster communication regarding funerals so that they could attend them (Tenhunen 2014, 41).

6.2.3. *Human resources*

Ethnographic work has studied in detail how women reschedule various practices with the arrival of electricity (for example, firewood collection, changes in time management of chore schedules, productive activities and television watching) which mutually impact each other (Winther 2008;

Millinger, Marlind, and Ahlgren 2012). Such shifts often involve reduced time on physically heavy work (drudgery) and to people who typically spend a large share of their time on such work increased time for relaxing is a sign of their improved human resources. The qualitative studies help to explain how and why this occurs. Electric light affects the *manner* in which household practices are performed, sometimes making them more efficient compared to when a kerosene lamp is used. Women in the Sundarbans described how the electric light helped them 'see better' and become more efficient, for example, by watching a boiling stew at a distance as they were cutting onions and being able to use both hands at the same time (Winther 2014, 55). The women also noted that electric light made it possible for several people to use the same light at the same time. Thus, in the case of scarce resources, families did not have to choose who amongst their children would use the light because they could use the illuminated space jointly, thus enhancing equal study facilities for girls and boys (54). This illustrates how the materiality of electric light, through its capacity to enlighten large spaces, often fixed on a surface, may influence people's time-use.²⁴

Some studies have looked at the links between children's study time and their parents' time use. In the Afghan study (Bamiyan), carpet-weaving was an established activity in the evening. Due to the electric light, the daughters could help their mothers in the evening and go to school during daytime (Standal 2008, 67–8). Daka and Ballet (2011) found a different pattern, also spurred by increased flexibility in that girls reallocated their study time from daytime to the evenings while continuing to help their mothers to the same extent as before electrification. The flexibility and rescheduling of tasks is important because it enhances efficiency and benefits women's position vis-à-vis husbands and family-in-law when there are greater opportunities to fulfil expectations, which in the Afghan study suggested less likelihood of domestic violence (Standal 2008, 85). With the possibility to quickly turn on the lights at night, some women reported that this allowed them to comfort their crying children at night and making sure everything was done 'on time' before their husbands became annoyed and beat them (Standal 2008).

The introduction of new appliances has also changed the *manner* in which practices are performed. Electrification in the US during the last century redefined the manner women ironed (Greenwood, Seshadri, and Yorukoglu 2005). When they switched from heavy cast irons to electric types which had a lighter weight, they avoided the process of heating the iron repeatedly and as a result women could manage the task with less physical effort than before. Thus, in addition to saving time, the modified ironing practice implied increased convenience and comfort. The case from Mali found that the shift from manual to electric grinding made women save up to 6 h per day (Sovacoal et al. 2013). Due to the arrival of electric water pumps and taps in a Zanzibari village, women and girls freed 20–25 h per week per household (Winther 2008, 58), while women in rural Uttar Pradesh freed up about 4 h a day for the same reason (Standal and Winther 2016, 37). In Zanzibar, this shift also meant that girls were no longer obliged to help their mothers collecting water and were sent to school to the same extent as boys.

In South Africa, the introduction of electric appliances invited changes in *the 'gender' of established practices* in that some men started engaging in cooking and ironing (Annecke 2005, 36; Matinga 2010, 184–5). In contrast, men would not (or only rarely) cook with traditional energy forms such as firewood and kerosene, and traditional ironing (with charcoal) was also women's sole responsibility (Matinga 2010, 148–9). The new technologies increased men's willingness to help with tasks considered to be women's tasks in their particular social context, thus modifying the conventions and norms governing specific social practices, and challenging gender norms (dimension 1). This shift was also spurred through legal backing and conscientisation asserted women's rights (Annecke 2005; also discussed in CRGGE 2006, 70). In combination, this led to a transformation of cooking and ironing as social practices in which men and women played slightly different roles than before.

Electricity may increase women's knowledge in important ways. In contexts where women became directly involved in electricity supply, they gained a new type of skills as well as higher

status (Standal 2008; Sovacool et al. 2013; Ulsrud 2015, 179). This exemplifies how the gendered organisation of supply (factor type 3) may affect women's human resources and their wider empowerment. In Afghanistan, women's access to television and radio programmes provided them with information about women's rights, which they believed had enhanced their role in family decision-making (Standal 2008). In South Africa, television taught women about their entitlements, voting processes and procedures for interacting with welfare institutions (Matinga and Annegarn 2013).

6.3. Agency

A few studies have observed increases in women's agency in the strong sense, hence their political power and ability to influence life decisions as compared to men. In most studies where a positive effect was found, they concerned cases in which women became involved in the supply of electricity (factor type 3). South Africa is an exception in that women's increased political power was linked to the high share of single female-headed households and the blanket subsidy for electrification (factor type 4) (Matinga and Annegarn 2013).

The studies from South Africa (Annecke 2005; Matinga 2010) and Zanzibar (Winther 2008) show in detail how women's agency in everyday matters increased through the many adjustments they made in daily routines, and more so compared to men who tended to stay more outside the home. However, most studies that have looked at decision-making in the realm of income and expenditures conclude that electricity access left this realm unchanged (Winther 2008; Standal 2008) and that women's influence on financial matters continued to be restricted through cultural conventions (factor type 1). In Afghanistan and India, decisions on expenditures were considered the privilege of the male leader of the extended family (Standal 2008; Standal and Winther 2016). In Zanzibar, enduring assets continued to be men's wealth due to discriminating customary rules for inheritance, marriage and divorce. Men invested in houses, electricity and other enduring assets, while women increasingly spent their incomes on providing for the families' everyday needs and experienced financial vulnerability in the long term (Winther 2008).

6.4. Negative events

Due to the complex ways in which electricity becomes embedded in a given context, it is not surprising that qualitative studies, which seek to grasp the multiple dynamics at work in a given context, sometimes find that there are negative effects associated with electrification. Electricity has increased social differences and social exclusion of poor people without access, of whom many are women (Winther 2008; Matinga 2010). Electricity has also strengthened patriarchal structures such as in the financial realm in Zanzibar, hence counteracted a central dimension in the process towards women's empowerment. Also in Uttar Pradesh, the arrival of electricity and appliances reinforced patriarchal structures because the modest improvements experienced by women solely provided them with opportunities to perform their traditional duties within the confines of their reproductive role (Standal and Winther 2016). Also, electrification spurred new expectations for dowry gifts, including television, refrigerators and air coolers (39), which is a phenomenon also observed among middle-class urban households in Kerala (Wilhite 2008a). In turn, the increasing burden of dowry negatively influences the rate of sex-selection abortions (abortion of females) and produces skewed sex ratios, which further reinforce gender inequality (John 2011).

6.5. Women's degree of agency in the realm of the intervention

The available research on women's degree of agency in the realm of electricity tends to focus on women-targeted interventions and decentralised systems. The remaining part of the literature observes that sociocultural aspects (factor type 1) and gender-blind interventions (factor type 3)

constituted important hindrances to women's influence over decisions on electricity. In Zanzibar and India, electricity's materiality in terms of fixed connections (factor type 2) and the gender conventions for decision-making and distribution of wealth (factor type 1) resulted in a situation where men became the owners of appliances, leaving women with limited power to decide on the installation of light and acquisition of appliances (Winther 2008, 160; Winther 2014; Standal and Winther 2016).²⁵ Again, South Africa stands out as an exception. Here, the demographic pattern (high share of single female-headed households), social protection policies and the blanket subsidy (factor type 4) also positively affected women's degree of influence over electricity at home (Matinga 2010; Annecke 2005).

