

Policy Brief

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DONE BY

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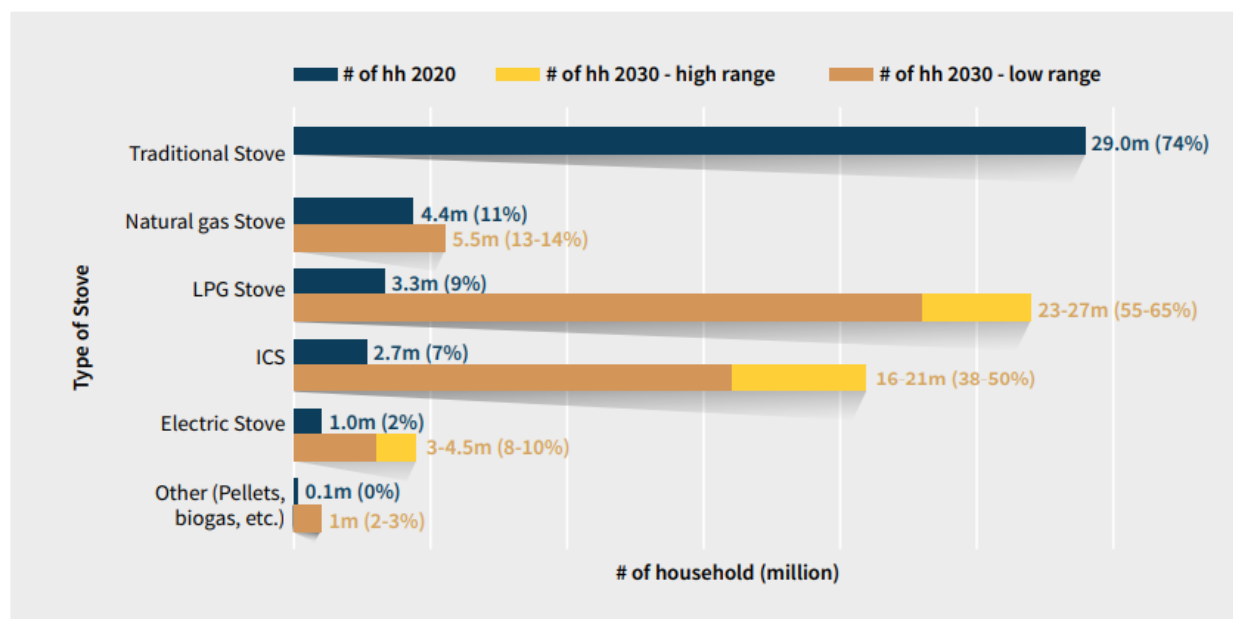
Policy Brief

Title:

A Transformative Approach to Biomass Utilization: A Case Study of Phultala Upazila of Khulna District

Introduction:

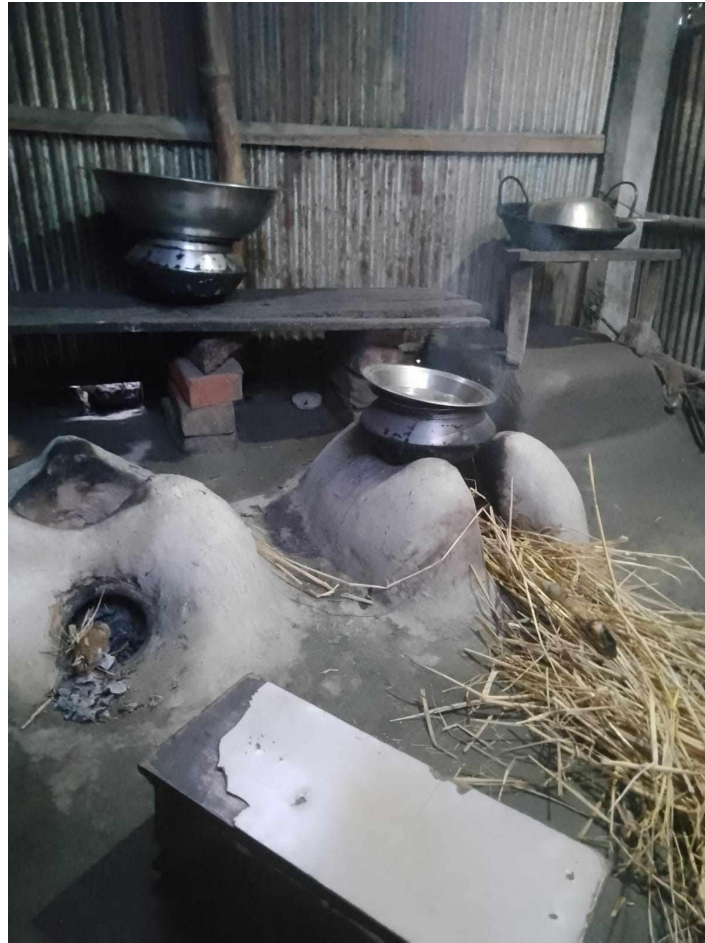
The International Energy Agency's 2022 report estimates that 2.3 billion people globally cook with biomass on a daily basis (IEA, 2023). As per the report of the Bangladesh Bureau of Statistics (BBS), approximately 92% of rural households in Bangladesh (Rahman, 2023) specifically in the Khulna district (97%) utilize a diverse range of biomass fuels for cooking every day (Biswas et al., 2023). The policy brief addresses the significance of sustainably utilizing biomass in cooking stoves by replacing Traditional Cooking Stoves (TCS) with Smart ICS (Improved Cooking Stoves). Our target beneficiaries are individuals who rely on biomass for everyday cooking and aim to promote sustainable utilization of biomass within their existing cooking routines in Phultala Upazila, Khulna. Indoor air pollution and health hazards arising from using TCS which runs on biomass cause an estimated welfare loss of \$1.5 trillion each year (World Bank, 2019). According to the Sustainable and Renewable Energy Development Authority (SREDA), ICS reduces firewood consumption by up to 50 percent (Roy & Hasan, 2022). To improve energy efficiency, reduce firewood consumption, and cut down on greenhouse gas emissions about 45 lakh ICS have been installed in households across the country (ibid). As such, Smart ICS will play a conducive role in further reducing toxic gas emissions and help to protect the environment as well.



Source: World Bank (n.d.)

Figure 1: 2020 cooks stoves and fuel market in bangladesh compared to the 2023 targets

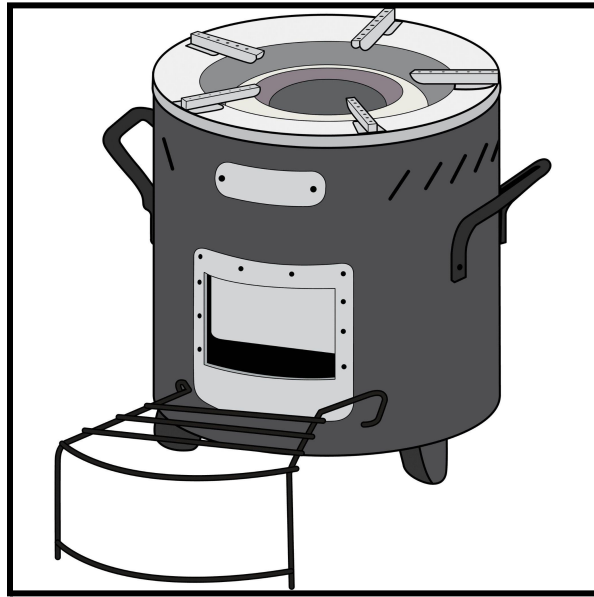
Design and Implementation:



Source: Picture taken by one of the authors

Figure 2: *Traditional cook stove*

Researchers propose the metallic ICS as the ideal type, emphasizing the distinctive features of metallic ICS through innovative combustion technology (Okino et al., 2021; Ahmad et al., 2022). This design not only efficiently retains heat but also directs a significant portion towards the cooking pot, with insulation minimizing heat wastage between the inner chamber and outer body.



Source: C-Quest Capital (n.d.)

Figure 3: Model of ICS

Regarding the design of the Smart ICS, it surpasses current ICS models in Bangladesh across various parameters, including fuel reduction, cooking time, lifespan, efficiency, and maintenance.

