

MONITORING REPORT
Version 2.0, 22.05.2018

ADES Solar and efficient stoves in Madagascar
GS 464
2nd Crediting Period: monitoring period 3 (01/01/2017 - 31/12/2017)

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

>> 1. The project is the local production and distribution of solar and efficient cook stoves to households and institutions in Madagascar. The Swiss-Madagascan non-governmental organization ADES (Association pour le Développement de l'Energie Solaire) has continuously expanded its activities and capacities since the project start in 2007 and today operates cook-stove workshops in Tuléar, Ejeda, Morondava, Morombe, Majunga, Fianarantsoa, Antananarivo and Antsirabe. In order to create awareness for new stove technologies and to convince people to buy a new stove, cooking demonstrations in villages and schools as well as training programs for solar cooking are conducted.

2. Installed technologies are locally produced solar and efficient cook stoves. Nine stove types are currently being disseminated: (1) solar box stove, (2) E-solar box stoves, (3) solar parabolic stove, (4) efficient wood stove OLI-b, (5) efficient wood stove OLI-45b, (6) efficient wood stove OLI-60b, (7) efficient charcoal stove OLI-c, (8) efficient charcoal stove OLI-45c, and (9) efficient charcoal stove OLI-60c.

3. Relevant dates:

Start date of the project: 27 August 2007

First crediting period: 01 January 2008 to 31 December 2014

Start date of second crediting period: 01 January 2015

Length of the second crediting period: 7 years

First monitoring period of 2nd crediting period: 01.01.2015 – 31.12.2015

Second monitoring period of 2nd crediting period: 01.01.2016 – 31.12.2016

Third monitoring period of 2nd crediting period: 01.01.2017 – 31.12.2017

Project is in continuous operation.

4. Total emission reductions achieved in this monitoring period are **287,347 tCO₂e**

A.2. Project Participants

>>

Name of Party involved (*) (host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Madagascar (Host)	Private Entity - ADES – Association pour le Développement de l'Energie Solaire	No
Switzerland (Annex 1)	Private Entity - Foundation myclimate - the Climate Protection Partnership	No

A.3. Location of the project activity:

>> Country: Republic of Madagascar

Regions: entire country of Madagascar

Town/cities, where existing production or distribution centres are located:

- Toliara (Tuléar): 23°21'S, 43°40'E
- Ejeda: 24°21'S, 44°31'E
- Morondava: 20°17'5"S, 44°19'3"E
- Morombe: 21°44'56"S, 43°21'47"E
- Majunga: 15°42'55.09"S, 46°19'8.42"E
- Fianarantsoa: 21°27'12.07''S, 47°05'08.42''E
- Antananarivo: 18°55'18.01''S, 47°31'05.58''E
- Antsirabe: 19°51'59.97''S, 47°02'00.30''E

Additional production and distribution centers will be opened in other parts of Madagascar.

A.4. Technical description of the project

>> The project currently produces and disseminates 9 types of stoves: three types of solar stoves and six types of efficient stoves.

1. Solar box stove	The box type solar stove is an easily built, insulated box. Due to incident solar radiation temperatures up to 150° C can be generated in the box which is sufficient to cook almost all meals: rice, manioc, mais, potatoes, vegetables, meat and fish.
2. Parabolic solar stove	The parabolic solar stove is using a parabolic mirror. In the focus point of the mirror there is a device where the cooking pot can be put. The parabolic mirror gathers the sun rays and this process leads to high temperatures at the focal point. These temperatures are high enough to cook, bake, grill and even fry.
3. Large solar box stove	The large solar box stove is a larger version of the solar box stove and suitable for institutional kitchens like in schools.
4. Efficient wood stove OLI-b	The efficient wood fired rocket stove is a simple steel construction with a clay core inside as combustion chamber and for insulation. The Oli-b stove is made for a regular cooking pots used in households.
5. Efficient wood stove Oli-45b	The efficient wood fired rocket stove is a simple steel construction with a clay core inside as combustion chamber and for insulation. The Oli-45b stove is made for cooking pots Nr. 45 and suitable for larger households or street kitchens.
6. Efficient wood stove Oli-60b	The efficient wood fired rocket stove is a simple steel construction with a clay core inside as combustion chamber and for insulation. The Oli-60b stove is made for cooking pots Nr. 60 and suitable for larger kitchens like in schools.
7. Efficient charcoal stove Oli-c	The efficient charcoal fired rocket stove is a simple steel construction with a clay core inside as combustion chamber and for insulation. The Oli-c stove is made for a regular cooking pots used in households.
8. Efficient charcoal stove Oli-45c	The efficient charcoal fired rocket stove is a simple steel construction with a clay core inside as combustion chamber and for insulation. The Oli-45c stove is made for cooking pots Nr. 45 and suitable for larger households or street kitchens.
9. Efficient charcoal stove Oli-60c	The efficient charcoal fired rocket stove is a simple steel construction with a clay core inside as combustion chamber

	and for insulation. The Oli-60c stove is made for cooking pots Nr. 60 and suitable for larger kitchens like in schools.
--	---

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

>> The approved monitoring methodology applied to the project activity is included in the Gold Standard methodology “Technologies and Practices to Displace Decentralized Thermal Energy Consumption - 11/04/2011”.
http://www.goldstandard.org/sites/default/files/revised-tpddtec-methodology_april-2015_final-clean.pdf

A.6. Registration date of the project activity:

>> 23 December 2009

In 2015 the project was successfully revalidated and reregistered with the Gold Standard for the first renewal of the crediting period.

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

>> The crediting period has been renewed for the first time in 2015. The start of the second crediting period was on 01 January 2015.

A.8. Name of responsible person(s)/entity(ies):

>>

Tobias Hoeck, myclimate
tobias.hoeck@myclimate.org

Hans Peter Frei, ADES
hanspeter.frei@bluewin.ch

Ramilson Faralahy, ADES
faralahy@adesolaire.org

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

>>

1. Starting date of operation

Start date of project activity (workshops in Tuléar and Ejeda in operation): 27 August 2007
Since then the project is in continuous operation.

2. Actual operation:

ADES is producing and promoting solar and efficient stoves in Madagascar and is continuously expanding its activities.

Since the start of the first crediting period (01.01.2008) until 31.12.2017 a total of 164,307 solar and efficient stoves have been produced and disseminated in Madagascar.

Total stove sales since project start according to stove type:

Year	Box	E-Box	OLI-45b	OLI-45c	OLI-60b	OLI-60c	OLI-b	OLI-c	Parabolic	School Box	Yoyo	Total
2008	1459	0	0	0	0	0	0	0	67	0	117	1643
2009	620	0	0	0	0	0	0	0	14	0	0	634
2010	1462	0	0	0	0	0	619	168	26	0	0	2275
2011	1346	0	0	234	0	0	1124	3824	111	0	0	6639
2012	1651	13	78	728	45	0	1310	6976	160	11	0	10972

2013	1473	227	111	625	58	30	2044	12286	114	3	0	16971
2014	621	336	113	831	63	155	3847	18967	99	4	0	25036
2015	471	12	152	799	105	100	5326	24182	75	13	0	31235
2016	350	18	591	640	155	113	3746	26240	124	7	0	31984
2017	181	2	184	930	63	139	3692	31655	62	10	0	36918
Total	9634	608	1229	4787	489	537	21708	124298	852	48	117	164307

Comment: Please note that the above table includes also stoves that are not counted for emission reduction calculations.