Studies on gender-sensitive electricity interventions (Standal 2008; Sovacool et al. 2013; Ulsrud 2015; Matly 2005; ADB 2015) have documented that women's direct involvement in supply (factor type 3) increased their decision-making power and that this positively affected gender norms and women's social position in the communities. This occurred through an expansion in the type of roles considered possible and appropriate for women. In Afghanistan, training women to install and maintain SHS was reported to change some men's perceptions of a woman's possible roles. As expressed by a man, himself being a mullah, in the aftermath of the project: 'I saw that women and men are equal in this and that women have capabilities' (Standal 2008, 93). Also contributing to women's higher esteem was the trained women's ability to endure the hardship experienced when parting from their family during the 6 months' training period. Their 'sacrifice' of leaving behind what is seen as the most important institution in life; family and community, in order to help bring development, was often mentioned by both women and men as warranting much respect and reflecting the women's strength (Standal 2008, 56).

Conversely, governmental regulations to ensure women's representation in all organisations in Nepal and India did not have the effect that women became active during the village electrification process (Upadhayay 2009; Winther 2014). In Nepal, cultural barriers (factor type 1) prevented women from voicing opinions and their competences were questioned despite their training and experience (Upadhayay 2009, 72–3).

6.6. Conditional factors

The reviewed case studies show that electricity access does not alone produce social impacts. We now summarise the ways conditional factors have come into play in the reviewed qualitative studies. The material and sociocultural context (*factor type 1*) has often constituted a barrier to women's empowerment through electrification, sometimes even reinforcing existing gender inequalities (Winther 2008; Winther 2014; Standal and Winther 2016). However, this was not the case in South Africa, where men, through a reorganisation of social practices, started to take on household tasks such as ironing and light forms of cooking, hence modifying the boundaries of what was considered women and men's household responsibilities (Annecke 2005; Matinga 2010). In Afghanistan, the picture was more mixed in that women's involvement in the supply of electricity challenged existing gender norms, while at the same time, the sociocultural context continued to be a barrier to women's agency, for example, through their lack of influence over household expenditures.

The design, management and ownership of the sociotechnical system (*factor type 2*) have mainly been treated in studies on decentralised systems and most research on this topic has been concentrated on electricity provision carried out by the public sector, NGOs and community-based arrangements and not on privately owned systems, though there are exceptions (CRGGE 2006, 56; Ilskog and Kjellström 2008).²⁶ The few studies that looked at the impact of price (and subsidy schemes) on women's access found that this mattered in important ways (World Bank 2012; Matinga 2010; Ilskog and Kjellström 2008). In Zanzibar (grid) and India (mini-grid), it was observed that electricity's materiality in terms of fixed connections resulted in men becoming owners of appliances, leaving women with limited decision-making power in the

realm of electricity (Winther 2008; Winther 2014). However, few studies have scrutinised the technical details in the system of supply and examined the links between technology and women's empowerment. When affordable and available, the type of access obviously conditions all the other impacts.

Many of the reviewed qualitative studies have emphasised that the gendered implementation process and organisation of electricity (factor type 3) conditioned electricity's impacts in important ways. In cases where gender or women targeted approaches were adopted, this resulted in women's inclusion in supply and wider empowerment processes (Matly 2005; Standal 2008; Sovacool et al. 2013). Conversely, gender-blind interventions implied that only men became involved in supply, reinforcing structures of inequality (Winther 2014; Standal and Winther 2016; see also Annecke 2005, 5; Matinga 2010, 48).²⁷

As to the role of policy, regulations and international actors (factor type 4), some studies show that gender-sensitive interventions were either informed by government policies in combination with international donors (Sovacool et al. 2013) or by non-governmental actors (Standal 2008). Grid studies from South Africa showed the significance of policies and subsidy schemes to women's access to electricity (Annecke 2005, 37; Matinga 2010, 57–8).

International donors are often directly involved in off-grid programmes, which tend to run parallel to or as extensions of conventional supply (IEG 2008, XV), and may thereby have a more direct influence in promoting a gender equality agenda. In contrast, the expansion of grids tends to be initiated and controlled by governments, though often financed by international multilateral development partners and banks, and are focused on infrastructure with few if any sociocultural interventions. Another explanation for the lack of gender approaches in grid interventions could be that most studied grid projects have emerged from policies designed over 30 years ago, hence previous to when gender considerations became an articulated issue in electrification programmes. Until rather recently, actors such as the World Bank have rarely included gender objectives in their project design (IEG 2008, 12–3). In sum, interventions influenced by international donors have addressed off-grid solutions adopting gender-sensitive approaches, while in the studied cases from grid areas donors have rarely been directly involved and gender issues have not formed part of project design or practice.

7. Discussion: evidence, explanations and knowledge gaps

The presented material has shown that the pathways to women's empowerment through electrification are multifaceted and that there is a need for more systematised knowledge on the electricity-gender nexus. The 'distribution of work' between quantitative and qualitative studies is striking. Quantitative studies have been carried out in grid areas and have primarily measured electricity's impact on single indicators for women's welfare (drudgery/time use, fertility and education), fuel use, employment and gender norms. Qualitatively oriented studies have looked at various types of supply and studied how electricity access in a given context has influenced women and men in everyday life, sometimes focusing on the role of the design of the systems of supply and the process of electrification.

Among the reviewed studies, almost all find a positive impact of electricity access on women's welfare and human resources. However, changes in men's situation are only rarely addressed, and when they are, men sometimes gain more than women in terms of saved time use on drudgery and increased employment. Hence, the overall impact on gender relations often remains an open question. Nonetheless, the reduced drudgery and enhanced capability to reorganise tasks are striking, and in one sense appears as the source of many other effects. The changes in time use partly occur through uptake of electrical appliances that substitute manual labour and partly as a result of women's desire to pursue other activities such as education, watching television and income-generating activities. However, in single studies aimed at quantifying electricity's impact, the limited number of variables and indicators has reduced the potential for understanding these

dynamics. For example, studies that have documented shifts in time use do not always provide data on fuel (UNDP/ESMAP 2004), whereas studies that have examined fuel and/or cooking technology (Van de Walle et al. 2015; ²⁸ Dinkelman 2011) do not include data on time use. In both kinds of studies, the authors suggest that the two aspects (time-use and fuel-use) may be linked. Moreover, the study of time use and employment in Nicaragua suggest that electricity 'monetised' the realm of cooking fuel, implying that electrification triggered a shift from collecting solid fuels to purchasing fuels to be used with gas stoves (Grogan and Sadanand 2013, 251). Here, data on fuel use and also wider, contextual data such as the particularities of the labour market could have shed more light on the underlying mechanisms for electricity's impact.²⁹

The uptake of modern stoves does not necessarily lead to a switch in fuel use for cooking (Heltberg 2004), and Nathan et al. (Forthcoming) suggest that the main drive to adaptation, hence, use of labour-saving devices for cooking, is women's access to income-generating activities. Furthermore, when men in South Africa started taking up cooking and ironing after electrification, it suggests that electricity, backed by institutional support for gender equality, catalysed a shift in gender roles and responsibilities. There appears to be an important relationship between household electricity access, time use, uptake of modern stoves, access to income opportunities and gender roles and relations, which remains largely unexplored. Statistical studies have also shown that access to using media and mobile phones has modified gender norms and caused significant reductions in high fertility rates, though such developments are unevenly distributed and we need to better understand how such shifts occur.