<i>Specifications</i>	<i>Existing ICS</i>	<i>Smart ICS</i>
Price	800-1200 Tk	2000-4000 Tk
Fuel Use Reduction	40-50%	66%
Cooking Time Reduction	Less cooking time	50%
Estimated Lifespan	3-5 years	4-7 years
Stove Type	Fixed	Portable
Regular Maintenance	Required	Not Required

***Figure 4:** Design and model specifications of existing and Smart ICS.*

The existing ICS in Bangladesh is a fixed-type stove designed for both domestic and institutional use. Priced at 800-1200 Tk for domestic settings and 3000-5000 Tk for institutional purposes, it offers a fuel use reduction of 40-50%. While requiring regular maintenance, its estimated lifespan ranges from 3-5 years. This stove, with moderate smoke emission, contributes to a 50% reduction in Carbon Dioxide (CO₂) emissions nationally. However, specific data on Carbon monoxide (CO) reduction and particulate matter reduction for wood fuel are not available.

In contrast, the Smart Stove this policy suggests is a portable solution priced between 2000-4000 Tk. Remarkably, it achieves a higher fuel use reduction coupled with a cooking time reduction of up to 50%. This stove boasts a longer estimated lifespan, and requires no regular maintenance. With less smoke emission, it contributes to a significant reduction in CO₂ emissions and an impressive reduction in CO emissions. Additionally, it reduces particulate matter when using wood fuel. This Smart Stove offers a practical and efficient alternative for users seeking portability and reduced environmental impact. Smart ICS offers a practical and efficient alternative for users seeking portability and reduced environmental impact. Interestingly, the greatest demand is for single burner stoves with two fuel chambers (Islam, Roy & Rahman, 2022) and the Smart ICS is also a single burner stove.

When the emissions from a single mouth cook stove with or without a chimney were compared to those from a traditional cook stove, it was discovered that the TCS produced higher levels of PM10, PM2.5, including BC and CO. Therefore, it can be said that a Smart ICS burns fuel better than the existing ICS.

It is pertinent to note that the statistical information pertaining to the Smart ICS has been sourced from Envirofit's official data on metallic cooking stoves to build an understanding of the possible outcomes of using Smart ICS in Bangladesh. Additionally, data for ICS units in Bangladesh has been derived from reputable organizations engaged in clean cooking stove initiatives within the country, including the Bondhu Foundation, Sustainable and Renewable Energy Development Authority, Household Energy Platform, among others.

The uniqueness of the Smart ICS that this policy brings forward lies in the incorporation of temperature and weight measurement technology, enabling precise fuel consumption calculations. A digital display, powered by a battery, will showcase this information. To ensure judicious fuel use, a policy will subsidize the final installment payment upon confirmation by the monitoring team, relying on the pre-installed device's AI chip. The chip maintains a consumption record. While users cover the initial three installments, we strive to enhance awareness and offer training for sustainable biomass use with the Smart ICS. Our primary research shows that there is no drainage system in Phultala Upazila, so cities and villages get waterlogged, and people are bound to cook inside their homes during the rainy season. A little rain floods the entire region. Sometimes, they place their stoves on the bed and cook. Under the circumstances, a Smart stove will play a conducive role since it is portable and provides clean cooking.

In our future endeavors, we plan to endorse Smart ICS usage under the UNFCCC's Clean Development Mechanism (CDM) carbon credit plan, facilitated by the IFC. By trading carbon credits globally, we aim to generate a revenue stream that supports the project and community development initiatives.

Impacts:



Source: Picture taken by one of the authors

Figure 5: *Cooking with traditional cookstoves in a rural area in Bangladesh*

General Impacts

1. *SDG 1:*

Transitioning from TCS to Smart ICS can reduce fuel consumption, save money, and alleviate poverty in Bangladesh (Climate Impact Partners, n.d.; myclimate, n.d.).

2. *SDG 3:*

According to the World Health Organization (WHO), 113,202 Bangladeshis die annually from indoor air pollution from TCS, and transitioning to Smart ICS could significantly reduce health concerns and mortality rates (Climate Impact Partners, n.d.; myclimate, n.d.; VNV Advisory, 2023).

