JCM Project Design Document Form

A. Project description

A.1. Title of the JCM project

Energy Saving for Semiconductor Factory with High Efficiency Centrifugal Chiller and Compressor

A.2. General description of project and applied technologies and/or measures

The project newly installs high-efficiency centrifugal chillers and air compressors in the clean room of the semiconductor plant to reduce CO_2 emissions from electricity consumption in Bangkadi Industrial Park in the Kingdom of Thailand. The project chiller is equipped with an inverter, which contributes to energy-saving by controlling the rotation speed of the compressor motor so as to continuously regulate the room temperature and humidity. In addition, the project non-inverter type multi-stage oil-free air compressor contributes to energy-saving, while providing high volume of compressed air required for the drive of the semiconductor manufacturing equipment.

A.3. Location of project, including coordinates

Country	Kingdom of Thailand
Region/State/Province etc.:	Pathumthani
City/Town/Community etc:	Tambol Bangkadi Amphur Muang
Latitude, longitude	13°58'47.6"N 100°33'23.0"E

A.4. Name of project participants

The Kingdom of Thailand	Sony Device Technology (Thailand) Co., Ltd.
Japan	Sony Semiconductor Manufacturing Corporation

A.5. Duration

Starting date of project operation	01/04/2017
Expected operational lifetime of project	8 years

A.6. Contribution from Japan

The proposed project was partially supported by the Ministry of the Environment, Japan (MOEJ) through the Financing Programme for JCM Model projects, which provided financial support of less than half of the initial investment for the projects in order to acquire JCM credits. As for the transfer of technology, the manufacturers provided instruction and manuals for

operation and maintenance during the initial installation. Maintenance support by the manufacturers will also be available upon request.

B. Application of an approved methodology(ies)

B.1. Selection of methodology (ies)

Selected approved methodology No.	TH_AM002
Version number	02.0
Selected approved methodology No.	TH_AM003
Version number	01.0

B.2. Explanation of how the project meets eligibility criteria of the approved methodology

[TH_AM002]

Eligibility criteria	Descriptions specified in the methodology	Project information
Criterion 1	Project air compressor is a non-inverter type multi-stage oil-free air compressor with an electric motor power of 55kW, 75kW, 110kW, 132kW, 145kW, 160kW, or 200kW installed in manufacturing process of semiconductors.	The installed compressor is model “ALE75W” made by KOBELCO and is a two-stage oil-free type compressor with a non-inverter and an electric motor power of 75kW under the process of semiconductor manufacturing.
Criterion 2	Periodical check is planned more than one (1) time annually.	An annual inspection is carried out by the manufacturer and a maintenance report is provided. For every 40,000 hours of operation, an overhaul is also conducted.

[TH_AM003]

Eligibility criteria	Descriptions specified in the methodology	Project information
Criterion 1	Project chiller is an inverter type centrifugal chiller with a capacity which is less than or equal to 1,500 USRt. * 1 USRt = 3.52 kW	The three installed chillers are the model “ETI-50” made by Mitsubishi Heavy Industries, Ltd. The project chillers are a centrifugal type with the capacity of 500 USRt each.

<table>
<tr>
<td>Criterion 2</td>
<td>
COP for project chiller i calculated under the standardizing temperature conditions* ($COP_{PJ,tc,i}$) is more than the threshold COP values set in the table below. (“x” in the table represents cooling capacity per unit.)
<table>
<tr><td>Cooling capacity per unit (USRt)</td><td>300≤x≤450</td><td>450<x≤550</td><td>550<x≤825</td><td>825<x≤1,500</td></tr>
<tr><td>Threshold COP value</td><td>5.59</td><td>5.69</td><td>5.85</td><td>6.06</td></tr>
</table>
$COP_{PJ,tc,i}$ is calculated by altering the temperature conditions of COP of project chiller i ($COP_{PJ,i)}$ from the project specific conditions to the standardizing conditions. $COP_{PJ,i}$ is derived from specifications prepared for the quotation or factory acceptance test data by manufacturer.

