

# Energy as the Golden Thread: What Do We Know?

## New research sheds light on connections among United Nations Sustainable Development Goals and highlights critical knowledge gaps

Energy has been called the “golden thread” connecting economic growth, social equity, and environmental sustainability—but what do we know about the drivers and impacts of energy transitions in low- and middle-income countries (LMICs)?<sup>1</sup> To answer this question, the Sustainable Energy Transitions Initiative (SETI) has characterized nearly 80,000 academic articles related to the social dimensions of energy and development.<sup>2</sup> The resulting review is systematic, broad in coverage, and replicable—and grounded in an “energy services” framework designed to help policy makers better understand how energy relates to end users’ well-being.

### KEY FINDINGS

**Changes in energy access and technology most clearly affect outcomes in 9 of the 17 UN Sustainable Development Goals (SDGs).** Research describes energy’s relationship to poverty (SDG 1), hunger (SDG 2), health and well-being (SDG 3), education (SDG 4), gender equality (SDG 5), work and economic growth (SDG 8), industry (SDG 9), infrastructure and innovation (SDG 10), climate action (SDG 13), and life on land (SDG 15).

**The energy thread is not always golden.** Energy interventions are not always positive (see Figure 1 in which the extent of the golden outer layer depicts the proportion of positive impacts), particularly regarding their effects on air quality, personal health, and the environment (climate, forests, and ecosystems). The impacts of some technologies such as solar (see Figure 2) are golden; fewer than 10% of the studies analyze solar’s impacts.

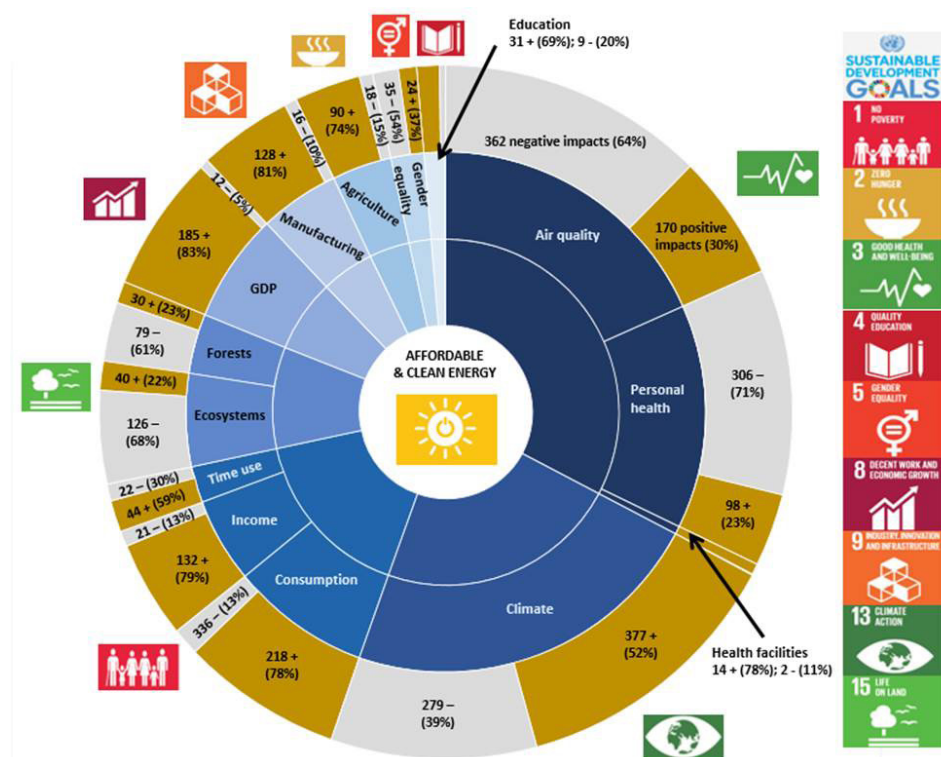
**Cooking services have been most studied in LMIC energy studies,** especially at the household level (cooking appears in 54% of such studies). A cooking-health-air-quality overlap is most notable.

**Studies on income and consumption are more evenly spread across energy services.** Among firms, industrial production and income have been most studied (in 52% of firm-level studies). Changes in GDP are also most often linked to industrial energy use.

### NOTABLE BLIND SPOTS

A relatively small number of studies consider the following impacts or sectors: (1) household income and education; (2) gender equity (studied almost exclusively in the context of cooking); (3) public service quality (health, schools, other); (4) agricultural and service sectors, relative to manufacturing and industry; and (5) environmental consequences for forests and ecosystems, relative to air quality and climate forcing. Meanwhile, despite the buzz about new technologies, little research considers the effects of off-grid and mini-grid solar and other renewables options (wind, micro-hydro, biogas) for delivering energy.

Figure 1. Quantitative studies of the effects of energy interventions, as they relate to various SDGs, for all technologies (3,183 studies)



Blue wedges = impact categories, organized by SDG; gray wedges = proportion of negative impacts; gold wedges = proportion of positive impacts; numbers in gray and gold wedges = number of studies; percentages = relative balance of positive vs. negative results. Studies showing unclear results are omitted.

<sup>1</sup> See <https://www.un.org/press/en/2012/sgsm14242.doc.htm>.  
<sup>2</sup> Usmani, F., “A Systematic Review of the Literature on Energy and Development,” forthcoming (e-mail: marc.jeuland@duke.edu).