3. *SDG 7, SDG 11, and SDG 13:*

Biomass cooking stoves provide clean, affordable energy, reducing toxic emissions by up to 82% (SDG 7) (Climate Impact Partners, n.d.; myclimate, n.d.; VNV Advisory, 2023). This promotes clean indoor and outdoor air, promoting sustainable cities and communities (SDG 11). Biomass cooking stoves reduce greenhouse gas and black carbon emissions. This contributes to climate action by minimizing the impact of climate change (SDG 13) (Climate Impact Partners, n.d.; myclimate, n.d.; VNV Advisory, 2023).

4. *SDG 15:*

Shifting to cleaner biomass stoves can help conserve forests and reduce the pressure on natural resources. This protects and promotes sustainable use of terrestrial ecosystems, reducing biodiversity loss, which aligns with SDG 15 (Climate Impact Partners, n.d.; myclimate, n.d.; VNV Advisory, 2023).

5. *SDG 17:*

Governments, NGOs, international organizations, and local communities can collaborate to achieve the SDGs by promoting ICS, and sustainably using biomass.

Environmental Impacts

Specifications	Existing ICS	Smart ICS
CO2 Reduction	50% (50.49 million tons of CO2 emission per year nationally)	66%
CO Reduction	N/A	82%
Particulate Matter Reduction	N/A	70%
Smoke Emission	Moderate	Less
Fuel Use Reduction	40-50%	66%

Figure 6: *Impact specifications of existing and Smart ICS.*

Traditional biomass stoves play a role in causing deforestation and harming the environment. Transitioning to more environmentally friendly ICS can aid in the preservation of forests and alleviate the strain on natural resources (VNV Advisory, 2023). Smart ICS can reduce biomass fuel consumption by around 30-37% compared to TCS, bringing about positive environmental benefits. It will reduce fuel use by 66%, reduce CO2 emission by 66%, reduce CO emission by 82%, and reduce particulate matter by 70%. Smart ICS would reduce long term particulate matter (PM2.5) exposures from around 200-300 µg/m3 to 75-150 µg/m3 (Larsen, 2016). The use of Smart ICS helps reduce indoor air pollution.

Social Impacts

1. *Health Advantages*

Chronic obstructive pulmonary disease in adults, lung cancer, ischemic heart disease, cerebrovascular illness, and acute lower respiratory infections in children under five are the main health effects of long-term exposure to PM2.5 in the home environment (Larsen, 2016). Smart ICS can mitigate respiratory problems, childhood pneumonia, and long-term health risks linked to indoor air pollution, notably benefiting women and children. Thus, the transition to Smart ICS notably reduces mortality rates, addressing a major public health hazard. It can yield more than 19-24% reduction in health effects if all households in the community adopt ICS (VNV Advisory, 2023).

2. *Empowering Women*

ICS simplifies cooking, providing women with more time which could be utilized for other activities, such as education and income generation. Engaging women to distribute these stoves promotes economic empowerment and poverty reduction in rural households (VNV Advisory, 2023).

3. *Reduced Fuel Consumption*

ICS lessens the financial burden on families by decreasing biomass fuel consumption, thus conserving natural resources and reducing the need for large fuel purchases (VNV Advisory, 2023).

4. *Time Efficiency*

ICS reduces cooking time, benefiting women who can use the saved time for education, income generation, and family (Ahmad et al., 2022).

Adaptation and Mitigation:

Smart ICS plays an instrumental role in climate change mitigation efforts by conserving energy, leading to fuel savings and a reduction in CO₂ emission. The Smart ICS aligns with the Bangladesh Delta Plan 2100 as it reduces greenhouse gas emission. It also helps to develop climate-smart cities with effective use of non depletable energy mechanisms, which is a vision of the “National Adaptation Plan” (NAP) of Bangladesh (2023-2050).

Adaptation measures include training and awareness, financial incentive, temperature and weight device, and portability.

