

MOEJ/GEC JCM Feasibility Study (FS) 2014
Summary of the Final Report

“Energy Saving by Micro Flush Toilet”

(Implementing Entity: LIXIL Corporation)

1. Overview of the Proposed JCM Project

Study partners	<p>Japan <Nippon Koei Co., Ltd></p> <ul style="list-style-type: none"> ● To develop JCM methodology which calculates greenhouse gas (GHG) emission reductions quantitatively ● To identify JCM candidate model project, etc... <p>Host country <Loxera Advisory Services></p> <ul style="list-style-type: none"> ● To introduce of Micro Flush Toilet (MFT) in detached houses ● To cooperate for investigation of business plan for introducing MTF, etc... <p><National Social Security Fund (NSSF)></p> <ul style="list-style-type: none"> ● To introduce of MTF in collective houses ● To cooperate for investigation of business plan for introducing MTF, etc... <p><FEP Corp></p> <ul style="list-style-type: none"> ● Same as NSSF <p><National Housing Corporation (NHC)></p> <ul style="list-style-type: none"> ● Same as NSSF <p><Serena Hotels></p> <ul style="list-style-type: none"> ● To introduce of MTF in Hotels ● To cooperate for investigation of business plan for introducing MTF, etc... <p><Sarova Hotels></p> <ul style="list-style-type: none"> ● Same as Serena Hotels 		
Project site	Kiserian, Kajiado County, and other counties ,Kenya		
Category of project	Energy Saving		
Description of project	<p>This Project aims to introduce MTF produced by LIXIL Corporation (LIXIL) into the detached houses developed by Loxera Advisory Services (Loxera). Loxera is the private company of the host country and they have been developing 32 detached houses.</p> <p>Moreover, Loxera have a plan to install 1,000 Jyokaso (septic tank) and 2 MTFs are able to install for 1 septic tank. Therefore, it is expected to have the Project with these septic tank and MTF.</p> <p>In this connection, this Project contributes to the water-saving in Kenya which suffering from water shortages, and also reduces the energy consumption of the water and sewerage management in Kenya.</p>		
Expected project implementer	Japan	LIXIL Corporation	
Expected project implementer	Host country	Loxera Advisory Services	
Initial investment	JPY 5,824,000	Date of groundbreaking	September, 2015
Annual maintenance cost	JPY 0	Construction period	6 months Construction-installation
Willingness to investment	Yes	Date of project commencement	March, 2016

Financial plan of project	<p>Loxera is the private company of the host country and they have a plan to develop 32 detached houses. In addition, they can implement not only selling 1,000 septic tank but also construction and maintenance by themselves. Therefore, there are no issues about their financial plan of detached house business.</p>
GHG emission reductions	<p>182 [kgCO₂/year] $(6-1.63)[L/flush] \times 16[flush/day] \times 365[days] \times 32 / 1,800[L/hr] \times 0.6kw \times 0.6672 [kgCO_2/kWh]$ 64 units of MTFs will be installed in 32 detached houses developed by Loxera. Reference scenario of one flush is calculated as 6 liter/flush. Reference scenario of water consumption is calculated as 1.63[liter/flush]. The flush number of times per day is calculated as 16 times. The grid coefficient, 0.6672 [kgCO₂/kWh], is adapted by the grid coefficient authorized in Kenya.</p>

2. Study Contents

(1) Project development and implementation

1) Project planning

i) Expected project implementer (Construction plan and Operational plan)

Loxera is project implementer in the host country. Loxera have already been developing total 8 detached houses in Kiserian, Kajiado County, Kenya. In addition to above development, they have plans i) to develop 32 detached houses in same area, in Kiserian, Kajiado Count, ii) to install 1,000 septic tank to existing houses in whole Kenya. Together with detached houses and septic tank, it is expected to install approximately 2,000 MTFs. LIXIL Cooperation have already installed 2 units of MTFs to one detached house developed/constructed by Loxera as shown in the right figure. (1 story: 15m x 14m: excluding garden, parking on the space). And, with the cooperation of Loxera and residents, it is planned to establish MRV structure for collecting actual usage and various data of MTF. As the figure on the right, 2 units of Toilet are installed in detached houses. Flow meter will be installed in these toilets and it is planned to carry out the MRV.