Education is a realm in which the evidence is clear: access to electricity enhances children's school enrolment and study time and girls' in particular. Even among poor households who obtain electricity access, girls gain disproportionately compared with boys. This provides a different perspective on the general thesis that wealthier groups tend to benefit most from having access to electricity, but again, the channels for electricity's effect on school enrolment is far from understood. As to phones, women's general mobility is restricted in many places and work migration is increasingly dividing families, hence the impact on women's empowerment of being able to communicate from home with the outside world is also a topic that deserves more attention.

As to electricity's impact on women's employment, the statistical studies provide varying results, and their explanatory strength would have been enhanced through more contextual insights. Moreover, increased employment rates for women might give them more control over resources in the long term, but not necessarily so. A central finding in the qualitative studies is that women do not always control their own incomes, and that the existing, gendered distribution of wealth sometimes serves to prevent women from obtaining control over electricity's uses and wider benefits. Men tend to have more power to decide and own appliances and mobile phones.

When women have been directly involved in supply and become associated with electricity's services (Afghanistan, Mali, USA), this has led to changes in gender norms in the local community. Strong institutional support including developing capacities and competencies for women's involvement appears to enhance the process of empowerment through electricity interventions. In contrast, gender blind electrification processes have implied that men became recruited as staff and served to reproduce structures of inequality. In South Africa, this trend was balanced through blanket subsidies which enhanced women's access to and power to decide on electricity, the latter being further aided by prevalence of female headed households. Most of the interventions which targeted women in the process were clearly donor influenced, and it is unclear from the evidence to what extent the observed changes in gender perceptions will endure after the donors pull out of the project. Based on the reviewed evidence, it appears that women's inclusion in electricity supply and access to particular television programmes are two relatively simple and effective policy tools that could enhance women's empowerment.

The evidence on electricity's impact on 'empowerment enablers', such as education, access to information through television, and time use, is relatively well documented but there is a need for more knowledge on other empowerment dimensions and the underlying mechanisms at work. One of the questions to which the reviewed studies answer far from unequivocally is whether

women by obtaining electricity access gain more decision-making power in relation to men. Electricity access induces an immediate reorganisation of social life where practices come out of the habitual realm, which may result in women getting more influence over decisions in everyday life. But whether this, as well as increased opportunities for income, translates into more agency and control over long-term resources is often answered negatively when the topic is investigated. Because agency and control over enduring assets are crucial elements of the process of empowerment, these issues deserve more attention in research, policy and practice on electricity provision. Finally, there is a pressing need for research on how various types of systems of supply, processes and framework conditions impact gender relations.

While we sympathise with recommendations provided in previous reviews on energy and gender (Kelkar and Nathan 2005; CRGGE 2006; Clancy et al. 2011) in that women have an equal right to be included and participate in forming solutions for electricity supply, we question the way the problem and solutions have often been framed. Women's rights and empowerment tend to be solely aligned with economic outcomes in terms of making women's labour more productive and enabling them to increase their income. International discourse has also focused on ensuring women's access to modern energy including electricity, capacity-building, and a supportive institutional and policy environment. While these recommendations are laudable and important as partial steps towards women's empowerment, the focus on quantitative evidence and checklists risks conflating gender-equality and 'women's issues', and further increasing women's work burden. Also, as shown in this review, there is a striking lack of evidence on the impact of electricity access on women and men's finances (incomes and expenditures) and control thereof. Ultimately, women's empowerment can only be understood by comparing how the provision of electricity access affects women's and men's relative rights, control over resources and decision-making power. Such studies would necessarily have to also include a focus on men's situation, and pay attention to the structures of gender inequality that always condition electricity's impact. This kind of knowledge would be useful not only for answering the question of whether electrification empowers women or not, but for shedding light on what the barriers are and what it would take to maximise women's empowerment through various types of access and processes. Currently, most studies on gendered impacts of electrification lack this comparative/relational dimension.

8. Conclusion: call for a broader and deeper kind of knowledge

This literature review has examined the empirical evidence on electricity's gendered impacts in the Global South. Drawing on Kabear (1999; 2001), we developed and employed a framework for analysis. The framework considers women's empowerment as a process towards gender equality, understood as women's and men's equal rights, access to and control over resources, and ability to influence matters that concern or affect them.

The first step for understanding the concept of empowerment was to identify empowerment's three dimensions which may all be influenced when women and men in a household obtains a given type of electricity access. We believe that the identified dimensions – rights, resources and agency – and the focus on potential negative effects are applicable not only for analysing women's empowerment through electricity access but through development interventions in general. In addition, we focused on women's agency within the realm of the intervention, and found that this constituted an important, conditional factor. We also brought attention to women's agency in electricity on the household level, which was often relatively constrained.

In addition to mapping the evidence in a consistent way, the framework brings attention to the mechanisms and underlying factors that are likely to condition the gendered impacts of various types of electricity access. In addition to women's degree of involvement in supply (factor 3), we highlighted the role of the material and sociocultural context (factor 1), the design of the socio-technical system of supply (factor 2) and the role of policy and regulations (factor 4). The framework enhances methodological clarity by showing how previous quantitative and qualitative

studies have, in distinct ways, contributed to documenting and explaining electricity's impacts and by employing the framework several knowledge gaps were revealed. We therefore believe that the framework can contribute to future research on women's empowerment.

At present, various off-grid solutions are implemented at a rapid speed, and it is noted that this is necessary in order to provide electricity access for all (IEA/World Bank 2015). The various types of access and their gendered nature and impacts merit the attention of research, and the combined use of quantitative and qualitative methods may help to account for how policies, the design and processes of interventions, together with the material and sociocultural context, jointly produce a given set of gendered impacts. We argue that the framework can be employed for enhancing dialogue on results and approaches between different research communities. This is crucial to accumulate a knowledge base on which policymakers and the civil society can act. As demonstrated in this article, there has been a distribution of work between quantitative and qualitative studies in that the former have tended to focus on grid access and quantified the impact of this on women's human resources (welfare indicators), while qualitatively oriented studies have focused on decentralised systems, including the process of electrification, and analysed various gendered dynamics and impacts. These distinct foci of research have reduced the explanatory power and robustness of the overall evidence available in literature. Statistical studies have offered solid evidence on the magnitude of electricity's impacts on a selected set of variables, but they have provided limited explanations. Based on single case studies and limited samples, the results deriving from anthropology, ethnography, human geography and qualitative methods have provided in-depth knowledge that allows for contextualised interpretation of results, which helps to account for the mechanisms through which electricity produces social effects.

When used in empirical studies, some of the dimensions and subdimensions may readily be transformed into indicators to quantify some of the impact of electrification (for example, time spent collecting firewood), while others are better understood qualitatively (for example, women's and men's social positions). In single studies that seek to cover as many dimensions as possible, we propose the use of mixed methods, which enhance the production of results that may also yield relevance elsewhere (transferability) and at the same time account for the underlying mechanisms for electricity's impact.