Mitigation measures include coordinating with national and global climate change goals and SDG, environmental benefits like reduced deforestation, GHG emission and biodiversity loss, health benefits like reduced risks of respiratory and long-term diseases, and reduced fuel consumption.

Climate Change Adaptation:

Smart ICS is an excellent climate change adaptation strategy. To highlight, Smart ICS is portable which can be considered as an adaptive method to counter challenges faced by rain induced flooding in Phultala Upazila with no drainage system to wash out rain water. People can cook anywhere during a crisis. Thus, ensuring food security as well.

Cost-Benefit Analysis:

A comprehensive cost-benefit analysis from the perspective of consumers and the environment illustrates that the benefits exceed the cost by more than 2.7 times approximately, which provides a strong rationale for the implementation of the policy project.

The costs in question include cost of implementation of policy including awareness, promotion, training, and incentives and costs borne by consumers including installment payments and fuel use. The costs were estimated based on thorough market research and expert opinion.

The benefits include environmental benefit from quantity savings in fuelwood use through lower consumption of fuelwood to operate ICS, consumer monetary savings through cost reduction due to reduced fuelwood requirements, time savings due to reduction in cooking time, and consumer health benefit associated with reduced indoor air pollutants emission.

Quantifiable benefits were estimated based on primary data collection. Attempts to quantify time and health were carried out based on the economic concepts of valuation of time at 50% of the female hourly rural wage rate and Value of Statistical Life (VSL) respectively.

Financing Strategy:

The financing strategic mix involves national resources like the Bangladesh Climate Change Trust Fund (BCCTF), international partners such as Global Environmental Facility (GEF) and contributions from the domestic private sector.

BCCTF is the first-ever national climate fund established by an LDC country. The funding comes from the national budget itself and allocation of Tk.300 crore for Khulna region for the FY 2023-24 has been made according to the Ministry of Finance Climate Funding Report 2023-24.

GEF is a potential fund towards reaching RE goal of 2041 as expressed by a renewable energy research organization of Bangladesh named Change Initiative. GEF has co-funded over 60 projects in Bangladesh related to climate change. They currently have allocated unutilized funds of around USD 4.58 million for projects in Bangladesh that can be accessed through the operational focal point in the country.

As for contributions from the private sector, we are targeting receiving funds through what is known as Corporate Social Responsibility that obligates larger organizations to put aside funds towards the environment and is mandatory for commercial banks as well. Our targets are Akij, Rahmifrooz, Bangla Cat, and Prime Asia Bank.

Policy Implications:

The policy brief complies with the “National Action Plan for Clean Cooking” (2020-2030) as set forth by the Government of Bangladesh in 2019. Smart ICS aligns with the “National Adaptation Plan of Bangladesh” (2023-2050), aiming for 40% household use of ICS by 2030, compared to only 3% to 5% currently in use (Aziz et al., 2022).

In addition to that, the policy aligns with the “Bangladesh Biodiversity Act 2017”, passed in line with Bangladesh’s constitutional mandate under Article 18A (Act No. of 1972) and international mandates under the “Convention on Biodiversity” which aligns with SDG15 as well (Lubaba, 2019).

It is worth mentioning that in 2019, the Bangladesh Parliament became the first legislature in the world to declare a planetary emergency, emphasizing on biodiversity and urging the global community to achieve net zero emissions by 2050 (Huq, 2020).

To highlight, the Mujib Climate Prosperity Plan (Climate Resilience Strategy) aims to promote wellbeing by using 21st century technology to make traditional lifestyle practices sustainable which Smart ICS aligns with as well. Hence, Smart ICS fits into the picture just perfectly with its ideal characteristics of reducing fuel consumption and hence protecting the environment.

Key Findings:

- Globally, almost 2.3 billion people cook their meals every day using biomass.

