地球規模課題対応
国際科学技術協力（環境・エネルギー分野）

アルジェリア国サハラを起点とする
ソーラーブリーダー研究開発
中間レビュー調査報告書

平成 26 年 7 月
（2014 年）

独立行政法人国際協力機構
産業開発・公共政策部

産公
ＪＲ
14-093

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目　　次

現地視察写真

現地視察　　写真１

合同中間レビュー報告書署名

第 4 回 AASEF 記念撮影（川田大使）

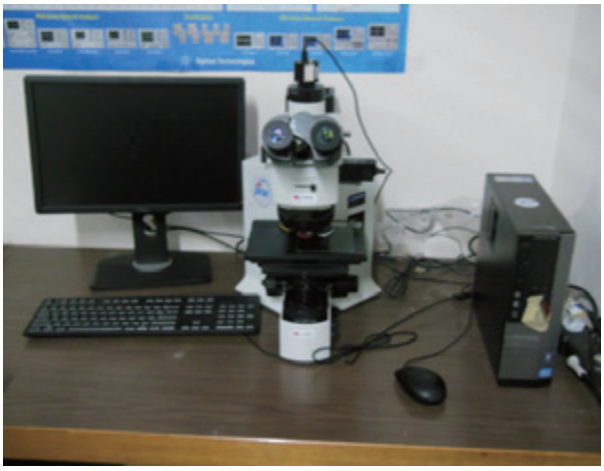
オラン科学技術大学学長表敬

サイーダ大学現地視察

現地視察　　写真２（オラン科学技術大学）

スタンブーリ電気工学部　研究室

遠隔地教育システム WebELS



光学顕微鏡（OM）

走査型電子顕微鏡（SEM）

原子間力顕微鏡（AFM）

超純水製造装置

X 線解析装置（独自予算）（約 4,000 万円）

マイクロ波シリカ還元装置（独自製作）

オラン科学技術大学（丹下健三設計、鹿島建設）

講堂

現地視察　　写真３（サイーダ大学）オランから南東約 180 km

PV N°	Type	manufacture	Size (mm) W	L	H	Pmax (W)	Isc (A)	Voc (V)	Ipm (A)	Vpm (A)
1	m-Si	Kyocera	1168	990	36	165	8,53	26	7,9	20,9
2	CIS	Solar frontier	1257	977	35	150	2,2	108	5,47	42.7
3	HIT	Sanyo	1580	812	35	233	5,84	51,6	8,36	24,94
4	Back contact	Sharp	1318	990	46	208,5	8,94	30,6	1,85	81.5
5	a-Si/u-Si	Kaneka	1240	1008	40	110	2,5	71	2.04	54

Table 1 characteristic for the five modules.

太陽光パネル（①京セラ② Solar Frontier（昭和シェル）③ Sharp ④三洋⑤カネカの 5 種類）

気象観測装置

太陽光発電性能評価システム

遠隔教育システム（WebELS）

サイーダ大学学内

超伝導直流送電用　地中温度測定システム

合同中間レビュー会合

アルジェリア側（学長、各グループリーダー）

日本側中間レビューチーム

第 3 回合同調整委員会（JCC）

プロジェクト調整員事務所（9 階）

略　語　表

略語	正式名称	日本語
AFREC	African Energy Commission	アフリカ・エネルギー委員会
CDER	Renewable Energy Development Center	再生可能エネルギー開発センター
C/P	Counterpart	カウンターパート
COP	Conference of the Parties	気候変動枠組条約締約国会議
JCC	Joint Coordinating Committee	合同調整委員会
JFY	Japanese Fiscal Year	会計年度（日本）
JICA	Japan International Cooperation Agency	独立行政法人国際協力機構
JST	Japan Science and Technology Agency	独立行政法人科学技術振興機構
M/M	Minutes of Meeting	協議議事録
PDM	Project Design Matrix	プロジェクト・デザイン・マトリックス
PO	Plan of Operation	行動計画
R/D	Record of Discussion	討議議事録
SATREPS	Science and Technology Research Partnership for Sustainable Development	地球規模課題対応国際科学技術協力
SSERC	Sahara Solar Energy Research Center	サハラを起点とするソーラーブリーダー研究開発センター
USTO-MB	University of Science and Technology of Oran “Mohamed Boudiaf”	オラン科学技術大学