Furthermore, we argue that the framework may serve to enlighten how the three different goals in energy interventions (welfare, economic empowerment and political empowerment) are interconnected, which may lead to the operationalisation of better targeted gender goals. Finally, given that the structural problem of gender inequality is placed at the core of the framework, it is a radical, 'agenda-setting' approach (Jahan 1995; cf. also Cornwall and Rivas 2015), and therefore a tool with capacity to examine the potential for transformation in gender relations – and for discovering which measures it would take in electricity policy and beyond to offset the structures that produce gender inequality. A crucial step towards this goal of transformation is to continue the debate on how to conceptualise empowerment in the realm of electricity access.

Beyond the abovementioned arguments for a systematised, broader and deeper kind of knowledge on women's empowerment through various types of electricity access, we suggest that the explanatory power of statistical studies could be enhanced by increasing the number of dependent variables. Thematically, their focus could be broadened by including the gendered control and uses of light and appliances (for example, whether lamps are used in kitchens, whether and how boys and girls use lights to study), which would help nuance the gendered impact of electricity access. Qualitative studies could contribute more effectively to the overall body of knowledge if they were attuned towards similar themes as statistical works (for example, education, employment, fertility) while focusing on the underlying mechanisms for electricity's impact. Women's and men's tasks and responsibilities are sometimes organised differently than what stereotyped images imply and there is a lack of focus on men's role and how men, women and gender relations are impacted by various types of electricity access. Finally, there is almost no research on commercial electrification initiatives, their impacts on gender relations and the ways they integrate gender issues into their activities, and this issue deserves more attention.

Notes

1. As accounted for in [Section 2](#), we first assessed the literature and then developed the framework. The reason why the article presents our results in the opposite order is to obtain better readability and reduce word length.
2. In the Global Tracking Framework, set up by Sustainable Energy 4 All, access to energy is defined not as actual subscriptions but as the 'ability of an end user to utilize an energy supply that can be used for desired energy services' when issues such as affordability and geographical location are accounted for (ESMAP 2015, vii). A problem with this method of accounting is that it is theoretical, as we do not know whether people with 'access' are actually using – or able to use – the energy.
3. Department for International Development, UK.
4. We have not assessed the methodologies used in statistical studies in detail (for example, assessed prospective designs or decision rules). When we denote a study 'causal', it implies that the study controls for other factors (than electricity) that may contribute to explain the observed differences between people with and without access.
5. Although an important matter, we do not treat health aspects in detail because these have rarely been treated in the electrification literature. Electrification of public institutions and services may have important health impacts, and the health aspects of cooking are treated in other types of work, which are also beyond the scope of this article.
6. Kabeer nonetheless acknowledges that structural inequalities exist, for example, based in class, caste and gender, and that they cannot be addressed or solved by individuals alone (Kabeer 1999, 457, Kabeer 2001, 27).
7. We consider rising employment rates as a sign of increased access to material endowments because employment is relatively enduring and likely to provide a person with new experiences and skills (human resources, see discussion later), which may be considered as an investment in future positions. However, for any type of income, women's potential for material and economic empowerment rests with their power to influence decisions regarding how the money should be spent or invested.
8. Here we draw on a combination of health considerations (Matinga 2010, 28–39) and the notion of time poverty in terms of having enough time for rest and leisure (World Bank 2006, 6). Because time poverty implies having limited choice regarding time use, as captured in the notion of 'time capabilities' (Walker, Berekashvili, and Lomidze 2014, 51), reduced drudgery may also imply increased agency in everyday life.
9. Denoting the two main groups as 'women' and 'men' is evidently a simplification because they are highly heterogeneous groups and vary internally according to age, education, occupation, sexual orientation and other characteristics (for example, intersectionality).
10. In quantitative studies, control groups are often established at the time of the study/evaluation and most studies account for causality by comparing the situation of households with and without a subscription. We found no study that had randomised control trials (RCTs, elaborated in White, 2013) for studying electricity's gendered impact. Simulation models (IEG 2008) have been developed to derive quantifiable estimations of the general (not gender disaggregated) social benefits from electrification, using a limited number of dummy values for estimating electricity's socioeconomic effects.
11. The way we distinguish between quantitative and qualitatively oriented research based on the literature review is in line with Patton (2001).
12. We do not draw on an often quoted study by Barkat et al. (2002) which does not account for causality in a treatment of electricity's socioeconomic impact in Bangladesh. For a critique of the way this study estimated productive gains from electrification, see IEG (2008, 109).
13. This review primarily focuses on rural areas, but we include this source because it provides an in-depth gender analysis of electrification and focuses on other sociocultural aspects as well.
14. Comparative case studies take two or more in-depth case studies as the object of analysis, and may enhance the production of generalisable knowledge about causal questions. See, for example, http://devinfo.live.info/impact_evaluation/ie/img/downloads/Comparative_Case_Studies_ENG.pdf.
15. None of the reviewed studies (except Winther 2014; Standal and Winther 2016) had followed a similar approach to analysing empowerment; thus, the analysis of previous research reflects our own interpretations of the material based on the proposed framework and does not reflect categorisations provided by the respective authors.
16. In another study from India (UNDP/ESMAP 2004, 60), Barnes and Sen found that women with electricity at home spent more time earning an income than households without, but this single difference estimate used within various economical strata (that is, not systematically controlled for) only applied to poor and middle-income groups and not to women from wealthy households who slightly reduced the time spent earning an income.
17. The study from the Philippines observed that people with electricity access spent 1 h less drudgery per day compared to those without electricity, and such differences may be due to several factors, for example, richer households might be more likely to own LPG stoves which lead to saved time collecting fuel.

18. These kinds of studies have also observed that women with electricity access spend more time reading than other women (UNDP/ESMAP 2004) but their likelihood of reading does not necessarily increase (IEG 2008).
19. When deriving at this conclusion, Daka and Ballet (2011) seem to have compared boys in households led by a man (with or without a wife) with girls in households led by a women, thus the result has important limitations.
20. In Zanzibar, electrification primarily benefitted people financially through employment in public institutions in the village. Apart from this sector and tourism (from which most local people were excluded), electricity did not spur main, new productive activities (Winther 2008, 60–1).
21. In South Africa, women shop owners sold electricity tokens, providing additional incomes (Matinga 2010), and in Afghanistan, the electric light enhanced women and children's opportunity to weave carpets in the evening, which was an important income source (Standal 2008). In Zanzibar, some women did handicrafts in the evenings which gave the small amounts of income. Shop owners rapidly included a range of electricity-related products in the village, but they were all men (Winther 2008). Access to using assets such as refrigerators allowed some women to sell cold drinks (Zanzibar, Winther 2008, 242) and fresh food (South Africa) and earn some income (Matinga 2010, 291).
22. IEG (2008, 46) found that people reduced the amount of sleep with 1–2 h, whereas time spent watching television was in the order 1–3 h. In Barnes and Sen's sample from India, women with a television set at home spent almost two hours per day watching television (UNDP/ESMAP 2004, 7). In Zanzibar people slept for about 1–2 h less after village electrification and 74 per cent of men and 52 per cent of women said they watch television at least three times a week. On average, those who watched did so for more than two hours on average on each occasion (Winther 2008).
23. Many of the reviewed studies were conducted before the general spread of mobile phones, so the presented evidence on this issue is limited in the present discussion.
24. The particular quality and brightness of electric light is also a key in cost-benefit models for estimating the welfare impact of electrification which involves comparison of the technical quality of electric light (lumen) with that of kerosene light (ESMAP 2002; IEG 2008).
25. As an illustration, the Sundarban survey ($N = 106$) observed that 27 per cent of the households subscribing to tariffs that allowed for either three or five light points did not have electric light in the kitchen (Winther 2014, 52).
26. In a study from Eastern and Southern Africa, Iliskog and Kjellström found that private organisations had a higher share of women staff than governmental organisations (Iliskog and Kjellström 2008, 2679).
27. In Zanzibar, two different processes on different levels led to distinct results. The grid project was managed top-down and included a concern for women end users, which resulted in electrified public services that benefitted women in particular. However, in the locally run process of electrifying a specific village, women's interests were not accounted for and their productive interests were ignored during electrification (Winther 2008).
28. Van de Walle et al. did not manage to document time-use due to 'noisy' data (2015, 9).
29. Not only the selection of indicators but also the selection of models may affect the relevance and validity of the results. In one of the reviewed studies (Salehi-Isfahani and Taghvatalab 2014), two different models were used on the same data set for estimating the impact of electrification on fertility rates. The two models produced contradicting results: one showed that electrification led to increased fertility while the other showed the opposite.

