Appendix 12: Institutional Cookstove Projects

1. Overview of the Approach

Institutional cookstove projects apply a KPT approach similar to the household CTEC with KPT approach in CLEAR. For project cookstoves using electricity, gaseous fuels, liquid fuels, or pelletized fuels, continuously tracked fuel or energy consumption must be used directly together with baseline and project KPT results. For institutional biomass cookstoves where direct continuous fuel tracking is not feasible, continuously monitored cookstove usage time from SUMs is used as the analogous tracked quantity. In both cases, baseline and project KPTs are used to determine the relationship between project cookstove activity and energy consumption in the baseline and project scenarios, and the tracked quantity would then be used to scale energy consumption to the monitoring period.

2. Scope

This methodology applies to institutional cookstove projects in which meals are prepared on-site for non-household populations. While the methods have been designed to primarily apply to school settings, they may also be applied to hospitals, clinics, prisons, religious institutions, and other facilities. The method covers projects involving one or more project cookstove technologies and one or more baseline cookstove technologies, including cases where multiple baseline cookstoves are displaced by multiple project cookstoves of differing sizes or capacities within the same institution. The methodology applies to both directly tracked project fuels and project technologies for which direct continuous fuel or energy tracking is not feasible.

3. Baseline

Baseline emissions are estimated using a paired before-KPT and after-KPT design. Ex ante baseline fuel use may be estimated from credible and recent (no more than five years old) sources. Such sources may include peer-reviewed or gray literature, fuel purchase records, institutional records, or other studies for feasibility assessment and project design. However, ex post baseline fuel consumption used for crediting shall be derived from a before-KPT conducted in the same institutions that later receive the project technologies. The before-KPT shall be complemented by a baseline scenario survey that defines the baseline technologies and fuels, and shall also collect information on seasonality and baseline technology mix. This follows the same baseline scenario logic currently required when a KPT is used to measure the baseline for the household methods. This survey shall be conducted in all institutions participating in the project.

3.1 Baseline Emissions for Directly Tracked Project Technologies

Baseline emissions during monitoring period *y* are calculated as:

$$BE_y = EQ_{base} \times TA_{proj,y} + UE_{base,y}$$

Where:

Parameter	Description	Unit
BE_y	Baseline emissions during year *y*	tCO2e
EQ_{base}	Baseline emissions quotient per unit of tracked project activity	tCO2e per TJ or tCO2e per kWh
$TA_{proj,y}$	Total tracked project activity during year *y*	TJ or kWh
$UE_{base,y}$	Upstream emissions from baseline fuels during year *y*	tCO2e

For directly tracked project technologies:

$$TA_{proj,y} = tEC_{proj,j,y}$$

Where:

Parameter	Description	Unit
$tEC_{proj,j,y}$	Total tracked energy consumption of project fuel or energy *j* during year *y*	TJ or kWh

The baseline emissions quotient is calculated from the before-KPT and after-KPT as:

$$EQ_{base} = [\Sigma_i (EC_{base,KPT,i} \times EF_{base,i})] \div TA_{proj,KPT}$$

Where:

Parameter	Description	Unit
$EC_{base,KPT,i}$	Energy consumption of baseline fuel *i* during the before-KPT	TJ
$EF_{base,i}$	Total emission factor for baseline fuel *i*, including fNRB adjustment where relevant	tCO2e per TJ
$TA_{proj,KPT}$	Tracked project activity during the after-KPT	TJ or kWh

For directly tracked project technologies:

$$TA_{proj,KPT} = tEC_{proj,KPT,j}$$

Where:

Parameter	Description	Unit
$tEC_{proj,KPT,j}$	Tracked energy consumption of project fuel or energy *j* during the after-KPT	TJ or kWh

And upstream emissions are defined as:

$$UE_{base,y} = \Sigma_i (EF_{base,upstream,i} \times EC_{base,KPT,i})$$

Where:

Parameter	Description	Unit
$EF_{base,upstream,i}$	Upstream emission factor for baseline fuel *i* (see Appendix 4 in the main CLEAR methodology document)	tCO2/TJ

3.2. Baseline Emissions for Biomass Project Technologies Using SUMs

For biomass project technologies where direct continuous fuel or energy tracking is not feasible, normalized SUMs usage is used as the tracked project activity.

