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# From cookstove acquisition to cooking transition: Framing the behavioural aspects of cookstove interventions

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ABSTRACT

A clean cooking energy transition necessitates effortful behaviour changes by cooks, financial decision makers, and other family members. A new inter-disciplinary CI-CHANGE model, rooted in technology adoption and behaviour change literature, provides an integrated framework to study the transition process. It provides new testable hypotheses on the *how* and *why* of the transition process using behavioural constructs such as perceptions and habits. In contrast, the current approach is to examine socio-demographic conditions and market/technology characteristics to identify- '*who*' are likely to move away from solid fuels and '*under what conditions*'. CI-CHANGE combines elements of the Transtheoretical Model (health behaviour change psychology), Theory of Planned Behaviour (social psychology), and the Unified Theory of Acceptance and Use of Technology (information systems research) to identify & prioritize intervention focus areas. Such framing highlights three key gaps in the current approach. First, based on process factor conditions of target audience, differential intervention strategies are necessary; second, post-sales interventions are required to support complex and effortful endeavor of accepting a new technology while fighting the old habit of traditional cooking; and third, entire transition process is fragile due to seasonal changes and no-cost reversal to solid fuels. Hence, long-term monitoring should back any intervention-specific climate/health gain projections.

## 1. Introduction

Nearly 2.7 billion people globally depend on solid unprocessed biomass (firewood, cattle dung and agricultural residue), and coal as their primary cooking fuel [1]. These fuels are generally burnt indoors in inefficient traditional cookstoves (TCS), namely three-stone fires & mud stoves, resulting in "kitchen smoke" [2]. The "mid-range economic value" of the negative consequences for health [3], environment [4] and societal development from global usage of TCS is estimated to be $123 billion per year [5].

Governments and civil society in developing countries along with international actors have promoted both transition technologies that make solid fuels burn in a *cleaner* manner such as "improved" cookstoves (ICS) as well as truly *clean* cooking solutions (CCS)- modern fuels, such as liquefied petroleum gas (LPG), electricity, biogas, and ethanol [6,7]. Only the most advanced ICS technologies seem to have the potential to provide the purported triple benefits (health, environment, social development) across a diverse range of local fuels, though it has not been consistently demonstrated in real-world conditions [8,9]. This is particularly true in terms of lowering household air pollution (HAP) linked health risks [6,10]. Hence, there is growing interest in intervention strategies that enable and motivate TCS households to *leap-frog* to CCS technologies [11]. The general term "intervention" is used throughout to describe "*any legislation, regulation, policy, program, project activity, or event*" that encourages a particular action [12].

Some developing nations like Brazil, Ecuador or Indonesia with high urbanization with concomitant economic development and high CCS subsidy achieved success in displacing TCS as the primary cooking fuel. Urbanization leads to modernity as well as lower access to solid fuels, while economic development allows governments to provide higher levels of CCS subsidies, raising incomes to afford commercial fuels as well as increasing the opportunity cost of solid fuel gathering [1,13–15]. Urban households are more likely to move away from solid fuels as they have higher monetary costs of solid fuels or higher opportunity costs of time & effort, relatively stronger perception of fuel scarcity, and more likely to have access to electricity which "*spurs people to a greater acceptance of modernity*" [16].

However, in countries like India and Kenya with a large number of poor rural communities, CCS (as well as ICS) have not been used

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consistently, sufficiently or correctly enough to displace TCS as the primary cooking solution [8,14,17,18]. Empirical evidence suggests that rural population with better access to solid fuel (compared to urban areas) prefer to spend their meager and irregular cash income (often derived from seasonal agricultural work) on other priorities where free alternatives are not available [19]. This may be especially true when the opportunity cost of time-savings from fuel switch in form of cash income is low [20]. For example, even the richest 10% of India's rural households (most with access to LPG) continue to depend on solid fuels to meet more than 50% of their cooking energy demand [10]; this phenomenon is known as cooking technology stacking [21,22]. Failure to achieve a successful, stable & long-term transition from TCS to CCS in rural, poor communities with striking public health, societal and environmental consequences poses a major development and multi-disciplinary research challenge in modern times [23].

The purpose of this paper is to examine the clean cooking energy transition through the lens of behaviour change occurring at the individual and household level. Section 2 lays out the multiple, complex behaviour changes that family members have to go through when CCS replaces TCS as the primary cooking fuel in a household (desired output). Two broad knowledge gaps in literature related to how and why of transition and audience segmentation, from an implementation perspective, are then identified in Section 3. In Section 4, the guiding principles and approaches to the creation of the framework are discussed. In Section 5, the inter-disciplinary transition framework CI-CHANGE to study cooking energy transitions is presented that details hypotheses around the 'how' and 'why' of the transition process. Section 6 deals with the utility of the framework in providing new potential insights about the transition and how it should be studied. Section 7 discusses the shortcomings and future research areas to test and improve this framework.