- In Bangladesh's rural households (92%) specifically in the Khulna district (97%), biomass fuels are widely used for cooking.
- The policy aims to address sustainable biomass utilization by replacing Traditional Cooking Stoves (TCS) with Smart ICS.
- Traditional Cooking Stoves (TCS) contribute to indoor air pollution and health hazards, causing an estimated welfare loss of \$1.5 trillion annually.
- Smart ICS reduces firewood consumption by up to 50%, with approximately 45 lakh ICS installed across the country.
- The metallic Smart ICS design emphasizes innovative combustion technology, efficiently retaining heat and directing it towards the cooking pot.
- The existing ICS in Bangladesh has a fuel use reduction of 40-50% with a lifespan of 3-5 years while the proposed Smart ICS is portable, priced between 2000-4000 Tk, achieving a higher fuel use reduction of 66%, with a longer lifespan of 4-7 years and reduced emissions.
- Smart ICS incorporates temperature and weight measurement technology for precise fuel consumption calculations.
- A digital display powered by a battery showcases information to ensure judicious fuel use.
- The policy subsidizes the final installment payment upon confirmation by the monitoring team.

- The project plans to endorse Smart ICS usage under the UNFCCC's Clean Development Mechanism (CDM) carbon credit plan, generating revenue to support community development initiatives.
- Addresses multiple Sustainable Development Goals (SDGs).
- The transition to Smart ICS can reduce fuel consumption, save money, improve health, and contribute to climate change mitigation.
- Smart ICS reduces biomass fuel consumption by 30-37% compared to TCS.
- Achieves a 66% reduction in CO₂ emissions, an 82% reduction in CO emissions, and a 70% reduction in particulate matter when using wood fuel.
- Helps reduce long-term particulate matter exposures, contributing to reduced indoor air pollution.
- Major health benefits include mitigating respiratory problems, childhood pneumonia, and long-term health risks.
- Empowers women by providing more time for education and income-generating activities.
- Reduces financial burden on families through decreased biomass fuel consumption.
- Smart ICS contributes to climate change mitigation by saving fuels and reducing CO₂ emissions.
- It aligns with Bangladesh's Delta Plan 2100 and National Adaptation Plan (NAP) by promoting renewable energy mechanisms and climate-smart cities.

- Comprehensive analysis indicates benefits exceed costs by more than 2.7 times, supporting the rationale for policy implementation.
- Benefits include environmental, monetary, time, and health benefits.
- The financing mix involves national resources like the Bangladesh Climate Change Trust Fund (BCCTF), international partners like the Global Environmental Facility (GEF), and contributions from the domestic private sector.
- BCCTF and GEF are potential funding sources, and contributions from the private sector (Akij, Rahimafrooz, Bangla Cat, Prime Asia Bank) will be sought through Corporate Social Responsibility.

Conclusion:

The proposed Smart ICS policy project offers a transformative solution, addressing challenges tied to traditional biomass cooking. It is worth noting that our policy will not be applicable in urban areas, where the most of the population relies on modern cooking methods like LPG or electric stoves. Success of this ICS relies on community engagement, strategic partnerships, and continuous monitoring. The initiative envisions improved health, environmental conservation, and economic empowerment, aligning with Sustainable Development Goals (SDGs). Anticipated improvements include better health outcomes, environmental protection, and socio-economic conditions. This paper represents a collective effort for positive change, demonstrating the potential for impactful change when technology, community engagement, and environmental consciousness converge. Through shared commitment, we aim to pave the way for a cleaner, healthier, and more sustainable world.

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Appendix:

COSTS

- Cost Of Project Implementation (Project Proposed Budget) :**

<i>Type</i>	<i>Amount (tk)</i>	<i>Breakdown</i>
Promotion & Awareness	490,000	Awareness Campaigns (per day): Tk. 700
Training	350,000	Training Sessions (per trainer per day): Tk. 500
Incentive	52,000,000	Cost of First Installment (per household): Tk. 1000
Contingency	5285000	10% of total budget
Total	58124000	

- **Cost Of New Technology:** There is the cost of purchase and installation.