[equation to calculate $COP_{PJ,tc,i}$]
$COP_{PJ,tc,i} = COP_{PJ,i} \times [(T_{cooling\text{-}out,i} - T_{chilled\text{-}out,i} + TD_{chilled} + TD_{cooling}) \div (37 - 7 + TD_{chilled} + TD_{cooling})]$

$COP_{PJ,tc,i}$: COP of project chiller i calculated under the standardizing temperature conditions* [-]
$COP_{PJ,i}$: COP of project chiller i under the project specific conditions [-]
$T_{cooling\text{-}out,i}$: Output cooling water temperature of project chiller i set under the project specific conditions [degree Celsius]
$T_{chilled\text{-}out,i}$: Output chilled water temperature of project chiller i set under the project specific conditions [degree Celsius]
$TD_{cooling}$: Temperature difference between condensing temperature of refrigerant and output cooling water temperature 1.5 degree Celsius set as a default value [degree Celsius]
$TD_{chilled}$: Temperature difference between evaporating temperature of refrigerant and output chilled water temperature, 1.5 degree Celsius set as a default value [degree Celsius]

*The standardizing temperature conditions to calculate $COP_{PJ,tc,i}$
Chilled water: output 7 degrees Celsius
input 12 degrees Celsius
Cooling water: output 37 degrees Celsius
</td>
<td>
The COP of each project chiller ($COP_{PJ,tc,i}$) is 6.15.

[Calculation result]
6.15 = 6.15 x [(37 - 7 + 1.5 + 1.5) ÷ (37 – 7 + 1.5 + 1.5)]
</td>
</tr>
</table>

	input 32 degrees Celsius	
Criterion 3	Periodical check is planned more than one (1) time annually.	An annual inspection, including washing of the tubes, is carried out by the manufacturer and a maintenance report is provided.
Criterion 4	Ozone Depletion Potential (ODP) of the refrigerant used for project chiller is zero.	The refrigerant type of the project chiller is "ASAHIKLIN AK-134a (HFC-134)" by AGC Chemicals, whose ODP is zero.
Criterion 5	A plan for prevention of releasing refrigerant used for project chiller is prepared. In the case of replacing the existing chiller with the project chiller, a plan for prevention of releasing refrigerant used in the existing chiller to the air (e.g. re-use of the equipment) is prepared. Execution of this plan is checked at the time of verification, in order to confirm that refrigerant used for the existing one replaced by the project is prevented from being released to the air.	To prevent the release of refrigerant into the atmosphere due to the project, at the time of chiller removal, the project owner plans to collect the refrigerant from the project chiller removed by using a refrigerant recovery machine and ensure the storage of the collected refrigerant. A letter of consent on not releasing refrigerant used for the project chiller was prepared by the participants from both sides.

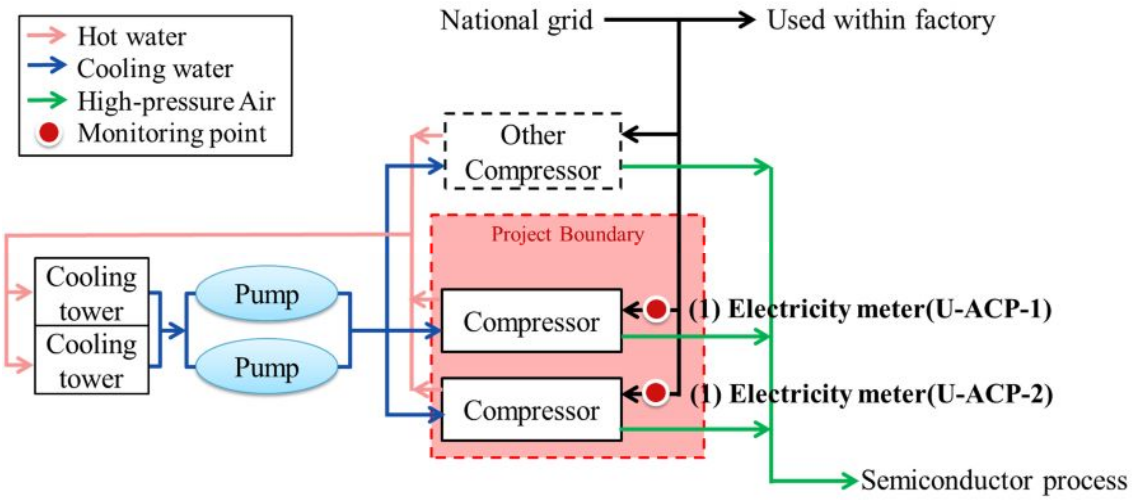
C. Calculation of emission reductions

C.1. All emission sources and their associated greenhouse gases relevant to the JCM project