Total stove sales since project start according to project scenario:

Year	Charcoal	Solar + OLI-b	Solar + OLI-c	Wood	Total
2008	768	2	5	868	1643
2009	429	1	1	203	634
2010	1212	327	76	660	2275
2011	3949	161	1271	1258	6639
2012	7968	250	1300	1454	10972
2013	13624	405	944	1998	16971
2014	20567	359	351	3759	25036
2015	25641	213	135	5246	31235
2016	27493	22	88	4381	31984
2017	33228	29	63	3598	36918
Total	134879	1769	4234	23425	164307

Comment: Please note that the above table includes also stoves that are not counted for emission reduction calculations.

3. Impact on applicability of methodology

No events occurred during this monitoring period, which impact the applicability of the monitoring methodology.

B.2. Revision of the monitoring plan

>> For the renewal of the crediting period the latest version of the methodology was applied. Please see latest monitoring plan in the PDD Version 8.3, section D.

In order to simplify the approach and reduce expenses for the monitoring field activities for the different stove types and project scenarios, we implemented the following changes from 2015 on:

- All stoves older than 5 years are not counted for emissions reductions and thus are also excluded from monitoring surveys.
- Solar stoves are not counted for emissions reductions and are not monitored. As a consequence the project scenario for combined application of solar & efficient stoves are no more used.
- For emissions reductions and also for monitoring we use only the two project scenarios “wood” and “charcoal”.

B.3. Request for deviation applied to this monitoring period

>>No request for deviation from the monitoring plan was submitted during this monitoring period.

Forward Action Requests:

The Gold Standard raised one FAR during the review for the renewal of the crediting period:

FAR: “The PP shall carry out baseline surveys as and when institutional stoves are implemented as a part of the project.”

The project does so far not count emissions reductions from institutional cook stoves. Baseline surveys will be conducted once institutional stoves have reached a sufficient scale.

The Gold Standard raised three FARs during last issuance review:

FAR 1: “The DOE shall at the time of next verification interview at least 5 clients having purchased more than three stoves and confirm with them that they act as resellers.”

>>The DOE shall check the requested information.

FAR 2: “The PP shall ensure that for future KPTs an appropriate sampling approach will be chosen and stoves from each age group will be included in a representative way in the sample group.”

>>No KPTs were conducted during this monitoring period. The PP will consider this FAR for next KPTs to be conducted in 2018.

FAR 3: “The PP shall ensure for the next KPT that the visits on each of the days during the KPT are properly documented and the verifying DOE shall check on a few sample households if the same were visited indeed on each of the days during the KPT by the surveyors.”

>>No KPTs were conducted during this monitoring period. The PP will consider this FAR for next KPTs to be conducted in 2018.

B.4. Notification or request of approval of changes

>> No request for design change was submitted to the Gold Standard during this monitoring period.

SECTION C. Description of the monitoring system

>> A description of the monitoring system (organizational structure, responsibilities of personnel etc.) can be found in the latest PDD in Section D.

Personnel & Qualifications:

Monitoring Manager CO2 Switzerland:

Mr. Hans Peter Frei, Engineer HTL, Auditor: ISO 9001: 2008 & ISO 14000

Monitoring Manager CO2 Madagascar:

Mr. Ramilson Faralahy,

Secondary degree,

University degree,

Animation and surveys professional experiences

Monitoring assistant manager CO2 Madagascar :

Mme Etienne Noëline Alpène :

University degree on Management & Finance,

Health animator consultant with PSI-Madagascar,

Animation and surveys professional experiences with Canadian Red Cross.

Responsibilities and quality assurance:

A monitoring manual has been compiled, where all necessary steps and procedures (organization, responsibilities, and tasks) are described in details for all monitoring activities. This manual is applied for all activities and allows for quality assurance at the different levels.

The ADES monitoring manager CO2 in Madagascar is responsible for all monitoring activities in the entire project area and is not involved in sales activities to guarantee an independent appraisal. For Kitchen Surveys, Kitchen Tests and other surveys paper records are kept with the ADES monitoring manager CO2 in Tuléar, Madagascar. Surveys are conducted by the monitoring manager CO2. The monitoring manager CO2 conducts household visits, fills in the questionnaires and transforms paper data into electronic data. The electronic data from the monitoring activities is then submitted to the

ADES monitoring manager CO2 in Switzerland, where it is checked on its accuracy and consistency. Final check and statistical analysis of the monitoring data is conducted by myclimate.

This organizational separation of data generation and data analysis combined with a two level data check guarantees for accurate and consistent results. The Project Database and the Customer Database are compiled and managed by myclimate.

The monitoring manager CO2 Madagascar conducts plausibility checks during data generation and preparation. Results that cannot be reconstructed are not considered and if required additional surveys or tests are conducted. Moreover, the monitoring manager CO2 Madagascar crosschecks data (especially sales reports) with other data available at the different production and distribution centers during monitoring visits. Delivery and stock lists for materials used also help to verify sales figures.

Monitoring and sales data is transferred to the monitoring manager CO2 Switzerland, who is also the responsible person for logistics. He thus can compare figures of delivered materials with the number of stoves sold. Final plausibility check is conducted during data analysis at myclimate.

ADES uses a customer relation management tool called “SalesForce”, which allows tracking all data during production and sale of the solar and efficient stoves. Every stove tracked by a unique number is linked to customer data. Since 2013 SalesForce includes also calculation of stove days and stove years, which serve as the basis for emission reduction calculation. This allows a more accurate calculation of stove years since now specific adjustment factor can be applied for each cluster and stove type (see Annex 3 for algorithm and source code applied).

All stove sales are carefully documented and recorded in the salesforce database, a customer relation management system that is filled by the sales managers and overviewed by the manager CO2 Madagascar. The manager CO2 Madagascar is responsible for all monitoring activities in Madagascar. Furthermore, also stoves sold to other organizations are listed in the sales record and marked accordingly with “not counted”. For these stoves no emission reductions are counted. This careful tracking of stove sales is a strict measure to avoid double counting.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	EF _{b,co2}
Data unit:	tCO2/t_fuel
Description:	CO2 emission factor arising from use of fuel in baseline scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4 Default IPCC values for wood / wood waste are applied. Default IPCC values for charcoal are applied. Country-specific value for emission during production of the fuel: Girard, P., Rousset, P, Vergnet, A., Rasamindisa, A., 1998. Comparing forestry wood species for the charcoal supply of Antananarivo city, Madagascar. In: Boiling Point, Issue 40, Household energy and health. (http://www.hedon.info/View+Article&itemId=10457 -> Mean of mentioned emission factors)
Value(s) :	1.7472 tCO2/t wood (=112.0 tCO2/TJ * 0.0156 TJ/ t) 6.344 tCO2/t charcoal (=112.0 tCO2/TJ * 0.0295 TJ/ t + 3.04 tCO2/t)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculation
Additional comment:	None