## 2. Cooking energy transition as a behaviour change challenge

Why should clean cooking energy transition process be viewed through the lens of behaviour change? Irrespective of the technology options, implementation strategy choices or geographical contexts, a successful household-level transition essentially involves undertaking new behavioural actions and ceasing old behavioural actions by three key individual(s) or group(s) within a household [24,25]. One, the cook (s) (almost exclusively women in target households) may have to change the type of food being cooked as some CCS models can be ill-suited to prepare all types of traditional food (ex. when the size of the traditional bread is bigger than the burner size) [26,27]. Further, fire-power and pot size differences between TCS and fixed-dimension CCS may alter cooking styles (e.g. requiring more attention to food as it cooks) or how what quantity of food can be prepared at one time [19,28]. Moreover, the cook's behaviour can also directly influence the health outcome metrics such as personal exposure level depending on where they cook and how they enhance ventilation [29].

Two, other household members (including children) may find real or perceived changes in the size, texture, taste, and flavor of food cooked in CCS that influence the familiarity or desirability of the meal [19]. The spatial behaviour of other family members in the household (near or away from the kitchen) during the cooking period also moderates the health impact of CCS interventions [25].

Three, the financial decision-maker(s) (often senior male members in target households) have to reallocate current consumption expenses and savings decisions, especially in cash-lean seasons, to cover significant expenses on regular fuel purchase and occasional CCS purchase/repair cost [19,30]. While the cook would have an important role in the decision-making process, the male members may have veto power [31]. However, in some cases, time/effort savings from CCS usage may lead to additional income generation to offset the expenses [32]. Further, male household members may also become responsible to arrange for transport of CCS (in case of LPG) from far-off supply point if door-step delivery is not available [14].

Thus, the "bundle" of behavioural actions by key individuals- cooks, financial decision-makers, and other family members can be viewed as the 'clean cooking energy transition'. It not only includes actions that lead to regular, consistent and sufficient usage of CCS [33] but also actions that can maximize the impact of such usage, especially from a health perspective [25]. Here, the 'desired behaviour change' at household level necessarily involves a multitude of relatively new, complex and effortful behavioural actions to be undertaken by the cook (s), financial decision-maker(s) and other household members at an individual level. Technology options, intervention strategy choices and geographical contexts would obviously promote or hinder these actions, but irrespective of these choices/contexts, behaviour changes are integral and in a way, demonstrative of the transition process.

Surprisingly, while behaviour change plays such an important part in the transition process [25], there are only sporadic mentions of behavioural aspects such as the role of habits [34], individual perceptions & knowledge [8,14], and motivation [30] to achieve the transition process. In most of the fifty plus CCS interventions that claimed to use 'behaviour change techniques[1]' (BCT), "their implementation as part an established behaviour change model or framework appeared to be rare" [25] with notable exceptions [30]. BCT strategies were primarily aimed at social marketing for uptake (purchase/acceptance) of CCS by undertaking interventions for information sharing, subsidies, and marketing by local community organizations with a focus on "willingness to pay" [25,35]. There are not many studies or even theoretical frameworks that explore 'willingness to use' CCS in lieu of TCS over the long term from behaviour change perspective. Hence, the "evidence gap" related to the behavioural aspects of transition merits urgent research attention [36].

Hereafter, we use the word key individuals to refer to primary cook (s), financial decision-maker(s) and other household members who possibly have direct or indirect veto power over CCS usage in the household kitchen. Also, the clean cooking energy transition would be referred to as transition for conciseness unless specified otherwise. Further, the terms 'transition' or 'desired behaviour change' would imply, unless specified otherwise, switching from TCS (old behaviour) to CCS (new behaviour) as the primary cooking fuel and maximization of its impact through other behavioural actions.

## 3. Knowledge gaps in transition literature

The transition process has been primarily framed in the cookstove literature as a technology-centric issue about the identification of a multitude of factors that encourage or discourage technology acquisition/uptake (purchase or acceptance) and usage of ICS or CCS [19,37]. Alternatively, it is also framed from a product-centric outlook as a consumer demand (ex. affordability) and supply (ex. lack of after sales support) issue that requires "cross-cutting enablers" (ex. quality standards and testing infrastructure) [5]. Notably, most past research is on ICS; studies on clean, modern fuels like LPG are much more limited [14].

Further, recent systematic reviews [8,14,38,39] have identified anywhere from eighteen to thirty-one such socio-economic, demographic and fuel-specific factors that influence the transition process. These factors "*operate on a spectrum: if factors are present or satisfactory they act as enablers; conversely, if absent or unsatisfactory, they act as barriers*" [14]. These include price of competing fuels [15] or ease of access to non-monetized fuel [20], high initial cost of CCS [40], volatility of LPG price linked to global oil markets [14], low irregular family income to pay for regular fuel expenses [15], infrastructure for reliability and accessibility of fuel supply [41], individual perceptions about

[1] Defined as an "*active component within a clean cooking intervention that helps produce behaviour change to improve human and/or environmental impact*" [25].