中間レビュー調査結果要約表

１．案件の概要		
国名：アルジェリア民主人民共和国		案件名：サハラを起点とするソーラーブリーダー研究開発
分野：再生可能エネルギー		援助形態：技術協力プロジェクト（科学技術）
所轄部署：産業開発・公共政策部		協力金額（評価時点）：3 億円
協力期間	（R/D）：2010 年 11 月 ～ 2015 年 11 月 （延長）： （F/U）： （E/N）（無償）	先方関係機関：オラン科学技術大学（USTO-MB）、サイーダ大学、アドゥラル再生可能エネルギー開発センター（CDER, Adrar）
		日本側協力機関：東京大学（代表研究機関）、東京工業大学、弘前大学、中部大学、独立行政法人国立情報研究所、独立行政法人物質・材料研究機構他
		他の関連協力：

１－１　協力の背景と概要

アルジェリア民主人民共和国（以下、「アルジェリア」と記す）経済は、近年のエネルギー価格高騰を背景に主力の石油・天然ガスセクターが好調で、貿易収支、経常収支とも黒字幅は拡大を続け、2005 年以降は対 GDP 費 10%以上の黒字を達成、1 人当たり GDP も 4,000 米ドル前後と中進国入りしつつある。しかし､同セクターの雇用吸収率 は全体の 2%にすぎず､同セクターへの偏重型経済構造（アルジェリア国輸出の約 98%、GDP 約 50%、歳入の 75%）は、所得格差や社会的格差の拡大等、さまざまな社会的不安要因となっている。2009 年に三選を果たしたブーテフリカ大統領は、「アルジェリア国家行動計画 2009」を策定、産業の多様化とそれを担う人材育成を最重要課題とし、実践的な専門教育や高等教育機会の拡充（今後 5 年間で 200 万人の大学就学・教授陣の 50%増員等）、5 年間で 300 万人の雇用創出等、格差是正へ向けたさまざまな政策を打ち出している。特に、科学技術振興には重点を置き、科学調査研究に対し 5 年間で 1,000 億ディナール（約 1,300 億円相当）の助成を行うとしている。同時に､主力のエネルギー分野では、石油・天然ガス等アルジェリア国エネルギー資源の全体像の把握（埋蔵量や新たな採掘サイト）と戦略的活用へ向けた調査研究を進めるとともに、エネルギーの多様化を進める観点から、太陽光発電等再生可能な次世代エネルギーに係る積極的な研究開発（政策・規制の整備や 研究開発の促進、産業化）を重点研究課題として掲げている。特に太陽光発電は、科学技術振興 や新規産業の形成・雇用創出、更に地方への電力供給網の拡充と安定的な供給の観点から、最重要分野として位置づけている。

国際的には、地域レベルのエネルギー委員会が不在のアフリカで、アフリカ・エネルギー委員会（African Energy Commission：AFREC）の設立（本部アルジェ）を提唱し、これを 7 年かけて実現させて、大陸規模のエネルギー協力や相互補完的統合の推進に係る牽引役となっている。また、①アルジェリアからニジェール国、ナイジェリア国を結ぶトランスサハラ・ガスパイプライン計画の考案・実施による フレアガスの削減や、②太陽光発電のための資源確保、エネルギー効率の向上、③アフリカ域内研究機関ネットワーク強化の 3 つを柱とした域内クリーン開発メカニズムを提唱し、アフリカ諸国への新技術の波及や自然エネルギー供給に係る拠点

としての機能を果たすとともに、気候変動枠組条約締約国会議（COP）新 フェーズ策定では、アフリカ・グループ議長として、アフリカでの地球温暖化防止対策の模索に係る主導的な役割を担っている。

こうした背景からアルジェリア政府は「太陽光発電」を次世代エネルギーの最重点分野に位置づけ、同分野において先進的な技術を有するわが国に対し、「地球規模課題対応国際科学技術協力」事業による「サハラを起点とするソーラーブリーダー研究開発」（以下、「本プロジェクト」）支援を要請してきた。