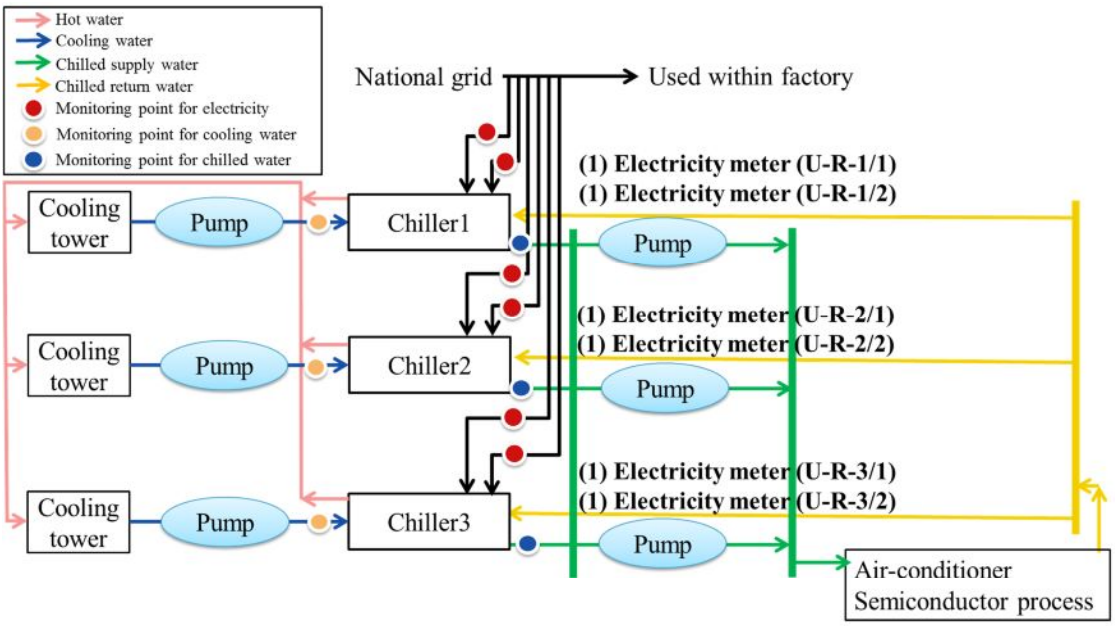
Reference emissions	
Emission sources	GHG type
Electricity consumption by reference air compressor	CO_2
Power consumption by reference chiller	CO_2
Project emissions	
Emission sources	GHG type
Electricity consumption by project air compressor	CO_2
Power consumption by project chiller	CO_2

C.2. Figure of all emission sources and monitoring points relevant to the JCM project

[TH_AM002]



[TH_AM003]



* Two electricity meters are installed in each chiller, because each chiller has two compressors.

C.3. Estimated emissions reductions in each year

Year	Estimated Reference emissions (tCO_2e)	Estimated Project Emissions (tCO_2e)	Estimated Emission Reductions (tCO_2e)
2013	-	-	-
2014	-	-	-
2015	-	-	-
2016	-	-	-

2017	n/a	n/a	274
2018	n/a	n/a	365
2019	n/a	n/a	365
2020	n/a	n/a	365
2021	n/a	n/a	365
2022	n/a	n/a	365
2023	n/a	n/a	365
2024	n/a	n/a	365
2025	n/a	n/a	89
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
Total (tCO_2e)			2,918

D. Environmental impact assessment	
Legal requirement of environmental impact assessment for the proposed project	No

E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

In order to cover a diverse group of stakeholders, Sony Device Technology (Thailand) Co., Ltd. held a local stakeholder consultation with the Thailand Greenhouse Gas Management Organization (TGO) and E-Square Inc. at Sony Device Technology (Thailand) Co., Ltd. on November 22nd, 2016. The member of TGO, Sony Device Technology (Thailand) Co., Ltd., Sony Corporate Services (Japan) Corporation. and E-Square Inc. participated in the consultation.