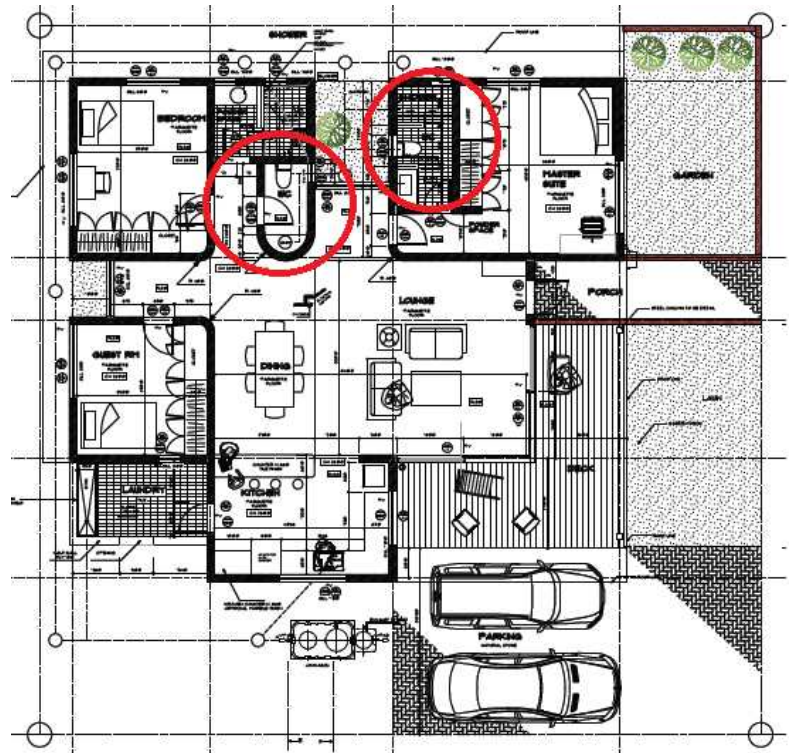


Figure 1 : Floor Plan of Detached House developed by Loxera

ii) Management Structure and Performance of the Project implementer

Loxera is the private company of the host country and they have a plan to develop 32 detached houses. In addition, they can implement not only selling 1,000 septic tank but also construction and maintenance by themselves. Therefore, there are no issues about their financial plan of detached house business.

iii) Profitability Evaluation

Business profitability of Loxera is described on ii) Management Structure and Performance of the Project implementer. In addition, LIXIL implemented the Credit Check for Loxera from the aspect of understanding the future business development.

iv) Initial Investment, Maintenance, MRV cost

According to the result of the investigation, market rate of standard size toilet to be used in middle-income class is 20,000 to 45,000 JPY. On the other hand, the price of MTF is about 70,000 JPY. Thus, to utilize of the JCM Demonstration Projects and JCM Model Projects, it is expected to recover the inferiority of a cost with its competitors product. Initial investment, mainenance cost, and MRV cost by LIXIL for 32 detached houses of Loxera are summarized in tablee below.

Table 1 Initial Investment, Maintenance, MRV cost related Micro Flush Toilet

#	Item	Cost	Unit	Defrayer
1	Initial Investment for detached house construction ^{note 1}	4,480,000	JPY	Loxera
2	Maintenance cost for MTF ^{note 2}	0	JPY/year	Loxera
3	Cost for power consumption ^{note 3}	0	JPY/year	End user
4	MRVcost ^{note 4}	1,344,000	JPY	Loxera

Note 1 : Condition before the budget of JCM Model Projects is provided. In considering the import method of MTF to Kenya, taking into account the reduction of customs and import duty, it is investigating a reduction from the original cost. In the above table, it is calculated as "70,000 JPY x 32 households x 2 units/household".