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Notes on contributors

Tanja Winther leads the research project and is a social anthropologist and power engineer affiliated with the Centre for Development and the Environment (SUM), University of Oslo, Norway.

Margaret N. Matinga is a social anthropologist and worked on this project through the consultancy company, Dunamai Energy, Malawi.

Kirsten Ulsrud is a human geographer specialising in energy transitions, based at the Department of Sociology and Human Geography, University of Oslo.

Karina Standal is a PhD candidate working on electricity and women's empowerment, based at the Centre for Development and the Environment (SUM), University of Oslo.

References

- ADB (Asian Development Bank). 2015. "Women Become Solar Warriors". Powering the Poor: Projects to increase access to clean energy for all, 5–11. Philippines: Asian Development Bank, Accessed 4 May 2017. <http://www.adb.org/sites/default/files/publication/29138/powering-poor.pdf>.
- Annecke, W. J. 2005. "Whose Turn Is It to Cook Tonight? Changing Gender Relations in a South African Township." Report of the Collaborative Research Group on Gender and Energy (CRGGE), the ENERGIA International Network on Gender and Sustainable Energy and the Department for International Development (DFID), UK. Published by independent researcher/consultancy firm: Gender and Energy Research and Training, Cape Town, South Africa, https://assets.publishing.service.gov.uk/media/57a08ca4e5274a27b2001317/R8346_finrep_annecke.pdf
- Arksey, H., and L. O'Malley. 2005. "Scoping Studies: Towards a Methodological Framework." *International Journal of Social Research Methodology* 8 (1): 19–32. doi:10.1080/1364557032000119616.
- Barkat, A., S. H. Khan, M. Rahman, S. Zaman, A. Poddar, S. Halim, N. N. Ratna, et al. 2002. "Economic and Social Impact Evaluation Study of the Rural Electrification Program in Bangladesh." Human Development Research Center (HDRC), NRECA International Ltd, Rural Electrification Board of Bangladesh and USAID for the Rural Power for Poverty Reduction Program. Dhaka: NRECA International Ltd. (National Rural Electric Cooperative Association).
- Bijker, W. E., and J. Law. 1994. "General Introduction." In *Shaping Technology/Building Society: Studies in Sociotechnical Change*, edited by W. E. Bijker and J. Law, 1–14. Cambridge, MA: Massachusetts Institute of Technology Press.
- Bourdieu, P. 1977. *Outline of a Theory of Practice*. Cambridge: Cambridge University Press.
- Butler, J. 1990. *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge.
- Clancy, J., F. Ummar, I. Shakya, and G. Kelkar. 2007. "Appropriate Gender-Analysis Tools for Unpacking the Gender-Energy-Poverty-Nexus." *Gender & Development* 15 (2): 241–257. doi:10.1080/13552070701391102.
- Clancy, J., M. N. Matinga, S. Oparaocha, and T. Winther. 2011. "Social Influences on Gender Equity in Access to and Benefits from Energy." Background paper to The World Development Report 2012, Washington, DC: World Bank. Accessed 4 May 2017. <https://openknowledge.worldbank.org/bitstream/handle/10986/9207/WDR2012-0029.pdf?sequence=1>.
- Cornwall, A., and A.-M. Rivas. 2015. "From 'Gender Equality and 'Women's Empowerment' to Global Justice: Reclaiming a Transformative Agenda for Gender and Development." *Third World Quarterly* 36 (2): 396–415. doi:10.1080/01436597.2015.1013341.
- Cowan, R. S. 1983. *More Work for Mother: The Ironies of Household Technology from Open Hearth to the Microwave*. New York: Basic Books.
- CRGGE (Collaborative Research Group on Gender and Energy). 2006. "From the Millennium Development Goals Towards a Gender-Sensitive Energy Policy Research and Practice: Empirical Evidence and Case Studied." Synthesis report. Leusden, the Netherlands: ENERGIA/DFID. Accessed 4 May 2017. https://assets.publishing.service.gov.uk/media/57a08c28e5274a31e0001030/R8346-dfid_synthesis.pdf.
- Daka, K. R., and J. Ballet. 2011. "Children's Education and Home Electrification: A Case Study in Northwestern Madagascar." *Energy Policy* 39: 2866–2874. doi:10.1016/j.enpol.2011.02.060.
- Danielsen, K. 2012. *Gender Equality, Women's Rights and Access to Energy Services. an Inspiration Paper in the Run-Up to Rio+20*. Denmark: Ministry of Foreign Affairs. Accessed 4 May 2017. https://www.kit.nl/gender/wp-content/uploads/publications/1975_Gender%20Rights%20and%20Energy%20Report%20final.pdf.
- Dinkelman, T. 2011. "The Effects of Rural Electrification on Employment: New Evidence from South Africa." *American Economic Review* 101 (7): 3078–3108. doi:10.1257/aer.101.7.3078.
- Elson, D. 1995. "Male Bias in the Development Process: An Overview." In *Male Bias in the Development Process*, edited by D. Elson, 1–28. Manchester: Manchester University Press.
- ESMAP. 2015. "Beyond Connections. Energy Access Redefined." ESMAP/Sustainable Energy 4 All (SE4ALL). Technical Report 008/15. Accessed 4 May 2017. <https://openknowledge.worldbank.org/bitstream/handle/10986/24368/Beyond0connect0d000technical0report.pdf?sequence=1&isAllowed=y>.