Baseline emissions during monitoring period *y* are calculated as:

$$BE_y = EQ_{base,SUMs} \times tNU_{proj,cred,y} + UE_{base,y}$$

Where:

Parameter	Description	Unit
BE_y	Baseline emissions during year *y*	tCO2e
$EQ_{base,SUMs}$	Baseline emissions quotient per unit of normalized project cookstove usage	tCO2e per normalized cookstove-hour
$tNU_{proj,cred,y}$	Credited normalized project cookstove usage during year *y*	Normalized cookstove-hours
$UE_{base,y}$	Upstream emissions from baseline fuels during year *y*	tCO2e

The baseline emissions quotient is calculated as:

$EQ_{base,SUMs} = \Sigma_i(EC_{base,KPT,i} \times EF_{base,i}) \div tNU_{proj,KPT}$

Where:

Parameter	Description	Unit
$EC_{base,KPT,i}$	Energy consumption of baseline fuel *i* during the before-KPT	TJ
$EF_{base,i}$	Total emission factor for baseline fuel *i*, including fNRB adjustment where relevant	tCO2e per TJ
$tNU_{proj,KPT}$	Total normalized project cookstove usage during the after-KPT	Normalized cookstove-hours

And upstream emissions are defined as:

$UE_{base,y} = \Sigma_i(EF_{base,upstream,i} \times EC_{base,KPT,i}) \times tNU_{proj,cred,y} \div tNU_{proj,KPT}$

Where:

Parameter	Description	Unit
$EF_{base,upstream,i}$	Upstream emission factor for baseline fuel *i* (see Appendix 4 in the main CLEAR methodology document)	tCO2/TJ

4. Project

Average project emissions are estimated using the after-KPT. The after-KPT shall be conducted 2 to 6 months after installation in the same institutions where the before-KPT was conducted. The after-KPT shall then be repeated according to the project monitoring schedule. CLEAR requires KPTs at least every two years and within the last four months of the monitoring period.

Project emissions during monitoring period *y* are calculated as:

$PE_y = EQ_{proj} \times TA_{proj,y} + UE_{proj,y}$

Where:

Parameter	Description	Unit
PE_y	Project emissions during year *y*	tCO2e
EQ_{proj}	Project emissions quotient per unit of tracked project activity	tCO2e per TJ, tCO2e per kWh,

		or tCO2e per normalized cookstove-hour
$TA_{proj,y}$	Total tracked project activity during year *y*	TJ or kWh
$UE_{proj,y}$	Upstream emissions from project fuels during year *y*	tCO2e

For directly tracked project technologies:

$$TA_{proj,y} = tEC_{proj,j,y}$$

For biomass project technologies using SUMs:

$$TA_{proj,y} = tNU_{proj,cred,y}$$

The project emissions quotient is calculated as:

$$EQ_{proj} = [\Sigma_j (EC_{proj,KPT,j} \times EF_{proj,j})] \div TA_{proj,KPT}$$

Where:

Parameter	Description	Unit
$EC_{proj,KPT,j}$	Energy consumption of project fuel *j* during the after-KPT	TJ
$EF_{proj,j}$	Total emission factor for project fuel *j*, including fNRB adjustment where relevant	tCO2e per TJ
$TA_{proj,KPT}$	Tracked project activity during the after-KPT	TJ or kWh

For directly tracked project technologies:

$$TA_{proj,KPT} = tEC_{proj,KPT,j}$$

And upstream emissions are defined as:

$$UE_{proj,y} = \Sigma_j (EF_{proj,upstream,j} \times EC_{proj,KPT,j,i})$$

Where:

Parameter	Description	Unit

$EF_{proj,upstream,j}$	Upstream emission factor for project fuel *j* (see Appendix 4 in the main CLEAR methodology document)	tCO2/TJ

For biomass project technologies using SUMs:

$$TA_{proj,KPT} = tNU_{proj,KPT}$$

For continuously tracked technologies, this follows the existing tracked-energy-plus-KPT structure.

For biomass project technologies where direct continuous fuel tracking is not feasible, the analogous tracked quantity is normalized project cookstove usage, not raw cookstove-on time. This is necessary because one hour on a small institutional cookstove does not represent the same cooking service as one hour on a larger cookstove.

For each project cookstove *k*:

$$NU_{proj,k,y} = U_{proj,k,y} \times CF_{k}$$

Where:

Parameter	Description	Unit
$NU_{proj,k,y}$	Normalized usage of project cookstove *k* during year *y*	Normalized cookstove-hours
$U_{proj,k,y}$	Cookstove-on time measured by SUMs for cookstove *k* during year *y*	hours
CF_{k}	Capacity factor for project cookstove *k*	n/a

Total normalized project cookstove usage is then:

$tNU_{proj,j,y}$ = sum over *k* of $NU_{proj,k,y}$

The same normalization shall be applied during the after-KPT:

$tNU_{proj,KPT,j-project}$ = sum over *k* of $[U_{proj,k,KPT} \times CF_{k}]$

Capacity factor is a normalization factor representing the relative rate of energy delivered to the pot by a project cookstove (cooking power), compared with a defined reference cookstove. The capacity factor shall be based on cooking power, as determined by the ISO institutional test standard (ISO 5714:2023). The reference cookstove shall be the project cookstove model or size class most commonly used in the project population. For each project cookstove type or size class *k*, the capacity factor shall be calculated as the firepower delivered (FPD) by cookstove *k* divided by the firepower delivered by the reference cookstove.

$$CF_k = FPD_k \div FPD_{ref}$$

Example:

Assume the most common project cookstove in the project population is the medium cookstove, so that cookstove is used as the reference cookstove.