Note 2 : Basically, periodic maintenance for the toilet (except failure) is not expected, maintenance cost is defined to 0 JPY.

Note 3 : MTFs (except the shower toilet), in principle, electrical power is unnecessary.

Note 4 : There are no MRV cost by end users. However, the expense of flow meter to be installed in each household burdened by Loxera (42,000 yen / unit) is described. And, periodical measurement will be implemented together with Loxera and LIXIL.

Regarding to cash planning, market rate of standard size toilet to be used in middle-income class is 20,000 to 45,000 JPY. On the other hand, the price of MTF is about 70,000 JPY. However, Since it is possible to greatly reduce the consumption of water, it is expected to have an attractive benefit for the person who is living expensive water tariff area. LIXIL and Loxera have been discussing to install the Toilets in such areas. In addition, the budget for detached house construction by Loxera is expected to use the loan from the bank in Kenya. The budget for supplying the LIXIL product to Loxera, it is under consideration to find an inexpensive way. However, there are no issues relating to the implantation of the Project.

**Figure 2 : Installed Micro Flush Toilet**

v) Risk Analysis

Risk analysis of the Project are summarized in Table below.

Table2 Risk Analysis for Installation of Micro Flush Toilet to Detached House

Issues for Consideration	Summary
Issue 1: Needs for adjustment of schedule between housing construction/sales and JCM Model Projects	It is necessary to adjust/consider of the schedule between housing constructions/sales and JCM Model Projects (application and getting the result). This Project will be implemented by private company, therefore, after the negotiations; it is possible to proceed promptly to the sales contract. However, it is intended for multiple of detached houses by Loxera. Thus, it is important to adjust the schedule.
Issue 2: Needs for sale of detached home by Loxera	Even if LIXIL manufactures/sells MTF, it is necessary to install detached houses, and to use by residences. Otherwise, GHG emission reductions are not achieved. And it is expected to take long time to sell detached houses. In addition, housing

Issues for Consideration	Summary
	construction also takes several months. Moreover, since the expansion of Loxera's business is ongoing, it is difficult to predict the number and time schedule of sale detached house by Loxera.
Issue 3: Implementation of accurate/ appropriate monitoring	Proper implementation of MRV is a principal thing in JCM. However, the characteristics of the facilities of the toilet, it is assumed that monitoring at all times from the outside is not intended very pleasant from the aspect of end user. In addition, in the detached houses, it is difficult to monitor the internal situation (private space).

2) Permits and Licenses for the project development and implementation

i) Construction of Detached Houses

Permits and Licenses relating to housing construction are necessary to apply by the housing construction operator (e.g. Loxera, NSSF, etc...). In Kenya, normally, housing construction operators and owner have made these licenses by themselves. Therefore, it is not considered as a problem of permits and licenses. E.g. Loxera has all permits and licenses for all detached houses which have been developing in same area, Kiserian, Kajiyado county, Kenya. In addition, the Project area's detached houses have no connectable water and sewerage facilities. Thus it is necessary to use ground water and wastewater treatment to use a septic tank by themselves. Therefore, while approval the water supply and sewerage is not required, it is necessary to acquire the groundwater use permission. In addition, Loxera has been applying for the planned Project to be carried out in 2015.

ii) Sales of Sanitary Ware

For the components (Pipe fittings, joint, pulp, and pump) to be used in MTFs introducing the project, it is managed as receiving the same authentication in KEBS (Kenya Bureau of Standards) if it is certificated by SGS (Certification of Société Générale de Surveillance). In fact, each transaction (each container) need to get the certification, LIXIL product has not certified yet by SGS because it has not shipped yet. SGS has already confirmed that the components of MTF can get their certification. There are no issues relating to the implementation of the Project.

3) Advantage of Japanese technology

MTF which is installed in the Project is described in detail below.