Data / Parameter:	EF _{p,co2}
Data unit:	tCO2/t_fuel
Description:	CO2 emission factor arising from use of fuel in project scenario

Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4 Default IPCC values for wood / wood waste are applied Default IPCC values for charcoal are applied Country-specific value for emission during production of the fuel: Girard, P., Rousset, P, Vergnet, A., Rasamindisa, A., 1998. Comparing forestry wood species for the charcoal supply of Antananarivo city, Madagascar. In: Boiling Point, Issue 40, Household energy and health. (http://www.hedon.info/View+Article&itemId=10457 -> Mean of mentioned emission factors)
Value(s) :	1.7472 tCO ₂ /t wood (=112.0 tCO ₂ /TJ * 0.0156 TJ/ t) 6.344 tCO ₂ /t charcoal(=112.0 tCO ₂ /TJ * 0.0295 TJ/ t + 3.04 tCO ₂ /t)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	If EF is in units of tCO ₂ /t _{fuel} , remove NCV term from emission calculations. Term can include a combination of emission factors from fuel production, transport, and use. The EF for charcoal includes the emissions during production of the fuel.

Data / Parameter:	EF _{b,non-co2}
Data unit:	tCO ₂ /t _{fuel}
Description:	Non-CO ₂ emission factor arising from use of wood-fuel in baseline scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5 Default IPCC values for CH ₄ and N ₂ O emissions for wood / wood waste are applied. Default IPCC values for CH ₄ and N ₂ O emissions for charcoal are applied. The following GWP100 are applied: 25 for CH ₄ , 298 for N ₂ O.
Value(s) :	0.1356 tCO ₂ eq/t wood 0.1563 tCO ₂ eq/t charcoal
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	These values were updated for the 2nd crediting period. GWP for second commitment period are applied.

Data / Parameter:	EF _{p,non-co2}
Data unit:	Data unit: tCO ₂ /t _{fuel}
Description:	Description: Non-CO ₂ emission factor arising from use of wood-fuel in project scenario
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5 Default IPCC values for CH ₄ and N ₂ O emissions for wood / wood waste are applied. Default IPCC values for CH ₄ and N ₂ O emissions for charcoal are applied. The following GWP100 are applied: 25 for CH ₄ , 298 for N ₂ O.
Value(s) :	0.1356 tCO ₂ eq/t wood 0.1563 tCO ₂ eq/t charcoal
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculation

Additional comment:	These values were updated for the 2nd crediting period. GWP for second commitment period are applied.
---------------------	---

Data / Parameter:	$P_{b,y}$
Data unit:	$t_{biomass}/unit-year$ and $t_{biomass}/unit-day$
Description:	Quantity of woody biomass consumed in the baseline scenario in year y and per day in year y.
Source of data used:	Results from KPT 2014. Data fulfills 90/30 rule, thus mean value is used.
Value(s) :	Wood scenario: 3.95 t wood/year and 0.0108 t wood/day Charcoal scenario: 1.09 charcoal/year and 0.0030 t charcoal/day
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculation
Additional comment:	These values were updated for the 2nd crediting period.

Data / Parameter:	$f_{NRB,i,y}$
Data unit:	Fractional non-renewability (%)
Description:	Non-renewability status of woody biomass fuel in scenario i during year y
Source of data used:	Official CDM default value is applied. This value was accepted by the DNA of Madagascar on 23 July 2012 and it is the latest available official value for fNRB. http://cdm.unfccc.int/DNA/fNRB/index.html
Value(s) :	72%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and project emissions calculation
Additional comment:	This value is fixed for the duration of the crediting period. However, the PP can at any time chose to reassess and adjust the NRB value.

References:

- Revised PDD V08.3: 150526_ADES_GS_VER_PDD_V8_3.pdf, Annex 2
- Project Database: 180410_ADES_Project_Database_2017_V02.xlsx

D.2. Data and parameters monitored

>> Since a fixed baseline is applied only project parameters but no baseline parameters are monitored.

Data / Parameter:	$P_{p,y}$
Data unit:	$t_{biomass}/unit-year$ and $t_{biomass}/unit-day$
Description:	Quantity of woody biomass consumed in the project scenario in year y and per day in year y.
Measured /Calculated /Default:	Measured
Source of data:	PFT Update 2016
Value(s) of monitored parameter:	Wood scenario: 1.54 t wood/year and 0.0042 t wood/day (PFT Update 2016) Charcoal scenario: 0.52 charcoal/year and 0.0014 t charcoal/day (PFT Update 2016)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Calibrated balance
Measuring/ Reading/ Recording frequency:	Updated every two years
Calculation method (if applicable):	A single project fuel consumption parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario.
QA/QC procedures applied:	Performance Field Tests conducted and analysed according to the requirements of the methodology “Technologies and Practices to Displace Decentralized Thermal Energy Consumption”

Data / Parameter:	U _{p,y}																																																
Data unit:	Percentage																																																
Description:	Usage rate in project scenario p during year y																																																
Measured /Calculated /Default:	Calculated																																																
Source of data:	Monitoring/Usage survey 2017																																																
Value(s) of monitored parameter:	Usage rates for the different age categories per scenario: <table><tr><th rowspan="2">age category</th><th colspan="2">Charcoal</th><th colspan="2">Wood</th></tr><tr><th>share in database</th><th>usage rate</th><th>share in database</th><th>usage rate</th></tr><tr><td>0-1 years</td><td>28%</td><td>96%</td><td>20%</td><td>89%</td></tr><tr><td>1-2 years</td><td>23%</td><td>100%</td><td>22%</td><td>78%</td></tr><tr><td>2-3 years</td><td>21%</td><td>94%</td><td>28%</td><td>79%</td></tr><tr><td>3-4 years</td><td>16%</td><td>98%</td><td>20%</td><td>90%</td></tr><tr><td>4-5 years</td><td>11%</td><td>98%</td><td>11%</td><td>77%</td></tr><tr><td>_Total_</td><td>100%</td><td></td><td>100%</td><td></td></tr><tr><td>single rate</td><td colspan="2">97.1%</td><td colspan="2">82.6%</td></tr></table>					age category	Charcoal		Wood		share in database	usage rate	share in database	usage rate	0-1 years	28%	96%	20%	89%	1-2 years	23%	100%	22%	78%	2-3 years	21%	94%	28%	79%	3-4 years	16%	98%	20%	90%	4-5 years	11%	98%	11%	77%	_Total_	100%		100%		single rate	97.1%		82.6%	
age category	Charcoal		Wood																																														
	share in database	usage rate	share in database	usage rate																																													
0-1 years	28%	96%	20%	89%																																													
1-2 years	23%	100%	22%	78%																																													
2-3 years	21%	94%	28%	79%																																													
3-4 years	16%	98%	20%	90%																																													
4-5 years	11%	98%	11%	77%																																													
Total	100%		100%																																														
single rate	97.1%		82.6%																																														
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions and project emissions calculation																																																
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.																																																
Measuring/ Reading/ Recording frequency:	Annual																																																
Calculation method (if applicable):	A single usage parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario																																																
QA/QC procedures applied:	Conducting surveys as required by the methodology “Technologies and Practices to Displace Decentralized Thermal Energy Consumption”																																																