From [ISO 5714:2023] (test protocols for institutional cookstoves), the cooking power values are:

- Small cookstove: 12 kW
- Medium cookstove: 24 kW
- Large cookstove: 36 kW

The capacity factor for each cookstove is calculated as:

$$CF_k = FPD_k \div FPD_{ref}$$

where the reference cookstove is the medium cookstove, so:

FPD_{ref} = 24 kW

The capacity factors are therefore:

- For the small cookstove: CF_{small} = 12 ÷ 24 = 0.5
- For the medium cookstove: CF_{medium} = 24 ÷ 24 = 1
- For the large cookstove: CF_{large} = 36 ÷ 24 = 1.5

This means:

- 1 hour of use on the small cookstove counts as 0.5 normalized cookstove-hours
- 1 hour of use on the medium cookstove counts as 1 normalized cookstove-hours
- 1 hour of use on the large cookstove counts as 1.5 normalized cookstove-hours

If, during a given monitoring period, SUMs record:

- Small cookstove: 1000 hours
- Medium cookstove: 2000 hours
- Large cookstove: 800 hours

Then normalized usage for each cookstove is:

- NU_{small} = 1000 × 0.5 = 500 normalized cookstove-hours
- NU_{medium} = 2000 × 1 = 2000 normalized cookstove-hours

- NU_{large} = 800 × 1.5 = 1200 normalized cookstove-hours

Total normalized project cookstove usage is then:

$tNU_{proj,y}$ = 500 + 2000 + 1200 = 3700 normalized cookstove-hours

Because the SUMs approach is less certain than direct continuous fuel or energy monitoring, the normalized usage rates measured during the monitoring period are capped at those measured during the KPT ($tNU_{proj,KPT,j-project}$).

5. Emission Reductions

Emission reductions during monitoring period *y* are calculated as:

$$ER_y = (BE_y - PE_y) \times (1 - LE_y)$$

Where:

Parameter	Description	Unit
ER_y	Emission reductions during year *y*	tCO2e
BE_y	Baseline emissions during year *y*	tCO2e
PE_y	Project emissions during year *y*	tCO2e
LE_y	Percentage deduction to account for leakage emissions during year *y*	%

Similar to CLEAR's household approach, project proponents shall either (1) apply a default adjustment factor of 2% to the emission reductions to approximate leakage emissions, or (2) evaluate the relevant potential sources of leakage and provide an evidence-based description and estimated quantification of each potential source and its relevance for the project.

6. Monitoring Schedule

The institutional cookstove monitoring would follow a paired KPT schedule:

- Before-KPT prior to installation
- After-KPT 2 to 6 months after installation in the same institutions
- Repeat after (project) KPTs according to the project monitoring schedule, and at least every two years

- KPTs should be undertaken within the last four months of the monitoring period for which credits are being issued

For all project technologies with direct metering, tracked fuel or energy data would be collected continuously.

For all biomass project technologies, SUMs would be installed on all project cookstoves and operated continuously.

7. Missing Data for SUMs

Missing SUMs data shall be treated as missing data, not as zero use. If missing SUMs data for a given institution in a monitoring period exceeds 20 percent of the possible project-technology days (PTDs), the project proponent shall apply the applicable stove use normalization discount in the table below to the normalized project cookstove usage($tNU_{proj,y}$) and shall provide a corrective action plan in the monitoring report describing how data loss will be reduced to less than 20% in the subsequent monitoring period. If missing SUMs data for a given institution equals or exceeds 50 percent of the possible PTDs, emission reductions for that institution may only be calculated using the cookstove usage data available for the monitoring period.

SUMs data missing (% of the possible PTDs)	Stove use normalization discount (%)
≤ 20	No discount
20-30	10
30-40	20
40-50	35
≥ 50	Can only use the cookstove use data available

8. Sampling and KPT Considerations

Sampling for institutional KPTs shall be stratified to reflect variation in institution type, user group, cooking regime, and project cookstove size, defined as:

Institution type: The type of institution where cooking takes place, based on its main function and the population it serves (e.g., day school, boarding school, hospital, prison, church).

User group: The main group of people for whom meals are prepared within the institution (e.g., primary students, secondary students, adults, patients, prisoners, mixed population).