Main feature of this technology (MTF) is to clean the sewage and waste by opening and closing the bottom of the toilet flapper valve to use lever (see Figure 3 and Figure 4) Than the structure of the this toilet, sewage and filth in the toilet to flow down in the opening and closing of the flapper valve. After that, it is possible to wash the inside of the toilet bowl in the wash water only 350ml. For preventing smell leak with a small water (about 700 ml) and flapper valve. In conclusion, it is also possible to achieve further saving water is to minimize the accumulated water. In addition, the structure of this MTF is recognized to have the same function of "Water trap"¹.



¹Enforcement Ordinance of Construction Standard Law in Japan, Article 29 and Article 30, Ministry of Construction NoticeNo. 1386 as a function of "Outhouse Toilet"

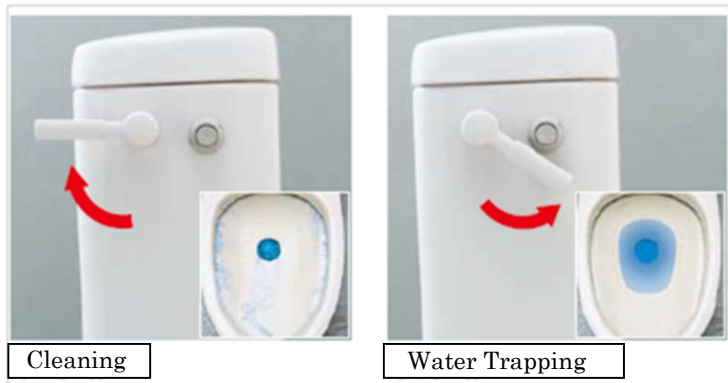


Figure 3 : Example of Lever Operation

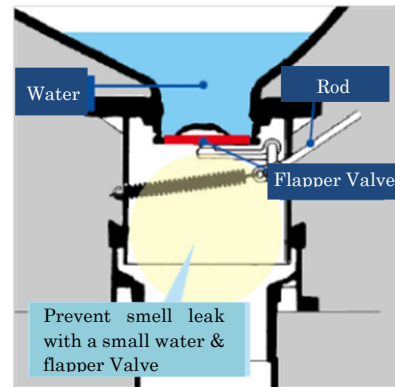
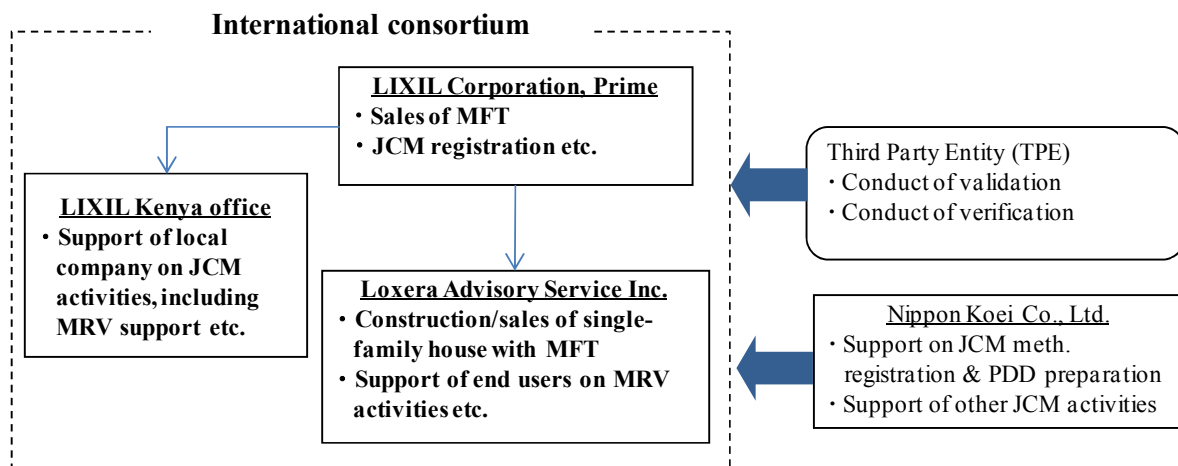


Figure 4 : Structure of Flapper

In addition, not only this Micro Flush Toilet, but also all toilet produced by LIXIL is possible to avoid adhesion of bacteria. All products are antimicrobial type.