Data / Parameter:	$N_{p,y}$
--------------------------	-----------

Data unit:	Number of days
Description:	Cumulative number of technology days in the project database for project scenario y
Measured /Calculated /Default:	Calculated
Source of data:	Sales Force database and project database
Value(s) of monitored parameter:	Wood: 6,020,697 Charcoal: 33,948,172
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N.A.
Measuring/ Reading/ Recording frequency:	Annual for verification
Calculation method (if applicable):	Cumulative number of technology days is calculated in the project database (salesforce) applying an algorithm that is described in the Annex to the monitoring report.
QA/QC procedures applied:	Transparent data analysis and reporting

Data / Parameter:	AF_{var}
Data unit:	ratio
Description:	AF_{var} is used to account for seasonal and weekly variation of biomass fuel consumption
Measured /Calculated /Default:	Calculated
Source of data:	Monitoring survey 2017
Value(s) of monitored parameter:	Wood: 0% Charcoal: 0%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N.A.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	Annual monitoring/usage surveys conducted with stove users reveal the latest figures for seasonal and weekly variation in fuel consumption.
QA/QC procedures applied:	Transparent data analysis and reporting

Data / Parameter:	Similar new project activity in the project area
Data unit:	Number of new project activities
Description:	List of similar cook stove projects and an assessment of how (e.g. target population, cook stove type, etc.) and to what degree overlap occurs

Measured /Calculated /Default:	Reported
Source of data:	Various sources: GS registry, CDM Pipeline, PoA Pipeline. etc.
Value(s) of monitored parameter:	There is one GS CDM cook stove program in Madagascar. The program distributes improved firewood and charcoal stoves. The stoves are labeled “TsinjoHarena” and can be clearly distinguished from the ADES branded cook stoves. Thus, there is no danger for double counting. Listed at GS: Tandavanala TsinjoHarena Improved cook-stoves in Vatovavy Fitovinany Region, Madagascar (ID: 103000000010202), Status is still validated as reported in last monitoring report. https://mer.markit.com/br-reg/public/project.jsp?project_id=103000000010202 Listed at the UNFCCC: PoA0492 Tandavanala TsinjoHarena Improved cookstoves in Madagascar with three CPAs, project was registered in April 2017: https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/XKB4WH1SU0CNG6O9IQV2T3DAEPZYJL/view
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Avoid double counting
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	ADES will report and monitor any similar new project activity in the project area in order to avoid double counting
QA/QC procedures applied:	n.a.

Data / Parameter:	Incentive scheme to surrender charcoal baseline stove
Data unit:	Number of stoves sold at discount
Description:	Number of efficient charcoal stoves sold at discount to households that hand in the baseline stove.
Measured /Calculated /Default:	Calculated
Source of data:	Sales force
Value(s) of monitored parameter:	53
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annually

Calculation method (if applicable):	Number of efficient charcoal stoves (Oli-c and Oli-45c) sold at a discount of 20% granted to households that hand in the baseline charcoal stove.
QA/QC procedures applied:	n.a.

In 2017 the number of clients that handed in their baseline stove (Oli-c and Oli-45c) in order to profit from a 20%-discount amounted to 53. In total 6,031 stoves were sold at a discount amounting to 5% of stoves sold. ADES will try to promote the discount model more intensively in order to increase the return rate in the coming years.

Leakage assessment

The applied methodology outlines five potential leakages, which were assessed and discussed in the PDD. No potential leakage was detected. The potential leakages are re-assessed below. The original justification is still valid and was updated based on latest data where applicable. It is reasonable to conclude that there is no risk for potential leakage.

<i>Leakage form</i>	<i>Estimate of risk</i>	<i>Justification</i>
a) The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project.	No risk	The displaced baseline technology is the least efficient and most common cooking method in the project area. It is highly unlikely that users outside the project boundary who cook on a more efficient, more convenient and less emitting technology (such as LPG, electricity,...) would switch back to open fires and traditional charcoal stove.
b) The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources.	No risk	The Kitchen Surveys conducted in the first crediting period and the Monitoring Survey 2017 show that 0% of stove users used the saved fuel for other purposes, which would include selling the fuel to non-project users.
c) The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario	No risk	There is one other CDM program ¹ with project activities in Madagascar that account for NRB fraction in the baseline scenario. The NRB fraction is a default factor published by the CDM and approved by the DNA in Madagascar. In case a project would significantly impact the NRB fraction, a new default value would be published (http://cdm.unfccc.int/DNA/fNRB/index.html). The mentioned PoA includes ethanol or biogas stove and household water purifying kit or buying water from community based water purification systems. Our project and the PoA do not share the same technologies. Thus, there is no danger for any miscounting of project technologies.
d) The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology	No risk	Baseline and project performance field tests subsume this potential for leakage (see methodology V03, page 15, footnote 17). The project has conducted BFT and PFT, thus there is no risk for this form of leakage.

¹ Ref. 7359 PoA for the reduction of emission from non-renewable fuel from cooking at household level: https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/2XJUR5NOWHY7T8BDAFM4613CIG9VS0/view

e) The project stipulates substitution within households who commonly used a technology with relatively lower emissions.	No risk	The project targets users that apply traditional open fires and inefficient charcoal stoves, which constitute the least efficient cooking technologies, which have higher emissions than the project stoves. Thus, there is no risk for this form of leakage.
--	---------	---

Sustainable Development Indicators:

Data / Parameter:	SD 1) Air quality
Data unit:	% of stove users stating improved air quality
Description:	Number of positive comments from stove users on air quality improvement with project stove
Measured /Calculated /Default:	Calculated
Source of data:	Monitoring survey 2017
Value(s) of monitored parameter:	Wood: 94% Charcoal: 98%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Sustainability indicator
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	Transparent data analysis and reporting

Data / Parameter:	SD 2) Livelihood of the poor
Data unit:	Hours / Ariary per household per year
Description:	Time (hours) and money (Ariary) saved per household per year due to fuel savings achieved by project stoves
Measured /Calculated /Default:	Calculated
Source of data:	Monitoring survey report 2017
Value(s) of monitored parameter:	Wood: 511 hours / year / household Wood: 173,249 Ar. / year / household Charcoal: 60,178 Ar. / year / household
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Sustainability indicators
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annual

Calculation method (if applicable):	n.a.
QA/QC procedures applied:	Transparent data analysis and reporting

Data / Parameter:	SD 3) Access to affordable and clean energy services
Data unit:	Number of persons
Description:	Number of persons that benefit from efficient and clean cooking technologies
Measured /Calculated /Default:	Calculated
Source of data:	Sales force / project database
Value(s) of monitored parameter:	887,573
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Sustainability indicators
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	Using total sales figures, usage rates and average number of household members
QA/QC procedures applied:	n.a.