- ESMAP (Energy Sector Management Assistance Programme). 2002. "Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits." Report no. ESM 255/02. Washington, DC: World Bank.
- Friedman, J. 1992. *Empowerment: The Politics of Alternative Development*. Cambridge, MA: Blackwell Publishers.
- Greenwood, J., A. Seshadri, and M. Yorukoglu. 2005. "Engines of Liberation." *Review of Economic Studies* 72: 109–133. doi:10.1111/roes.2005.72.issue-1.
- Grogan, L., and A. Sadanand. 2013. "Rural Electrification and Employment in Poor Countries: Evidence from Nicaragua." *World Development* 43 (C): 252–265.
- Heltberg, R. 2004. "Fuel Switching: Evidence from Eight Developing Countries." *Energy Economics* 26 (5): 869–887. doi:10.1016/j.eneco.2004.04.018.
- Hoque, N. 1988. *Rural Electrification and Its Impact on Fertility: Evidence from Bangladesh*, 200. Ann Arbor, MI: University Microfilms International.
- Hughes, T. P. 1983. *Networks of Power. Electrification in Western Society, 1980–1930*. Baltimore: Johns Hopkins University Press.
- IEA (International Energy Agency). 2015. "World Energy Outlook 2015." Accessed 30 June 2016. <http://www.worldenergyoutlook.org/weo2015/>.
- IEA/World Bank. 2015. "Sustainable Energy for All 2015—Progress toward Sustainable Energy." The International Energy Agency (IEA) and The World Bank. Washington, DC: World Bank.
- IEG. 2008. *The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits. an IEG Impact Evaluation*. Washington, DC: World Bank Independent Evaluation Group.
- Ilskog, E., and B. Kjellström. 2008. "And Then They Lived Sustainably Ever After? Assessment of Rural Electrification Cases by Means of Indicators." *Energy Policy* 36: 2674–2684. doi:10.1016/j.enpol.2008.03.022.
- Jahan, R. 1995. *The Elusive Agenda: Mainstreaming Women in Development*. London: Zed Books.
- Jensen, R., and E. Oster. 2009. "The Power of TV: Cable Television and Women's Status in India." *The Quarterly Journal of Economics* 124 (3): 1057–1094. doi:10.1162/qjec.2009.124.3.1057.
- John, M. E. 2011. "Census 2011: Governing Populations and the Girl Child." *Economical Political Weekly* 46 (16): 10–12.
- Kabeer, N. 1999. "Resources, Agency, Achievements. Reflections on the Measurement of Women's Empowerment." *Development and Change* 30: 435–464. doi:10.1111/1467-7660.00125.
- Kabeer, N. 2001. "Reflections on the Measurement of Women's Empowerment." In *Discussing Women's Empowerment - Theory and Practice*, edited by Anne Sisask. SIDA Studies No. 3. Stockholm, Sweden: Novum Grafiska AB.
- Kelkar, G., and D. Nathan. 2005. "Gender Relations and the Energy Transition in Rural Asia." Report to DFID, KaR R 8346: Gender as a key variable in energy. New Delhi: UNIFEM, South Asia Regional Office.
- Khandker, S. R., H. A. Samad, R. Ali, and D. F. Barnes. 2014. "Who Benefits Most from Rural Electrification? Evidence in India." *The Energy Journal* 35 (2): 75–96. doi:10.5547/ISSN0195-6574-EJ.
- La Ferrara, E., A. Chong, and S. Duryea. 2012. "Soap Operas and Fertility: Evidence from Brazil." *American Economic Journal: Applied Economics* 4 (4): 1–31.
- Lewis, J. 2015. "The Impact of Technological Change within the Home." *Journal of Economic History* 75 (2): 539–543.
- Matinga, M. N. 2010. "We grow up with it': An ethnographic study of the experiences, perceptions and responses to the health impacts of energy acquisition and use in rural South Africa.' PhD diss., University of Twente/CSTM, Enschede, The Netherlands.
- Matinga, M. N., and H. J. Annegarn. 2013. "Paradoxical Impacts of Electrification on Life in a Rural South African Village." *Energy Policy* 58: 295–302. doi:10.1016/j.enpol.2013.03.016.
- Matly, M. 2005. "Women's Electrification Report of the Collaborative Research Group on Gender and Energy (CRGGE)." The ENERGIA International Network on Gender and Sustainable Energy and the Department for International Development (DFID), UK. London: Department for International Development (DFID).
- Millinger, M., T. Marlind, and E. O. Ahlgren. 2012. "Evaluation of Indian Rural Solar Electrification: A Case Study in Chhattisgarh." *Energy for Sustainable Development* 16 (4): 486–492. doi:10.1016/j.esd.2012.08.005.
- Nathan, D., I. Sakhya, R. Rengalakshmi, M. Manjula, S. Gaekwad, and G. Kelkar. Forthcoming "The Value of Rural Women's Labour in Production and Wood Fuel Use: A Framework for Analysis." *Economic and Political Weekly*.
- Ortner, S. 2006. *Anthropology and Social Theory: Culture, Power and the Acting Subject*. Durham: Duke University Press.
- Patton, M. Q. 2001. *Qualitative Research and Evaluation Methods*. 3rd ed. London: Sage Publications.
- Portes, A. 1998. "Social Capital: Its Origins and Applications in Modern Sociology." *Annual Review of Sociology* 24: 1–24. doi:10.1146/annurev.soc.24.1.1.
- Rogers, B. 1980. *The Domestication of Women. Discrimination in Developing Societies*. London: Kogan Page.
- Rohracher, H. 2001. "Managing the Technological Transition to Sustainable Construction of Buildings: A Socio-Technical Perspective." *Technology Analysis & Strategic Management* 13 (1): 137–150. doi:10.1080/09537320120040491.
- Salehi-Isfahani, D., and S. Taghvatalab. 2014. "Rural Electrification and Female Empowerment in Iran: Decline in Fertility." Paper presented at the IIEA Annual Conference, Boston College, October 2014.
- Schultz, T. P. 1993. "Returns To Women's Education." In *Women's Education in Developing Countries: Barriers, Benefits, and Policies*, edited by E. M. King and M. A. Hill, 51–93. Baltimore, MD: The Johns Hopkins University Press.
- Shove, E. 2003. *Comfort, Cleanliness and Convenience: The Social Organization of Normality*. Oxford: Berg Publishers.