E.2. Summary of comments received and their consideration

Stakeholders	Comments received	Consideration of comments received
Thailand Greenhouse Gas	How were the attendees selected for the LSC (Local Stakeholder Consultation) and would it be possible	The attendees were selected after consideration by TGO prior to the LSC. If third parties or organizations

Management Organization	for organizing the LSC to be held for academic researchers, students and manufacturers of similar semiconductors in Thailand in order to promote knowledge and technology sharing with regard to the JCM projects?	were invited to the LSC, the content of the consultation would need to be reconsidered and limited accordingly as confidential information regarding manufacturing is also included and reported through the LSC. *No action is needed.*
	Is an inverter applied to the project chillers?	An inverter is applied to all of the project chillers. *No action is needed.*
	How is the COP (Coefficient of Performance) value of the chillers calculated and how did Sony measure it?	The COP was calculated based on the cooling capacity and electricity consumption which were measured and published at the time of the shipping by the manufacturer *No action is needed.*
	Does the COP reach the maximum value at full load?	This projects installs an inverter type chiller which can operate at the precise capacity needed to meet the demand. The COP value of the inverter type chiller in this project generally reaches its maximum in the following conditions 1) Cooling water is 12 degrees (lower limit) and 2) The part load ratio is between 40% and 60%. *No action is needed.*
	Is it possible to implement the JCM projects according to the original schedule of the JCM project cycle in spite of the fact that the two methodologies are still under	We are currently moving forward with the implementation of these projects as per the original schedule and are aiming for the issuance of credits by March 2018 at the latest.

	approval?	*No action is needed.*
	What is the capacity of the project chillers?	The capacity is 500 USRt for each chiller in the proposed project. *No action is needed.*
Sony Device Technology (Thailand) Co., Ltd.	What is the benefit for Thailand through these JCM projects?	GHG emission reductions with advanced energy saving can be achieved by installing high efficiency technologies transferred from Japan through these projects. *No action is needed.*
Sony Corporate Services (Japan) Corporation.	How will the credits acquired through these JCM projects be divided?	More than half of the total credits will be allocated to the Japanese government. The project participants will divide and allocate the rest of credits through the consultation between Thailand and Japanese side. *No action is needed.*

F. References

Reference lists to support descriptions in the PDD, if any.

Annex

Estimated emissions reductions in each year(TH_AM002)			
Year	Estimated Reference emissions (tCO_2e)	Estimated Project Emissions (tCO_2e)	Estimated Emission Reductions (tCO_2e)
2013	-	-	-
2014	-	-	-
2015	-	-	-
2016	-	-	-
2017	550.8	512.0	38

2018	731.1	679.6	51
2019	731.1	679.6	51
2020	731.1	679.6	51
2021	731.1	679.6	51
2022	731.1	679.6	51
2023	731.1	679.6	51
2024	731.1	679.6	51
2025	180.2	167.5	12
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-
2030	-	-	-
Total (tCO_2e)			407

Estimated emissions reductions in each year(TH_AM003)			
Year	Estimated Reference emissions (tCO_2e)	Estimated Project Emissions (tCO_2e)	Estimated Emission Reductions (tCO_2e)
2013	-	-	-
2014	-	-	-
2015	-	-	-
2016	-	-	-
2017	3,165.8	2,929.0	236
2018	4,202.0	3,887.7	314
2019	4,202.0	3,887.7	314
2020	4,202.0	3,887.7	314
2021	4,202.0	3,887.7	314
2022	4,202.0	3,887.7	314
2023	4,202.0	3,887.7	314
2024	4,202.0	3,887.7	314
2025	1,036.1	958.6	77
2026	-	-	-
2027	-	-	-
2028	-	-	-
2029	-	-	-

2030	-	-	-
Total (tCO_2e)			2,511

Revision history of PDD		
Version	Date	Contents revised
1.0	06/11/2017	First edition
2.0	20/02/2018	Second edition