Data / Parameter:	SD 4) Human and institutional capacity
Data unit:	Number of schools and number of persons reached
Description:	Number of school visits conducted and number of people reached by awareness creation
Measured /Calculated /Default:	Measured
Source of data:	ADES school program records
Value(s) of monitored parameter:	In 2017 ADES conducted awareness creation activities with 7,979 persons (6,672 school children, 902 teachers, 405 parents) in 104 different schools.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Sustainability indicators
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

Data / Parameter:	SD 5) Quantitative Employment
Data unit:	Number of local employees

Description:	Number of jobs offered by ADES to local employees at very good conditions: Non-limited (permanent) contracts; cover of school fees for all children; and cover of health insurance for entire family.
Measured /Calculated /Default:	Measured
Source of data:	ADES employment records
Value(s) of monitored parameter:	135 local employees In 2017 ADES employed 135 persons in Madagascar: 82 men (61%) and 53 women (39%)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Sustainability indicators
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

>> According to the applied methodology, there is no need to calculate baseline emissions separately. When the baseline fuel and the project fuel are the same and the baseline emission factor and project emission factor are considered the same, overall GHG reductions achieved by the project activity are calculated as follows (see applied methodology, page 14):

$$ERY = \sum_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel, nonCO2})) - LE_{p,y}$$

Where:

$\sum_{b,y}$ = sum over all relevant (baseline b/project p) couples

$N_{p,y}$ = cumulative number of project technology days included in the project database for project scenario p against the baseline scenario b in year y.

$U_{p,y}$ = cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)

$P_{p,b,y}$ = Specific fuel savings for an individual technology of project p against an individual technology of baseline b in year y, in tons/day, as derived from the statistical analysis of the data collected from field tests.

$NCV_{b,fuel}$ = Net calorific value of the fuel that is substituted or reduced ((IPCC default for wood fuel, 0.015 TJ/ton)

$f_{NRB,b,y}$ = fraction of biomass used in year y for baseline scenario b that can be established as non-renewable biomass

$EF_{fuel,CO2}$ = CO2 emission factor of the fuel that is substituted or reduced. 112 tCO2/TJ for wood/wood waste.

$EF_{fuel, nonCO2}$ = Non-CO2 emission factor of the fuel that is reduced

$LE_{p,y}$ = leakage for project scenario p in year y (tCO₂eq/yr)

The parameters $NCV_{b,fuel}$ and $NCV_{p,fuel}$ are not applicable to this project since EF is in units of tCO₂/t_{fuel} (see methodology page 21). Therefore the formula applied is:

$$ERY = \sum_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * (f_{NRB,b,y} * EF_{fuel,CO_2} + EF_{fuel, nonCO_2})) - LE_{p,y}$$

E.2. Project emissions calculation

>> According to the applied methodology, there is no need to calculate project emissions separately. When the baseline fuel and the project fuel are the same and the baseline emission factor and project emission factor are considered the same, overall GHG reductions achieved by the project activity are calculated as follows (see applied methodology, page 14):

$$ERY = \sum_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO_2} + EF_{fuel, nonCO_2})) - LE_{p,y}$$

Where:

$\sum_{b,y}$ = sum over all relevant (baseline b/project p) couples

$N_{p,y}$ = cumulative number of project technology days included in the project database for project scenario p against the baseline scenario b in year y.

$U_{p,y}$ = cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)

$P_{p,b,y}$ = Specific fuel savings for an individual technology of project p against an individual technology of baseline b in year y, in tons/day, as derived from the statistical analysis of the data collected from field tests.

$NCV_{b,fuel}$ = Net calorific value of the fuel that is substituted or reduced ((IPCC default for wood fuel, 0.015 TJ/ton)

$f_{NRB,b,y}$ = fraction of biomass used in year y for baseline scenario b that can be established as non-renewable biomass

EF_{fuel,CO_2} = CO₂ emission factor of the fuel that is substituted or reduced. 112 tCO₂/TJ for wood/wood waste.

$EF_{fuel, nonCO_2}$ = Non-CO₂ emission factor of the fuel that is reduced

$LE_{p,y}$ = leakage for project scenario p in year y (tCO₂eq/yr)

The parameters $NCV_{b,fuel}$ and $NCV_{p,fuel}$ are not applicable to this project since EF is in units of tCO₂/t_{fuel} (see methodology page 21). Therefore the formula applied is:

$$ERY = \sum_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * (f_{NRB,b,y} * EF_{fuel,CO_2} + EF_{fuel, nonCO_2})) - LE_{p,y}$$

E.3. Leakage calculation

>>According to PDD, no significant leakages are currently included.

Based on the monitoring conducted no leakages were identified in the possible leakage effects identified in PDD. Leakage therefore is:

$$\sum LE_i = 0$$

E.4. Emission reductions calculation / table

>> According to the applied methodology, we applied the formulae:

$$ERY = \sum_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO_2} + EF_{fuel, nonCO_2})) - LE_{p,y}$$

Where:

$\Sigma_{b,y}$ = sum over all relevant (baseline b/project p) couples

$N_{p,y}$ = cumulative number of project technology days included in the project database for project scenario p against the baseline scenario b in year y.

$U_{p,y}$ = cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)

$P_{p,b,y}$ = Specific fuel savings for an individual technology of project p against an individual technology of baseline b in year y, in tons/day, as derived from the statistical analysis of the data collected from field tests.

$NCV_{b,fuel}$ = Net calorific value of the fuel that is substituted or reduced ((IPCC default for wood fuel, 0.015 TJ/ton)

$f_{NRB,b,y}$ = fraction of biomass used in year y for baseline scenario b that can be established as non-renewable biomass

$EF_{fuel,CO2}$ = CO2 emission factor of the fuel that is substituted or reduced. 112 tCO2/TJ for wood/wood waste.

$EF_{fuel, nonCO2}$ = Non-CO2 emission factor of the fuel that is reduced

$LE_{p,y}$ = leakage for project scenario p in year y (tCO2eq/yr)

The parameters $NCV_{b,fuel}$ and $NCV_{p,fuel}$ are not applicable to this project since EF in units of tCO2/t_{fuel} (see methodology page 21). Therefore the formula applied is:

$$ER_y = \Sigma_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel, nonCO2})) - LE_{p,y}$$

The table below summarizes the values used in **2017** for the parameters of the applied formula:

Parameter	Scenario: Wood	Scenario: Charcoal
Baseline fuel use (tons/day)	0.0108	0.0030
Project fuel use (tons/day)	0.0042	0.0014
$P_{p,b,1}$: Fuel savings (tons/day)	0.0066	0.0016
Fraction NRB	0.72	0.72
U_p	82.6%	97.1%
N_p	6020697	33948172
$EF_{fuel,CO2}$	1.7472	6.3440
$EF_{fuel, nonCO2}$	0.1356	0.1563
AF_{var}	0%	0%
LE_p	0	0

The formula for emission reduction calculations including the values used for the parameters is:

Scenario “Wood”:

$$ER_{2017} = 6,020,697 * 0.826 * 0.0066 * (0.72 * 1.7472 + 0.1356) - 0$$

Scenario “Charcoal”:

$$ER_{2017} = 33,948,172 * 0.971 * 0.0016 * (0.72 * 6.3440 + 0.1563) - 0$$

ER per calendar year: 2017

scenario	ER tCO2e
WOOD	45,772
CHARCOAL	241,575
TOTAL	287,347

References

- Project Database: 180410_ADES_Project_Database_2017_V02.xlsx

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO ₂ e)	211,797	287,347

E.6. Remarks on difference from estimated value in the PDD

>> Projected overall emission reductions in the PDD are lower than actual emission reductions achieved by the project in the monitoring period. This is due to the following reasons:

- Actual usage rates are higher than assumed in the ER forecast in the PDD. Single average weighted usage rates for the two scenarios are 82.6% and 97.1% compared to a drop-off rate of 90% applied annually in the PDD. Further, also in the year 2017 more stoves were sold than in the PDD forecast (34,146 vs. 20,200). This leads to more stoves in operation in this monitoring period (120,440, see Project Database, sheet “stove sales, cell B136) compared to the forecast in the PDD (86,152, see „150312_ADES_ER_forecast_calculation_2nd_CP_V2_1.xlsx“, sheet „ER sales 2015 2021“, cell K41). This leaves a balance of 34,288 stoves more in operation and counted for ER calculation by end of 2017 in the monitoring period compared to the forecast in the PDD. This explains the higher ER achieved in 2017 compared to ER forecast.

Annex 1

References

No.	Reference	Description	File name
1	Project Database	Stove sales and ER calculations	180410_ADES_Project_Database_2017_V02.xlsx
2	Total Sales Record	Total Sales Record is available in the Salesforce Database	SalesForce Database
3	PDD	PDD, version 8.3, dated 26.05.2015	150526_ADES_GS_VER_PDD_2nd_CP_V08_3.pdf
4	SD 4: Schools visited by ADES	List of schools visited in 2017	180220_LIST OF SCHOOL VISITED_2017.xlsx
5	SD 5: Jobs created by ADES	Number of ADES employees in 2017	180104_ADES_Employees_2017.xlsx
6	Monitoring/Usage Survey Report	Monitoring/Usage Survey Report 2017	180410_ADES_MS_US_Report_2017_V02.pdf
7	Monitoring/Usage survey data	Monitoring/Usage Survey Data 2017	180410_Monitoring_Usage_Analysis_2017_V02.xlsx

Annex 3

Algorithm and source code for salesforce

CO₂ Emission Reduction Calculation applied in SalesForce

Algorithm

Below is an explanation of the algorithm used for the calculation of the stove days, i. e. the number of days that the stove was used during the monitoring period.

1. All the stoves that were sold to clients or resellers are retrieved from the database, except:
 - a. OLI-60b, OLI-60c, and solar stoves.
 - b. Stoves that were sold more than 5 years ago.
 - c. Stoves sold to institutions.
 - d. Stoves sold outside of project region, i. e. outside of Madagascar.
2. If the client has exactly one stove, the stove days are calculated as follows: if the stove was bought in the monitoring year, the number of days between the selling date and the end of the year is calculated. Otherwise, since the stove was bought before, it was used during the whole monitoring year, so the stove days are 365 or 366 for a leap year.
3. If the client has two or three stoves, only the newest is counted. The scenario of the client is determined by the stove type, because it could be that the client has two older OLI-c stoves and one newer OLI-b stove. In that case, even though the scenario of the client might be “Charcoal”, the stove should be counted in the “Wood” scenario.
4. If the client has more than three stoves, he is considered as a reseller, and every stove is counted (obviously the same applies for stoves sold to resellers):
 - a. The stove days for OLI-b and OLI-45b are assigned to the wood scenario.
 - b. All other stoves are assigned to the charcoal scenario.
5. All stoves that were sold to resellers are counted for the CO₂ ER calculation only thirty (30) days after their delivery to the reseller. Example: A reseller buys stoves on the 1st of June 2012. For the calculation of the CO₂ ER, those stoves are counted from the 1st of July 2012 on. The thirty days is an average number of days that the reseller needs to sell the stoves to clients. But this does **not** apply for stoves that were sold to clients who count as resellers! This is based on the assumption that a client who buys a couple of stoves will directly use them or give them to someone to use (otherwise he/she would make a contract as reseller to get the stoves cheaper).

Source Code

```
/*
 * Class for the calculation of the stove days (number of days that the stoves were in use during
 monitoring period)
 */
public class CO2ERCalc {
    //Constants
    public static final Integer CLIENT_MAX_STOVE_CNT = 3;    //A client with more than 3
products is considered as reseller
    public static final Integer FIRST_MONITORING_YEAR = 2008; //First year that was monitored

    private List<Client__c> clients;                //List of clients with bought stoves
    private List<Sale__c> resellerSales;            //List of resellers with bought/sold stoves
    private Date monitoringPeriodStart;              //Start date of the monitoring period
    private Date monitoringPeriodEnd;                //End date of the monitoring period
    private Date countedPeriodStart;
    private Map<String,Decimal> mapStoveDays;        //Map containing the stove days per cluster
    private String allClientSalesQuery;              //Query to get ALL client sales from database
    private String allResellerSalesQuery;            //Query to get ALL reseller sales from database
    private String clientSalesQuery;                 //Query to get client sales from database
    private String resellerSalesQuery;               //Query to get reseller sales from database
```

```

    private Map<String,Map<String,Integer>> stoveTypeCnt;    //Counter for stoves per year and type
    private Map<String,Map<String,Integer>> stoveClusterCnt; //Counter for stoves per year and
cluster
    private Map<String,Integer> stovesNotCounted;           //Map that contains stoves that are not
counted for ER calculation
    private Map<String,Map<String,Integer>> stovesWithRecovery;//Map of stoves for which an old
fatam-pera has been recovered
    private Integer countedYears;                           //Number of
years for which sold stoves are counted for ER calculation (default 5)

//Constructor
public CO2ERCalc(Integer monitoringYear, Integer countedYears) {
    //Map that holds the stove days per cluster
    mapStoveDays = new Map<String,Decimal>{
        'Charcoal' => 0,
        'Solar + OLI-b' => 0,
        'Solar + OLI-c' => 0,
        'Wood' => 0
    };

    //Initialize monitoring period
    monitoringPeriodStart = Date.newInstance(monitoringYear,1,1);
    monitoringPeriodEnd = Date.newInstance(monitoringYear,12,31);
    this.countedYears = countedYears;

    /*
    * The user can define the number of counted years. According to the algorithm,
    * "Stoves that were sold more than 5 years ago" are not calculated; the monitoring year is included
    => (monitoringYear - 4).
    */
    //countedPeriodStart = Date.newInstance(monitoringYear-4,1,1);
    countedPeriodStart = Date.newInstance(monitoringYear-(countedYears-1), 1, 1); //If 5 years
was chosen, countedPeriodStart will be (monitoringYear - (5-1)) == (monitoringYear - 4)

    //Initialize counters
    stoveTypeCnt = new Map<String,Map<String,Integer>>();
    stoveClusterCnt = new Map<String,Map<String,Integer>>();
    stoveClusterCnt.put(""+monitoringPeriodEnd.year(), new Map<String,Integer>{'Solar + OLI-b' =>
0, 'Solar + OLI-c' => 0}); //In order to show that for these clusters, no stoves are counted
    initStovesNotCounted();

    //Initialize map of stoves for which a fata-pera has been recovered
    initStovesWithRecovery();

    //Define queries to get sales from database
    allClientSalesQuery = 'SELECT Cluster__c, '+
        '(SELECT Stove__r.Type__c, Date_of__Sale__c FROM Sales__r '+
        'WHERE Date_of__Sale__c <= '+String.valueOf(monitoringPeriodEnd)+
        ' ORDER BY Date_of__Sale__c ASC) '+
        'FROM Client__c';
    allResellerSalesQuery = 'SELECT Date_of__Sale__c, Stove__r.Type__c FROM Sale__c '+
        'WHERE Reseller__c != null AND Date_of__Sale__c <=
'+String.valueOf(monitoringPeriodEnd);

    clientSalesQuery = 'SELECT Cluster__c, Region__c, '+
        '(SELECT Stove__r.Type__c, Date_of__Sale__c FROM Sales__r '+