4) MRV Structure

This project plans to conduct MRV for GHG emission reduction from the installation of MTF to detached houses in Kenya. Therefore, it is considered to measure the flush water consumption in actual usage. MRV implementation structure by international consortiums for the Project implemented by LIXIL and Loxera is shown below figure.



Note: MFT means Micro Flush Toilet

Figure 5 MRV Implementation Structure

MRV Implementation Structure of the Project is expected to implement not only implementation flow of MRV (monitoring, reporting, and verification), but also investigation of capacity development for stakeholders in Kenya related to MRV. Thus, it is expected to build a foundation for realizing MRV implementation structure sustainably and stability. Moreover, monitoring of the Project is planned to measure volume of water consumed in toilets as described above. Also ,at the initial stage of this feasibility study, it was consider to be declared the number of flash, but the device for count the number of flushes have not been confirmed.

From the above, in the Project, flow meter will be installed for each MTF to measure the cleaning water directly. However, it is unusual that monitoring of flushing water of the toilet, and it is necessary for agreement by end users. These matters are issues for considerations in future. Therefore, if it is difficult to get data by actual measurement, alternative solution such as sampling measurement will be considered.

Moreover, the target project of this study, regular monitoring of the flush water consumption is required. However, it is not feasible to have everyday monitoring by person due to the characteristics of toilet. Therefore, the Project consider to install monitoring equipment which can get data by equipment itself as shown in table below.

Table 3 Specification of Monitoring Equipment

Item	Specification
Name of Equipment	Aichi Tokei Denki Co.,Ltd; Instantaneous Integrating Flow meter
Corresponding flow rate	More than 0.3 [liter/min]
Power	Lithium battery (No external power required in 4 years)
Structure	Anti-dust and indoor type (IP64)
Weight	Approx. 250 [g]
Simultaneous indication	0.05L/min
Accumulated indication	000000.00 L
Max. available pressure	1MPa, 20 degree Celsius : liquid
Available liquid temperature	0 to 60 degree Celsius

[Features]

- Built-in lithium batteries (No external power supply is required)
- Indications of both instantaneous flow-rate and integrating flow volume by only 1 flow meter
- Revolving display unit (It can be fixed to a easy-to-read position)
- Simplified structure with the vane wheel type measuring principle
- Measurement of various liquids
- Reset function for indications of Integrating Flow Volume (Total) and Integrating Flow Volume (Trip)
- Value holding function for Instantaneous Flow-Rate indication
- Pulse output function (Option)



Source : Aichi Tokei Denki Co., Ltd.

Photo : Monitoring equipment

5) Environmental integrity and Sustainable development in host country

Through the project implementation, MTF can mitigate maximum 90 % of water consumption, comparing to conventional flush toilet. By using MTF, it contributes to not only water saving in Kenya but also energy saving in Kenyan water treatment system. Also, it contributes to mitigation of polluted sludge and prevention of environment deterioration etc. In addition, in case of using septic tank, processing ability can be improved with longer retention time.

By diffusion of MTF in Kenya, power saving in water system, GHG emission reduction, improvement of public health etc. will be realized. And, Kenya has faced water shortage by rapid economic growth and urbanization. MTF can support such issues from the viewpoint of effective water usage and contributes to sustainable development in Kenya in term of energy resource and water resource.

6) Toward project realization (planned schedule and possible obstacles to be overcome)

To implement the Project, the following issues shall be considered properly.

[Issue 1] Schedule arrangement between house construction & housing sales and JCM financing programme

It is necessary to consider how to apply for JCM financial programme in parallel with project implementation (house construction and housing sales).

[Issue 2] Proper housing sales by Loxera

Based on the progress and plan of housing sales by Loxera, production of MTF will be adjusted. In case of sudden demand in Kenya, not only production in Japan but also third country production will be considered with Lixil overseas bases.