- Shove, E. 2010. Beyond the ABC: Climate Change Policy and Theories of Social Change." *Environment and Planning A* 42: 1273-1285. doi: [10.1068/a42282](https://doi.org/10.1068/a42282).
- Skutsch, M. M. 2005. "Gender Analysis for Energy Projects and Programmes." *Energy for Sustainable Development* 9 (1): 37-52. doi:[10.1016/S0973-0826\(08\)60481-0](https://doi.org/10.1016/S0973-0826(08)60481-0).
- Sovacool, B. K., S. Clarke, K. Johnson, M. Crafton, J. Eidsness, and D. Zoppo. 2013. "The Energy-Enterprise-Gender Nexus: Lessons from the Multifunctional Platform (MFP) in Mali." *Renewable Energy* 50: 115-125. doi:[10.1016/j.renene.2012.06.024](https://doi.org/10.1016/j.renene.2012.06.024).
- Standal, K. 2008. "Giving light and hope in Rural Afghanistan: Enlightening women's lives with solar energy." Master Thesis, University of Oslo, Norway.
- Standal, K., and T. Winther. 2016. "Empowerment through Energy? Impact of Electricity on Care Work Practices and Gender Relations." *Forum for Development Studies* 43 (1): 27-45. doi:[10.1080/08039410.2015.1134642](https://doi.org/10.1080/08039410.2015.1134642).
- Tenhunen, S. 2014. "Gender, Intersectionality and Smartphones in Rural West Bengal." In *Women, Gender and Everyday Social Transformation in India*, edited by K. B. Nielsen and A. Waldrop, 33-46. London: Anthem Press.
- Ulsrud, K. 2015. "Village-level solar power in practice: Transfer of socio-technical innovations between India and Kenya." PhD diss., University of Oslo, Norway. Accessed 4 May 2017. <http://urn.nb.no/URN:NBN:no-52241>.
- Ulsrud, K., T. Winther, D. Palit, H. Rohrer, and J. Sandgren. 2011. "The Solar Transitions Research on Solar Mini-Grids in India: Learning from Local Cases of Innovative Socio-Technical Systems." *Energy for Sustainable Development* 15 (3): 293-303. doi:[10.1016/j.esd.2011.06.004](https://doi.org/10.1016/j.esd.2011.06.004).
- UNDP/ESMAP. 2004. "The Impact of Energy on Women's Lives in Rural India." United Nations Development Programme (UNDP) and The World Bank Energy Sector Management Assistance Programme (ESMAP). Washington, DC: World Bank.
- Upadhyay, S. 2009. "Evaluating the effectiveness of micro-hydropower projects in Nepal." Master Thesis San Jose State University, CA. SHSU Scholar Works.
- Van de Walle, D., M. Ravallion, V. Mendiratta, and G. Koolwal. 2015. "Long-Term Gains from Electrification in Rural India." *The World Bank Economic Review* 1-36. October 2015. doi:[10.1093/wber/lhv057](https://doi.org/10.1093/wber/lhv057)
- Walker, J., N. Berekashvili, and N. Lomidze. 2014. "Valuing Time: Time Use Survey, the Capability Approach, and Gender Analysis." *Journal of Human Development and Capabilities* 15 (1): 47-59. doi:[10.1080/19452829.2013.837033](https://doi.org/10.1080/19452829.2013.837033).
- Warde, A. 2005. "Consumption and Theories of Practice." *Journal of Consumer Culture* 5 (2): 131-153. doi:[10.1177/1469540505053090](https://doi.org/10.1177/1469540505053090).
- Wilhite, H. 2008a. *Consumption and the Transformation of Everyday Life: A View from South India*. London: Palgrave Macmillan.
- Wilhite, H. 2008b. "New Thinking on the Agentive Relationship between End-Use Technologies and Energy-Using Practices." *Energy Efficiency* 1: 121-130. doi:[10.1007/s12053-008-9006-x](https://doi.org/10.1007/s12053-008-9006-x).
- Winther, T. 2008. *The Impact of Electricity: Development, Desires and Dilemmas*. Oxford, UK: Berghahn Books.
- White, H. 2013. "The Use of Mixed Methods in Randomized Control Trials." In *Mixed Methods and Credibility of Evidence in Evaluation. New Directions for Evaluation*, Vol. 138, edited by D. M. Mertens and S. Hesse-Biber, 61-73. Hoboken, NJ: Wiley Online Library. doi:[10.1002/ev.20058](https://doi.org/10.1002/ev.20058).
- Winther, T. 2015. "Impact Evaluation of Rural Electrification Programmes: What Parts of the Story May Be Missed?" *Journal of Development Effectiveness* 7 (2): 160-174.
- Winther, T. 2012. "Negotiating Energy and Gender: Ethnographic Illustrations from Zanzibar and Sweden." In *Development and Environment. Practices, Theories, Policies*, edited by K. Bjørkdahl and K. B. Nielsen, 191-207. Oslo: Akademika Publishing.
- Winther, T. 2014. "The Introduction of Electricity in the Sundarban Islands: Conserving or Transforming Gender Relations?" In *Women, Gender and Everyday Social Transformation in India*, edited by K. B. Nielsen and A. Waldrop, 47-61. London: Anthem Press.
- World Bank. 2006. "Gender, Time Use, and Poverty in Sub-Saharan Africa." World Bank Working paper no 73. Washington, DC: World Bank.
- World Bank. 2009. "Welfare Impacts of Rural Electrification. A Case Study from Bangladesh." Policy Research Working Paper 4859. Washington, DC: World Bank.
- World Bank. 2011. "Gender Equality and evelopment." World Development Report 2012. Washington, DC: World Bank.
- World Bank. 2012. "Lao PDR, Power to the People: Twenty Years of National Electrification." Asian Sustainable and Alternative Energy (ASTAE) Programme. Washington, DC: World Bank. Accessed 4 May 2017. <http://siteresources.worldbank.org/INTEAPASTAE/Resources/LaoPDR-PowertoPeople.pdf>.
- World Bank. 2013. "Long-Term Impacts of Household Electrification in Rural India." Policy Research Working Paper No. 6527. Washington, DC: Word Bank. Parts of the material were later published as van de Walle, D. et al. 2015.
- Yamin, A. E. 2009. "Suffering and Powerlessness: The Significance of Promoting Participation in Rights-Based Approaches to Health." *Health and Human Rights* 11 (1): 5-22. doi:[10.2307/40285214](https://doi.org/10.2307/40285214).

Appendix A. Overview of key studies reviewed

Empowerment dimensions										Conditional factors									
The key studies reviewed										System of supply, policy									
No	Access	Theme	Area	Method	Author(s)	1			2 Access to resources			3 Agency		Negative events		Agency intervention		Context	
						OI	MO	ME	SR	HR	A1	A2	AI-HH	AI-S	F1	F2	F3	F4	
1	Grid	Employment	South Africa	Statistical	Dinkelmann (2011)		+	+											
2	Grid	Time-use and employment	Nicaragua	Statistical	Grogan and Sadanand (2013)		+	+											
3	Grid	Employment	USA (1930–60)	Statistical	Lewis (2015)														
4	Grid	Fertility	Bangladesh	Statistical	Hoque (1988)														
5	Grid	Fertility	Iran	Statistical	Salehi-Isfahani and Taghvatalab (2014)	+													
6	Grid	Time-use and fuel use	India	Statistical	UNDP/ESMAP (2004)														
7	Grid	Education	Bangladesh	Statistical	World Bank (2009)														
8	Grid	Education and time use	India	Statistical	Khandker et al. (2014)														
9	Grid	Employment, stoves	India	Statistical	Van de Walle et al. (2015)		+												
10	Grid	Impacts in slums	South Africa	Mixed	Annecke (2005)														
11	Grid	General, health	South Africa	Ethnography	Matinga (2010)														
12	Grid	Inclusion of women in el.	USA (1880–1970)	Document analysis	Matly (2005)														
13	Grid	General, electrification	Tanzania, Zanzibar	Ethnography + survey	Winther (2008)														
14	Off-grid	Evaluation, solar mini-grid	India, Chhattisgarh	Survey	Millinger, Marling, and Ahlgren (2012)														
15	Off-grid	Multipurpose platform	Mali	Qualitative interviews	Sovacool et al. (2013)														
16	Off-grid	SHS, women's political role	Afghanistan	Qualitative in-depth	Standal (2008)														
17	Off-grid	PV mini-grid, carework	India, Uttar Pradesh	Qualitative in-depth	Standal and Winther (2016)														

(Continued)

(Continued).