```

```

        'WHERE Stove__r.Type__c != \''+Label.Type_OLI_60b+'\'' AND Stove__r.Type__c
!= \''+Label.Type_OLI_60c+'\''+
        'AND Stove__r.Type__c LIKE \'OLI%\' AND Stove__r.Unusable__c = NULL '+
        'AND Date_of_Sale__c <= \''+string.valueOf(monitoredPeriodEnd)+' AND
Date_of_Sale__c >= \''+String.valueOf(countedPeriodStart)+' AND
        ' ORDER BY Date_of_Sale__c ASC) '+
        'FROM Client__c '+
        'WHERE Region__c != \'Other\' AND Is_Institution__c = false';
    resellerSalesQuery = 'SELECT Date_of_Sale__c, Stove__r.Type__c FROM Sale__c '+
        'WHERE Reseller__c != null AND Date_of_Sale__c <=
'+String.valueOf(monitoredPeriodEnd)+' AND Date_of_Sale__c >=
'+String.valueOf(countedPeriodStart)+'
        'AND Stove__r.Type__c != \''+Label.Type_OLI_60b+'\'' AND Stove__r.Type__c !=
\'+Label.Type_OLI_60c+\''+
        'AND Stove__r.Type__c LIKE \'OLI%\'";
    }

    //Return client sales query
    public String getClientSalesQuery() {
        return clientSalesQuery;
    }

    //Return reseller sales query
    public String getResellerSalesQuery() {
        return resellerSalesQuery;
    }

    //Return client sales query
    public String getClientSalesQuery() {
        return clientSalesQuery;
    }

    //Return reseller sales query
    public String getResellerSalesQuery() {
        return resellerSalesQuery;
    }

    //Return stove days per cluster
    public Map<String,Decimal> getStoveDaysMap() {
        return mapStoveDays;
    }

    //Return monitoring year
    public Integer getMonitoringYear() {
        return monitoredPeriodStart.year();
    }

    //Return stoves per type and year counter
    public Map<String,Map<String,Integer>> getStoveTypeCnt() {
        return stoveTypeCnt;
    }

    //Return stoves per cluster and year counter
    public Map<String,Map<String,Integer>> getStoveClusterCnt() {
        return stoveClusterCnt;
    }

```

```

//Return stoves that are not counted for ER calculation
public Map<String,Integer> getStovesNotCounted() {
    return stovesNotCounted;
}

//Return stoves for which a fatam-pera was recovered
public Map<String,Map<String,Integer>> getStovesWithRecovery() {
    return stovesWithRecovery;
}

//Calculate stove days for stoves sold to clients
public void calculateClientSales(List<Client__c> clients) {
    List<Sale__c> sales; //Sales of a client
    Decimal stoveDays; //Stove days for one stove in wood or charcoal cluster

    for (Client__c client : clients) {
        sales = client.Sales__r;

        //Client has one, two or three stoves
        if (sales.size() <= CLIENT_MAX_STOVE_CNT && sales.size() > 0) {
            //If client has more than one stove, only the newest is counted
            Sale__c sale = sales[sales.size()-1];
            String cluster = (sale.Stove__r.Type__c == 'OLI-b' || sale.Stove__r.Type__c == 'OLI-45b') ?
'Wood' : 'Charcoal';
            incStoveTypeCnt(sale.Stove__r.Type__c, sale.Date_of_Sale__c.year());
            incStoveClusterCnt(cluster, sale.Date_of_Sale__c.year());
            incSecondaryStoves(sales.size()-1);
            stoveDays = calculateStoveDays(sale);
            updateCluster(cluster, stoveDays);
        }

        //Client has more than three products and is considered a reseller, i.e. every product is counted
        else {
            calculateResellerSales(sales);
        }
    }
}

//Calculate stove days for stoves that have been sold through resellers
public void calculateResellerSales(List<Sale__c> sales) {
    Decimal stoveDays; //Stove days for one stove
    String stType; //Type of stove
    String cluster; //Cluster of stove depending on type

    for (Sale__c sale : sales) {
        stType = sale.Stove__r.Type__c;

        //If the stove is an OLI-b or OLI-45b, count it to the wood cluster, otherwise to the charcoal
cluster
        cluster = (stType == 'OLI-b' || stType == 'OLI-45b') ?
            'Wood' : 'Charcoal';

        incStoveTypeCnt(stType, sale.Date_of_Sale__c.year());
        incStoveClusterCnt(cluster, sale.Date_of_Sale__c.year());
    }
}

```

```

        stoveDays = calculateStoveDays(sale);
        updateCluster(cluster, stoveDays);
    }
}

//Calculate the number of days that the stove was used during the monitoring year
private Decimal calculateStoveDays(Sale__c sale/*, String cluster, String region*/) {
    Decimal stoveDays; //Adjusted number of days that the stove has been used during monitoring
year
    Integer stoveAge; //Age of stove

    //Calculate age of stove
    stoveAge = monitoringPeriodEnd.year() - sale.Date_of_Sale__c.year();

    //Stove has been bought in monitoring year
    if (stoveAge == 0) {
        stoveDays = sale.Date_of_Sale__c.daysBetween(monitoringPeriodEnd);
    }

    //Stove has worked for more than one year, i.e. it has worked during the whole monitoring year
    else stoveDays = (Date.isLeapYear(monitoringPeriodEnd.year())) ? 366 : 365;

    return stoveDays;
}

//Update the cluster by adding the stove days to it
private void updateCluster(String cluster, Decimal stoveDays) {
    stoveDays += mapStoveDays.get(cluster);
    mapStoveDays.put(cluster, stoveDays);
}

//Increment counters for client sales
public void incClientStoveCnt(List<Client__c> clientSales) {
    //Count all stoves sold to clients
    for (Client__c client : clientSales) {
        List<Sale__c> sales = client.Sales__r;

        //Client is considered as a reseller
        if (sales.size() > CLIENT_MAX_STOVE_CNT) {
            incResellerStoveCnt(sales);
        }
        else {
            //Increment cluster and stove type count
            for (Sale__c sale : sales) {
                incStoveClusterCnt(client.Cluster__c, sale.Date_of_Sale__c.year());
                incStoveTypeCnt(sale.Stove__r.Type__c, sale.Date_of_Sale__c.year());
            }
        }
    }
}

//Increment counters for reseller sales
public void incResellerStoveCnt(List<Sale__c> resellerSales) {
    //Count all stoves sold to resellers
    for (Sale__c sale : resellerSales) {
        //Increment cluster count