Cooking regime: The typical pattern of meal preparation at the institution, including how often meals are cooked, whether feeding is continuous or partial (e.g., boarding school with three meals per day, day school with lunch only, church with occasional feeding events), and whether water is boiled or filtered.

Project cookstove size: The relative cooking capacity of a project cookstove, based on a predefined size or capacity measure used to distinguish smaller and larger cookstoves (e.g., 20 litre cookstove, 100 litre cookstove).

A **practical stratum** is defined as:

stratum = institution type × user group × cooking demand regime × project cookstove size

Each stratum should include at least 5 institutions (or all of the institutions if the number is 5 or fewer).

KPT duration should reflect the institutional regime. For example:

- 7 days for boarding schools or continuous-feeding institutions
- 5 days for day schools
- Where explicitly justified, shorter periods for intermittent institutions such as churches or clinics

The objective of the sampling design shall be to produce a representative estimate of fuel consumption per person-meal across the full project population. Within each stratum, institutions shall be selected using a transparent and predefined sampling approach, with a minimum of 5 institutions per stratum, or the entire stratum, whichever is fewer.

The KPT sample shall be required to meet the 95/10 precision rule for the target parameter of fuel or energy consumption per person-meal, with a minimum of 50 KPT samples (with each sample including all stoves in use at that site) across the project. Results from the sampled institutions shall then be weighted by stratum when estimating the overall project-level fuel consumption per person-meal, so that strata representing larger shares of the project population contribute proportionally to the final estimate. This weighting shall be necessary to avoid overrepresenting small or atypical strata and to ensure that the final project-level estimate reflects the actual composition of institutions and cookstove types in the project boundary.

9. Additional KPT Guidance for Institutional Settings

Scales and Weighing Capacity

- Scales used for institutional KPTs shall be appropriate for the larger fuel quantities commonly encountered in schools, hospitals, prisons, churches, and other institutional settings.
- Scales shall have sufficient capacity, resolution, and stability for the expected fuel loads.
    - Following the standard KPT protocol, the scale should have ±1% accuracy. It should also have sufficient capacity to quickly and accurately measure the fuel that the institution will use in one day. For example, if the institution maintains a

stock of 500kg of wood and is likely to use 100 kg/day, then the capacity and resolution should be at least 100 ± 1 kg; if the institution maintains a stock of several thousand kg and is likely to use several hundred kg/day, then capacity and resolution should be larger, perhaps 500 ± 5 kg or even 1000 ± 10 kg.

- KPT teams shall include personnel who are trained and physically able to move, handle, and weigh larger quantities of fuel safely and consistently.
- Where fuel quantities are too large to weigh in a single batch, the monitoring plan shall specify a clear procedure for subdividing loads and summing weights without loss of accuracy.

Fuel Inventory Definition and Separation

- Fuel inventories shall be clearly defined at the start of the KPT and physically separated from any fuel stocks that are not intended to be included in the monitored cooking system.
- The KPT protocol shall include procedures to prevent accidental additions to or removals from the monitored fuel inventory by institutional staff, students, or other members of the institutional population.
- Any fuel brought to the institution during the KPT period, such as wood brought by students, shall be placed in a separate, clearly identified pile until it can be documented and incorporated into the monitored inventory through the standard KPT procedures.
- Any fuel removed from the monitored inventory for non-study purposes shall be documented separately and excluded from the fuel use calculation.

Timing of Inventory Measurements

- Initial and daily inventory weights shall be completed before cooking begins each day.
- Because cooking in institutional kitchens may begin very early in the morning, the monitoring plan shall specify staffing and procedures that allow daily fuel weighing to occur before any fuel is withdrawn for cookstove use.
- Enumerators and relevant kitchen staff shall be trained on the requirement that cooking shall not begin, and fuel shall not be moved from the monitored inventory, before the daily weight has been recorded.
- Where early-morning cooking schedules make this difficult, the project shall document an alternative procedure that preserves the integrity of the daily fuel inventory and does not introduce additional uncertainty into the measured fuel consumption.

Recording of Person-Meals

- Projects shall record the total number of person-meals served on each day of the KPT using a standardized daily log.
- Person-meal records shall distinguish the main groups served where relevant, such as students, teachers, staff, patients, or boarding populations, if those groups receive different meal quantities or schedules.

- Daily person-meal totals recorded during the KPT shall be cross-checked against other available records, such as enrollment, attendance or boarding rosters, patient census records, meal service logs, or kitchen preparation records.
- Any material discrepancy between the recorded person-meal totals and the relevant cross-check records shall be documented and resolved before the KPT results are finalized.
- The KPT reporting documentation shall clearly define what counts as a person-meal and that definition shall be applied consistently across all institutions and across both baseline and project KPTs.