Solar Cooking Economic Impact Summaries
Sources and Calculations

SCI compiled the Solar Cooking Economic Impact Summaries using various sources and data, making estimates and extrapolations where necessary due to data gaps. The summaries aim to highlight the potential economic benefits of adopting solar cooking globally, as people transition from solid fuels. Savings are derived from avoided environmental and health costs. SCI acknowledges that this is a complex and evolving area of study, and the figures provided are rough estimates based on various factors.

SCI requests users of this information to cite SCI and relevant sources as appropriate.

Number of known solar cookers

Data from the Solar Cookers International Distribution of Solar Cookers Map:
https://www.solarcookers.org/work/capacity/distribution-solar-cookers

Proportion of population with primary reliance on polluting fuels and technologies for cooking

World Health Organization (WHO)
https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-phe-population-with-primary-reliance-on-polluting-fuels-and-technologies-for-cooking-proportion. Note: WHO defines this indicator as, "the percentage of the population that relies on polluting fuels and technologies as the primary source of domestic energy for cooking" and reports "this indicator is calculated as the number of people using polluting fuels and technologies divided by total population, expressed as a percentage. Based on the recommendations included in the WHO Guidelines for indoor air quality: household fuel combustion, the fuels and technologies that are considered polluting include biomass, coal, kerosene, gasoline, diesel, rubber, and trash."

Average household size

United Nations, Population Division

https://www.un.org/development/desa/pd/data/household-size-and-composition
Where gaps existed in the United Nations' database, the Global Data Lab served as a secondary source.
https://globaldatalab.org/areadata/hhsize/?levels=1&interpolation=1&extrapolation=1&extrapolation_years=3&nearest_real=0

CO2 emissions prevented from using existing solar cookers

Accurately calculating CO_2 emissions from firewood is complex and evolving. Many variables are involved, including wood type, moisture content, stove type, combustion level, cooking phase (starting, full flame, smoldering, extinguishing), and test type: International Organization for Standardization (ISO), Water Boiling Test, etc.

There is a range of emission factors used in various sources. For example:

- The article "Emission factors of wood and charcoal-fired cookstoves" uses 1560-1620 g/kg (1.56-1.62 metric ton of CO_2/metric ton of wood).
- The article "Cookstove Emissions and Performance Evaluation Using a New ISO Protocol and Comparison of Results with Previous Test Protocols" (free version at PubMed Central) reports mean values ranging between 1480-1550 g/kg (1.48-1.55 metric ton of CO_2/metric ton of dry wood) as emission factors from three stone fires using the ISO protocol.

To simplify the presentation of SCI's estimates of impacts from cooking, SCI chose to use a single figure. SCI chose to use an emission factor of 1.49 metric ton of CO_2/metric ton of wood as a conservative estimate between the range of sources.

SCI is monitoring reputable sources of information for updates. Additional insight about firewood emission and associated impacts is described in the 2023 article "Scaling up gas and electric cooking in low- and middle-income countries: climate threat or mitigation strategy with co-benefits?"

In addition, based on survey data from solar cooks and collaborators, including Friends of the Old (FOTO), SCI estimates that one solar cooker saves one ton of wood per year.

Potentially prevented CO2 emissions by switching from solid fuels to solar cooking

These figures are reached by dividing the population number with reliance on solid fuels by the average household size of each country and then multiplying that figure by 1.49 metric tons of CO2. Figures are per year.

GDP Per Capita

The World Bank
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

Potential savings if 100% of people using solid fuels switched to solar cooking ¼ of the time

Calculations were made by adding estimated savings in avoided healthcare costs (welfare costs) and the estimated savings from avoided CO2 emissions (the social cost of carbon) and dividing that total by 4 anticipating that people will solar cook ¼ of the time. This assumes 100% of the population relies on solid fuels switching to solar cooking. These savings are per year.

Welfare costs (health)

The welfare costs of household air pollution were determined by obtaining the number of premature deaths per country due to household air pollution from the World Health Organization Global Health Observatory Data Repository.

https://apps.who.int/gho/data/node.main.BODHOUSEHOLDAIRDTHS?lang=en

To assign a dollar amount to each premature death, the methodology described in the World Bank and Institute for Health Metrics and Evaluation's report, The Cost of Air Pollution: Strengthening the Economic Case for Action, was used to determine the Value of a Statistical Life (VSL) for each country.

https://documents1.worldbank.org/curated/en/781521473177013155/pdf/108141-REVISED-Cost-of-PollutionWebCORRECTEDfile.pdf

VSL is often determined through willingness-to-pay (WTP) studies, which assess the amount people are willing to spend to avoid premature death. However, such studies are lacking for many countries, so often a base VSL from an existing study is adjusted to suit other countries' contexts. These adjustments consider characteristics likely to influence how individuals in different circumstances value mortality risks.

The effect of income on VSL, known as income elasticity, is widely documented for numerous countries. The World Bank and IHME report used income elasticity values of 1.2 for low- and middle-income countries and 0.8 for high-income countries.

A base VSL of $3.83 million, representing the mean VSL estimate from a database of quality-screened WTP studies conducted in high-income OECD countries, was adjusted for each country by accounting for the GDP per capita ratio to OECD GDP per capita in the same year, with adjustments based on income elasticity. The VSL was then multiplied by the number of premature deaths from household air pollution per country to determine total welfare costs from household air pollution per country in a given year.

Environmental costs (social cost of carbon)

The United States Environmental Protection Agency (USEPA) calculates the social cost of carbon. The social cost of carbon is a measure, in dollars, of the long-term damage done by a tonne of carbon dioxide emissions each year. This metric integrates knowledge from multiple disciplines and includes aamages related to human health and well-being, labor, energy, water, land, infrastructure, and food production.

The EPA's methodology and worksheet were used to calculate savings in avoided CO_2 emissions.

EPA Methodology: https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

EPA Worksheet: https://www.epa.gov/system/files/documents/2024-03/epa-sc-ghg-workbook_1.0.1.xlsx)

The discount rate is used to adjust future costs to present-day values, balancing how we value current versus future impacts. A higher discount rate results in lower present-day values for future damages, making the estimate more conservative. For this calculation, SCI used the EPA's 2.5% discount rate, which yields the most conservative damage estimate.

SCI used the most recent dollar year available, 2023, to calculate the social cost of carbon in USD.

The 2.5% discount rate and 2023 dollar year means that $148.52 worth of damage is done for every tonne of CO_2 emitted annually.