<i>Cost of Smart ICS (taka)</i>	4000
<i>Number of installments</i>	4
<i>Subsidized</i>	1
<i>Consumer expense</i>	3
<i>Installment cost (taka)</i>	1000
<i>Total stove cost for consumer (taka/year)</i>	156000000

- **Cost Of Fuel:**

	Smart ICS
<i>Fuel cost (taka/kg)</i>	20
<i>Fuel consumption (kg/household/month)</i>	80
<i>Fuel cost (taka/household/month)</i>	1600
<i>Fuel consumption (kg/household/year)</i>	960
<i>Fuel cost (taka/household/year)</i>	19200
<i>Total fuel cost (taka/year)</i>	998400000

BENEFITS

- **Fuel Amount Savings:**

<i>Fuel consumption (kg/household/year)</i>	
<i>TCS</i>	2400
<i>Smart ICS (60% savings)</i>	960
<i>Fuel savings (kg/household/year)</i>	1440
<i>Amount of fuel saved (yearly)</i>	74880000 kg or 82500 tons

- **Fuel Cost Savings:**

<i>Fuel market price (taka/kg)</i>	20
<i>Fuel cost (kg/household/year)</i>	
<i>TCS</i>	48000
<i>Smart ICS (60% savings)</i>	19200
<i>Fuel cost saved (kg/household/year)</i>	28800
<i>Total cost saved (taka/year)</i>	1497600000

- **Reduction In Cooking Time:**

<i>Cooking time (hr/household/day)</i>	
<i>TCS</i>	4
<i>Smart ICS (50% reduction)</i>	2
<i>Rural wage rate of females (taka/hr)</i>	40
<i>Percentage of wage rate</i>	50
<i>Cooking time value (taka/household/year)</i>	
<i>TCS</i>	58400
<i>Smart ICS (50% reduction)</i>	29200
<i>Value of time saved (taka/household/year)</i>	29200
<i>Total time saved (taka/year)</i>	1518400000

- **Reduction In Emission Of Smoke:** Smoke contains large quantities of particulate matter, particularly PM2.5, as well as other HAP pollutants. PM2.5 is a primary focus as it is conducive to development of the 5 major respiratory diseases.

<i>PM2.5 24-hour concentration</i>	
<i>TCS</i>	420-500 µg/m ³
<i>Smart ICS (70% reduction)</i>	75-150 µg/m ³

Long-term exposure of PM2.5 results in an estimated 80% mortality rate. With the decrease in PM2.5 emissions due to use of smart ICS, there are health benefits. So, there is around 20% reduction in health effects and mortality rate.

- **Health Benefits:** These were split into two concepts: avoided deaths and prevented illness. Each is monetized using different methods of valuing benefits. Estimation of benefit of avoided illness is done by equating the value a day spent in illness to 50% of average rural wage rate per day.

Estimation of benefit of avoided death is done using an economic concept called the Value of Statistical Life (VSL). This amount is a reflection of what people are willing to pay to reduce death risk. This estimation is based on Navrud and Bindhjem (2010). In their study, they conducted meta-analysis to estimate VSL for people in OECD countries, including BD. The empirically estimated function was

$$\ln VSL = 0.22 + 1.0 \ln(gdp) - 0.445(r)$$

<i>Component</i>	<i>Data</i>	<i>Source</i>
<i>gdp (GDP per capita)</i>	BDT 188409	Bangladesh Bank
<i>r (mortality rate)</i> <i>no. of deaths due to TCS (n)</i> <i>total population (p)</i> <i>r=n/p</i>	113000 173000000 15.63	World Health Organization (WHO)
<i>Average wage rate</i>	BDT 8000	Trading economics

<i>Value of avoided illness (50% of average wage rate) (taka/person)</i>	4000
<i>Total value of avoided illness (assuming 2 working members in family) (taka/year)</i>	416000000
<i>Value of avoided death (VSL estimation) (taka)</i>	6137942
<i>Total value of avoided death (taka/year)</i>	6137942

The VSL estimated by this process stands at BDT 6.1 million, equivalent to around 33 times that of the GDP per capita.

BC-ratio

- Total valued benefit- 3438137942
Total valued cost- 1212524000
- BC-ratio (using 7% discount rate)- 2.7
BC-ratio (using 3% discount rate)- 2.8
BC-ratio (using 10% discount rate)-2.6
- Comparison is made between benefits and costs through their ratio. A benefit-cost ratio more than one shows that benefits exceed costs. In regards to the implementation of smart ICS, the BCR is 2.7. Benefits are 2.7 times the costs, meaning we should go ahead with the promotion and implementation of policy.