[Issue 3] Implementation of proper and accurate monitoring

Normally lavatory basin is not popularly sold to end-users, it seems therefore to be difficult to implement monitoring with them. So proper monitoring method, such as sampling etc. shall be considered in case of monitoring with many users.

(2) JCM methodology development

In the JCM methodology, there are some terms and special definitions are made for smooth understandings. In this JCM methodology, the following descriptions were prepared.

Terms	Definitions
Micro flush toilet	The toilet system which consists of lavatory basin, toilet seat, water tank etc. and has consumes water less than two (2.0) liters for one flush.
Flush water	Flush water uses for flushing solid waste and/or waste water from laboratory pan.
Water supply system	Water for micro toilet uses water is produced by water supply system which consists of intake, transmission lines, treatment plant and distribution lines etc.

As for the summary of the methodology, the following descriptions were prepared.

Items	Summary
<i>GHG emission reduction measures</i>	This methodology applies to the project that aims for saving energy by introducing MTF for the target facility, commerce facilities etc. in Kenya.
<i>Calculation of reference emissions</i>	Reference emissions are GHG emissions from using reference toilet, calculated with water consumption of project toilet and CO2 emission factor for water supplied.
<i>Calculation of project</i>	Project emissions are GHG emissions from using project toilet,

<i>emissions</i>	calculated with water consumption of project toilet and CO2 emission factor for water supplied.
<i>Monitoring parameters</i>	Water consumption of project toilet (micro flush toilet)

1) Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Toilet is utilized for solid waste and urine.
Criterion 2	Water usage for one flush is less than two liters.
Criterion 3	Water for toilet is supplied by water supply system
Criterion 4	Waste water after flushing discharges to septic tank or sewerage system.
Criterion 5	Toilet shall be taken care of good hygiene.
Criterion 6	Proper maintenance service/framework, which consists of Manufacturer or agent who appointed from the manufacturer etc., shall be set.

2) Calculation of GHG emissions (including reference and project emissions)

Based on the draft JCM methodology, the information of GHG emissions and relating information and data was prepared below.

Reference emissions are calculated by multiplying water consumption of project toilet and CO2 emission factor for water supplied.

$$RE_{i,p} = \Sigma(WC_{RE,p} \times CEF_{water} / 1,000)$$

$RE_{i,p}$: Reference emissions during the period p [tCO2/p]

$WC_{RE,i,p}$: Water consumption of reference toilet during the period p [liter/p]

CEF_{water} : CO2 emission factor for supplied water [tCO2/m3]

Project emissions are also calculated by multiplying water consumption of project toilet and CO2 emission factor for water supplied.

$$PE_{i,p} = \Sigma(WC_{PE,p} \times CEF_{water} / 1,000)$$

$PE_{i,p}$: Project emissions during the period p [tCO2/p]

$WC_{PE,p}$: Water consumption of project toilet during the period p [liter/flush]

$CEF_{water,i,p}$: CO2 emission factor for consumed water [tCO2/m3]

Then, emission reduction of MTF system in Kenya can be calculated with the following formula.

$$ER_{i,p} = RE_{i,p} - PE_{i,p}$$

$ER_{i,p}$: Emission reductions during the period p [tCO₂/p]

$RE_{i,p}$: Reference emissions during the period p [tCO₂/p]

$PE_{i,p}$: Project emissions during the period p [tCO₂/p]

3) Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
CEF_{water}	When project toilet consumes water supplied, CO ₂ emission factor for supplied water (CEF_{water}) is used with the following calculation. CEF_{water} [tCO ₂ /m ³] = $EF_{water-production}$ [kWh/m ³] * EF_{elec} [tCO ₂ /kWh]	Based on the official data /information from Kenyan organization, this value will be calculated.
$WC_{RE,p}$	Water consumption of reference toilet i during the period p [liter/flush] is selected six (6) liter from the data of reference scenario. Note : The above data is set tentatively and will be fixed by the completion of Final Report.	Specifications of reference toilets which are in widespread use in Kenyan market.