The key studies reviewed					Empowerment dimensions										Conditional factors										
No	Access	Theme	Area	Method	Author(s)	1			2 Access to resources			3 Agency				Negative events		Agency intervention		Context		System of supply, policy			
						OI	MO	ME	SR	HR	A1	A2				AI-HH	AI-S	F1	F2	F3	F4				
18	Off-grid	Micro-hydro, mini-grid	Nepal	Qualitative interviews	Upadhayay (2009)																				
19	Off-grid	Gender, PV mini-grid	India, Sundarbans	Mixed	Winther (2014)																				
20	TV	Television and fertility	Brazil	Statistical	La Ferrara, Chong, and Duryea (2012)	+																			
21	TV	Cable TV and women's status	India	Statistical	Jensen and Oster (2009)	+																			

Empowerment dimensions/sub-dimensions:

- OI Overarching issues
- MO Material Opportunities (short term)
- ME Material Endowments (long term)
- SR Social resources
- HR Human resources
- A1 Agency 1: ability to influence life decisions (including political power)
- A2 Agency 2: ability to influence decisions in everyday life
- Negative events: observation of negative events on any of the empowerment dimensions as a results of the intervention.
- Negative in the realm of the intervention:
- AI-HH Agency in the realm of the intervention, household level
- AI-S Agency in the realm of the intervention, system of supply
- Conditional factors:
- F1 Material and socio-cultural context
- F2 Socio-technical design of the system of supply
- F3 The gendered organisation of supply and process of implementation
- F4 The role of policies, regulations and international actors

In the table, a highlighted field indicates that a given aspect was studied. For statistical studies, ‘+’ reflects that the intervention (provision of electricity access) had a positive impact on the given empowerment dimension/sub-dimension.

Appendix B. Drudgery, employment and uptake of modern stoves

Results deriving from statistical studies on electricity's impact on drudgery, employment and uptake of modern stoves.	
Study	Impact/implication of having household (hh) electricity access to grid
UNDP/ESMAP (2004) <i>Rural India</i>	<p><i>Drudgery, compared with hh without access:</i> women spent 40 min less time daily collecting fuel (drudgery) and cooking (59). If household owned TV set: firewood collection reduced by 13 min more per day (to 19 min per day collecting firewood). For all income groups: electricity access implied reduced time collecting fuel (60–1).</p> <p>Context: women spent more than 5 hrs daily collecting firewood (3.5 h), cooking (3 h) and processing food (1.8 h); 15 per cent owned a kerosene stove, 10 per cent low pressure gas stove, 2 per cent electric stove.</p> <p>Suggested mechanism: rescheduling of cooking practices.</p> <p>Data: Energy survey (1996), six Indian states. Do not account for confounding factors.</p> <p><i>Likelihood of owning a kerosene stove:</i> Significantly increased by 13.1 per cent.</p> <p>Time spent on regular wage work: no significant change in women's time use, significant increase in men's time use (14.6%) (31–32).</p> <p>Time spent on casual work: women significantly increased time use by 4.2 days/year and men reduced by 8.4 days/year.</p> <p>Suggested mechanism: access to subsidised kerosene may explain the marked uptake of kerosene stoves, as kerosene previously used for lighting might be used for cooking (5).</p>
Van de Walle et al. (2015) <i>Rural India</i>	<p>Data: India Rural Economic and Demographic Survey (REDS) from 1981/82 and 1998/99, 15 Indian states. Account for confounding factors.</p> <p><i>Drudgery:</i> both women and men significantly reduced the time collecting firewood by 3.3 h/month (85). Boys reduced the time collecting firewood by 0.38 h/month. Girls: no significant change. Kerosene consumption: relatively stable (household with and without only use fairly same amount).</p> <p>Context, before electricity access: women spent 12.2 and men 6 h/month collecting fuel (83). Boys spent 1.09 and girls 0.72 hrs/month (85).</p> <p>Suggested mechanism: unreliable electricity supply is thought to be the reason why kerosene consumption remains relatively stable after electricity access (authors do not examine occurrence of kerosene stoves or examine whether kerosene might be used for other purposes than cooking).</p> <p>Data: India Human Development Survey (IHDS) 2005, 16 Indian states. Account for confounding factors.</p> <p><i>Drudgery:</i> significant reduction: men reduced the time collecting firewood by 65 and women reduce by 45 min/day.</p> <p>Employment: women's likelihood of being employed significantly increased by 23 per cent, no significant change for men (261). The number of hours spent on salaried work significantly increased by 4 hrs/day for both women and men (256).</p> <p>Context (before electricity access): men spend twice as much time as women collecting firewood (255). Gas stoves allegedly becoming more common.</p> <p>Suggested mechanism: authors imply that gas stoves may be an intermediary factor for women's increased employment and the general reduced drudgery, and that electricity monetises the realm of cooking fuels.</p> <p>Data: World Bank Living Standards Monitoring Study (LSMS) for Nicaragua from 1998 to 2005, and Nicaraguan census 1971. Account for confounding factors.</p> <p><i>Fuel use, firewood:</i> significant reduction in likelihood (3.9%) of using firewood as main fuel for cooking. Significant increase in likelihood (5.6%) of using electricity for cooking. <i>Fuel use, electricity:</i> share of households using electricity as the main type of fuel for cooking rose from 5 to 15 per cent.</p> <p>Employment: 9 per cent increase in women's employment over 5 years due to household access (3080). Women's average wages decreased in the period, while men's wages increased. Men's likelihood of being employed was unchanged.</p> <p>Context: high share of households with only women members, rising unemployment.</p> <p>Suggested mechanism: increased uptake of appliances, reduced drudgery, microenterprises also facilitated by electrification.</p> <p>Data: South African Census 1996 and 2001 and additional data. Accounts for confounding factors.</p>
Khandker et al. (2014) <i>Rural India</i>	
Grogan and Sadanand (2013) <i>Rural Nicaragua</i>	
Dinkelmann (2011) <i>Rural South Africa</i>	

Appendix C. School enrolment and study time

Results deriving from statistical studies on electricity's impact on school enrolment and study time.	
	Impacts/implications of having household (hh) electricity access to grid
UNDP/ESMAP (2004) <i>Rural India</i>	Women's propensity to read: among those who report that they regularly read, 90 per cent had electricity. Total sample: 11 per cent reported to be reading (63). Within each income group and caste: higher likelihood that women with electricity access read compared to those without access . Data: Energy survey (1996), six Indian states. Do not account for confounding factors. School enrolment: girl's enrolment increased by 14 per cent. Boys: no statistically significant change. Suggested mechanism: girls' increased years in school may be linked to a reallocation of duties from day to evening: reduced opportunity cost for parents. Data: India Rural Economic and Demographic Survey (REDS) from 1981/82 and 1998/99 conducted in 15 Indian states. Account for confounding factors.
World Bank (2013) <i>Rural India</i>	Study time: increased time use on homework, girls in female led households benefitted most. In female led households (no man), women assisted children with homework, in male led households, a man tended to assists children with homework. Context: in 87 per cent of the households the children did homework in the evenings (2868). Girls spent more time on household chores than boys (2871).
Daka and Ballet (2011) <i>Madagascar (mixed urban/rural)</i>	Suggested mechanism: the ability to do homework in evening caused the increased study time. Data: examined 162 children in 100 households in Madagascar, 71.6 per cent with electricity access and 28.4 per cent without. Does not account for confounding factors.
World Bank (2009) <i>Rural Bangladesh</i>	School enrolment: increases by 20 per cent for rich girls and 16.3 per cent for poor girls (22,37). Increases by 16 per cent for rich boys and 13 per cent for poor boys. Study time: increases by 20.5 min per day for rich girls, 16.3 min for rich boys (22). Context before electricity access: Girls and boys completed 4 years of schooling.
Jensen and Oster (2009) <i>Rural India</i>	Data: Cross-sectional survey (2005). Account for confounding factors. School enrolment: girls 6–12 years: increase by 12 per cent, caused by access to cable television. Not found for other groups of girls or for boys. The study also focused on impact of cable TV on women's status (acceptance for discriminating norms). Data: Panel data set (2001–2003), five Indian states. Account for confounding factors.