```

```

String cluster = (sale.Stove__r.Type__c == 'OLI-b' || sale.Stove__r.Type__c == 'OLI-45b') ?
    'Wood' : 'Charcoal';
incStoveClusterCnt(cluster, sale.Date_of_Sale__c.year());

//Increment stove type count
incStoveTypeCnt(sale.Stove__r.Type__c, sale.Date_of_Sale__c.year());
}
}

//Increment type counters
private void incStoveTypeCnt(String type, Integer year) {
    Map<String,Integer> tmpMap;
    Integer cnt;

    //Check if year and type are in map, otherwise add them
    if (!stoveTypeCnt.containsKey("+year")) stoveTypeCnt.put("+year, new Map<String,Integer>());
    if (!stoveTypeCnt.get("+year").containsKey(type)) {
        tmpMap = stoveTypeCnt.get("+year");
        tmpMap.put(type, 0);
    }

    tmpMap = stoveTypeCnt.get("+year");
    cnt = tmpMap.get(type) + 1;
    tmpMap.put(type, cnt);
    stoveTypeCnt.put("+year, tmpMap);
}

//Increment cluster counters
private void incStoveClusterCnt(String cluster, Integer year) {
    Map<String,Integer> tmpMap;
    Integer cnt;

    //Check if year and cluster are already in map, otherwise add them
    if (!stoveClusterCnt.containsKey("+year")) stoveClusterCnt.put("+year, new
Map<String,Integer>());
    if (!stoveClusterCnt.get("+year").containsKey(cluster)) {
        tmpMap = stoveClusterCnt.get("+year");
        tmpMap.put(cluster, 0);
    }

    tmpMap = stoveClusterCnt.get("+year");
    cnt = tmpMap.get(cluster) + 1;
    tmpMap.put(cluster, cnt);
    stoveClusterCnt.put("+year, tmpMap);
}

//Increment recovery counters
private void incStovesWithRecoveryCnt(String type, Integer year) {
    Map<String,Integer> tmpMap;
    Integer cnt;

    //Check if year and cluster are already in map, otherwise add them
    if (!stovesWithRecovery.containsKey("+year")) stovesWithRecovery.put("+year, new
Map<String,Integer>());
    if (!stovesWithRecovery.get("+year").containsKey(type)) {
        tmpMap = stovesWithRecovery.get("+year");

```

```

        tmpMap.put(type, 0);
    }

    tmpMap = stovesWithRecovery.get("+year);
    cnt = tmpMap.get(type) + 1;
    tmpMap.put(type, cnt);
    stovesWithRecovery.put("+year, tmpMap);
}

//Increment secondary stove counter
private void incSecondaryStoves(Integer inc) {
    Integer cnt = stovesNotCounted.get('Secondary stoves');
    cnt += inc;
    stovesNotCounted.put('Secondary stoves', cnt);
}

//Initialize map of not counted stoves
private void initStovesNotCounted() {
    stovesNotCounted = new Map<String,Integer>();
    stovesNotCounted.put('Outside project area',
        [SELECT Count() FROM Sale__c
        WHERE Client__r.Region__c = 'Other' AND Stove__r.Unusable__c = NULL AND
Client__r.Is_Institution__c = false
        AND Stove__r.Type__c LIKE 'OLI%' AND Stove__r.Type__c != :Label.Type_OLI_60b AND
Stove__r.Type__c != :Label.Type_OLI_60c
        AND Date_of_Sale__c <= :monitoringPeriodEnd AND Date_of_Sale__c >=
:countedPeriodStart]);
    stovesNotCounted.put('Institution',
        [SELECT Count() FROM Sale__c
        WHERE Client__r.Is_Institution__c = true AND Stove__r.Type__c != :Label.Type_OLI_60b
        AND Stove__r.Type__c != :Label.Type_OLI_60c AND Stove__r.Unusable__c = NULL AND
Stove__r.Type__c LIKE 'OLI%'
        AND Date_of_Sale__c <= :monitoringPeriodEnd AND Date_of_Sale__c >=
:countedPeriodStart]);
    stovesNotCounted.put('New model',
        [SELECT Count() FROM Sale__c
        WHERE (Stove__r.Type__c = :Label.Type_OLI_60b OR Stove__r.Type__c =
:Label.Type_OLI_60c)
        AND Stove__r.Unusable__c = null AND Stove__r.Type__c LIKE 'OLI%'
        AND Date_of_Sale__c <= :monitoringPeriodEnd AND Date_of_Sale__c >=
:countedPeriodStart]);
    stovesNotCounted.put('Broken',
        [SELECT Count() FROM Sale__c WHERE Stove__r.Unusable__c != NULL AND
Stove__r.Type__c LIKE 'OLI%'
        AND Date_of_Sale__c <= :monitoringPeriodEnd AND Date_of_Sale__c >=
:countedPeriodStart]);
    stovesNotCounted.put('Solar stoves',
        [SELECT Count() FROM Sale__c WHERE (NOT Stove__r.Type__c LIKE 'OLI%')
        AND Date_of_Sale__c <= :monitoringPeriodEnd AND Date_of_Sale__c >=
:countedPeriodStart]);
    stovesNotCounted.put('Older than '+String.valueOf(this.countedYears)+' years', [SELECT
Count() FROM Sale__c WHERE Date_of_Sale__c < :countedPeriodStart]);
    stovesNotCounted.put('Secondary stoves', 0);
}

//Get stoves for which a fata-pera has been recovered

```

```

private void initStovesWithRecovery() {
    List<Sale__c> recoveredStoves = [SELECT Date_of_Sale__c, Stove__r.Type__c FROM Sale__c
                                   WHERE Stove__r.Recovery_Fatampera__c = TRUE AND Date_of_Sale__c
<= :monitoringPeriodEnd
                                   AND (Stove__r.Type__c = 'OLI-c' OR Stove__r.Type__c = 'OLI-45c')];
    stovesWithRecovery = new Map<String,Map<String,Integer>>();

    for (Sale__c sale : recoveredStoves) {
        incStovesWithRecoveryCnt(sale.Stove__r.Type__c, sale.Date_of_Sale__c.year());
    }
}

```