## SEARCH METHODS

Our search combined three groups of broadly specified terms: (1) LMIC country/region, (2) energy technology or fuel, and (3) impacts or energy-use-related descriptors. We identified 77,479 articles across multiple academic publications databases, and we screened these for relevance on the basis of title and abstract reviews. One-tenth of these studies were double-screened and, when relevant, double-coded to ensure consistency. Roughly 10% (8,017 articles) were retained for detailed coding along the following dimensions: energy service (e.g., cooking, lighting, water pumping), technology (e.g., improved cookstoves, grid electricity, solar), impact categories (from intra-household up to national economy or ecosystem scales), and pluralistic conception of methods (quantitative/qualitative, type of quantitative method, and empirical design). Though relevance was assessed against the need to consider the social dimensions of energy, our analysis primarily focuses on quantitative impact studies.

## COVERAGE OF REVIEWED STUDIES

Research on energy in LMICs is increasing (Figure 3), but its geographic coverage is uneven (Figure 4). Many large countries are well represented, but some (e.g., Indonesia) are not. Lower-income countries in sub-Saharan Africa (ground zero for energy poverty) receive less attention than is warranted.

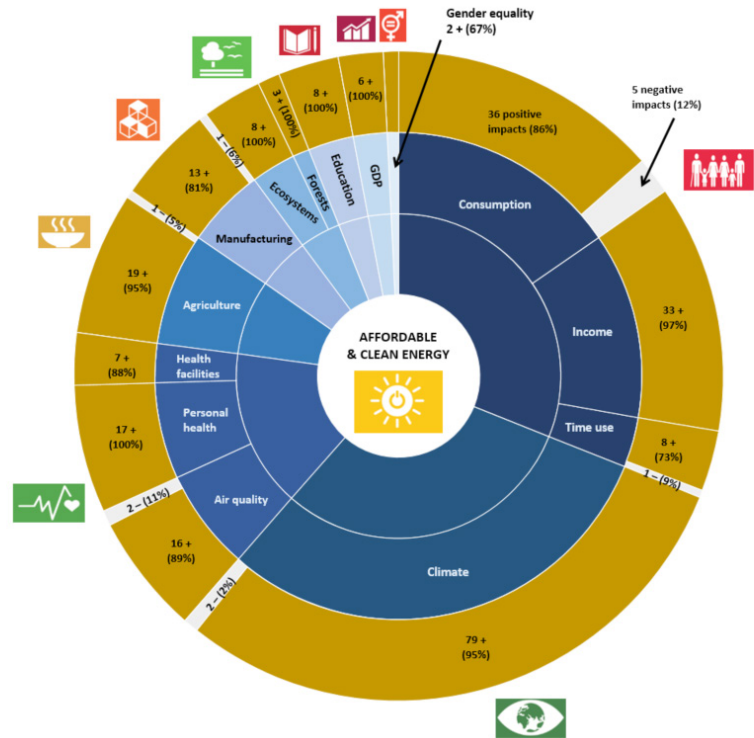
### Gender equity

Very few (just 67) quantitative studies demonstrate the effect of energy on gender equity. Most (57, or 85%) focus on cooking services; the next major foci are lighting (22%) and heating (19%). Some studies consider multiple services.

### Health facilities

Within the body of interdisciplinary literature on the effects of energy services on household health (438 unique studies), approximately 80% of studies focus on cooking, followed by heating (24%) and lighting (11%). Only 16 studies consider the impacts of energy on health facilities.

Figure 2. Quantitative studies of the effects of energy interventions, as they relate to various SDGs, for solar (277 studies)



Blue wedges = impact categories, organized by SDG; gray wedges = proportion of negative impacts; gold wedges = proportion of positive impacts; numbers in gray and gold wedges = number of studies; percentages = relative balance of positive vs. negative results. Studies showing unclear results are omitted.

Figure 3. Number of articles included in the review, by year of publication

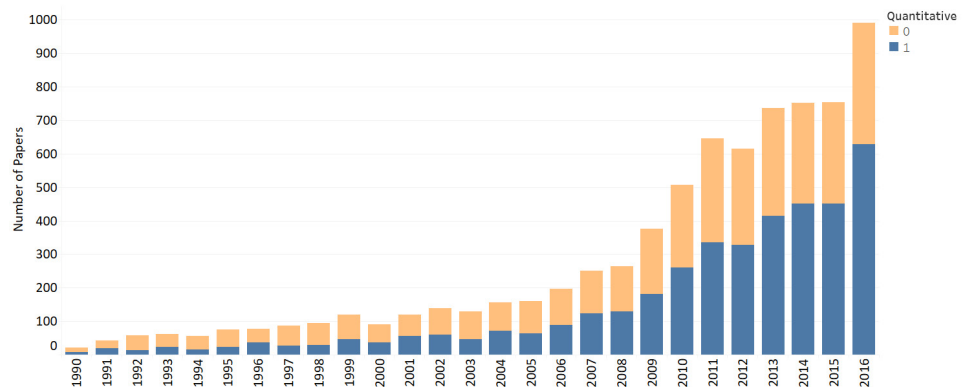


Figure 4. Number of articles included in the review, by country focus