本プロジェクトは、ソーラーブリーダー（ソーラーシリコン工場と太陽光発電所）の持続的な拡大の可能性を検証し、地球エネルギー新体系の基礎研究（太陽電池の性能、超伝導ケーブルの導入）、人材開発の基礎を確立することを目的とし、①シリコン製造の熱力学プロセス、②シリコン製造テストプラント、③太陽電池の性能、④高温超伝導ケーブル運用、⑤ Web-Based E-Learning System（WebELS）導入、⑥サハラソーラーエネルギー技術開発ワークショップ開催の 6 つの協力分野からなる案件である。オラン科学技術大学（University of Science and Technology of Oran“Mohamed Boudiaf”: USTO-MB）、サイーダ大学をカウンターパート（Counterpart：C/P）機関として、2010 年 11 月より 2015 年 11 月まで 5 年間の予定で実施されており、現在、1 名の長期専門家（業務調整）を派遣中である。今回実施する中間レビュー調査は、5 年間の協力期間の中間時点において、プロジェクト活動の実績、成果を評価、確認するとともに、今後のプロジェクト活動に対する提言を導くことを目的とする。

１－２　協力内容

（1）プロジェクト目標

ソーラーブリーダー（ソーラーシリコン工場＋ Si 太陽光発電所）の持続的な拡大の可能性を検証し、地球エネルギー新体系の基盤研究、人材開発の基礎が確立される。

（2）アウトプット

アウトプット 1 ：Si 製造の熱力学的プロセスデザインを行い、現在用いられている珪石ではなく、砂漠に豊富にある硅砂を原料とする Si 還元プロセス技術を開発する。

アウトプット 2：砂を原料とする Si 製造のテストプラント構築とアルジェリア側 Si 還元プロセスの確立。

アウトプット 3：各種太陽電池の性能（効率、耐久性）の定量的データを蓄積し、砂漠地域における太陽電池の活用法における課題と対策を整理する。また、この地域における太陽エネルギーの新しい活用法についての検討を行う。

アウトプット 4：高温超伝導ケーブルシステム運用に関する問題点の摘出と対策の提示。

アウトプット 5：アフリカ地域のエネルギー工学研究の拠点を形成し、日本発の多機能遠隔教育・情報交流システム：WebELS を活用した（複素エネルギー）遠隔教育・研究を行う。

アウトプット 6：サハラソーラーエネルギー技術開発ワークショップの開催（日本・アルジェリア交互）。

（3）投入

日本側：

専門家派遣：延べ短期専門家 29 名及び長期派遣プロジェクト調整員 1 名

機材供与（カッコ内数値は供与数）：

WebELS 用サーバー（一式）（1）、走査型分析電子顕微鏡（SEM-EDX）（1）、
原子間力顕微鏡（AFM）（1）、ソーラーパネル性能試験装置（一式）（1）、
超純水製造装置（DIW）（1）、光学顕微鏡（一式）（1）、
気象モニタリングシステム（1）

本邦研修：14 名

費用総額：148,327,000 円（2014 年 3 月末迄）

アルジェリア側：

人員の配置：計 36 名

施設の提供：USTO-MB における日本人専門家用執務室及び WebELS 設置スペース、ラボラトリーでの供与機材設置用スペース

ローカルコスト負担：約 47,925,000 ディナール（2014 年 5 月中旬現在）

２．評価調査団の概要

	担当分野	氏　名	所　属
調査者	団長 / 総括	鈴木　薫	JICA　産業開発・公共政策部　参事役
	評価分析	栗田　貴之	（株）アイコンズ　シニアコンサルタント
	通訳（日仏）	岡田　登	一般財団法人日本国際協力センター
調査期間	2014 年 5 月 4 日～ 5 月 15 日		評価種類：中間レビュー

３. 評価結果

３－１　実績の概要

（1）アウトプット 1 に係る活動

1-1　Si 製造の熱力学的プロセスデザイン：既に 100％達成。

1-2　砂の高純度化：既に 100％達成。

1-3　砂漠の砂（シリカ：SiO_2）を原料とする Si 還元プロセス技術の開発（＊:日本のみ）：66％達成。2014 年 10 月ころをめどに 100％達成する見通し。

（2）アウトプット 2 に係る活動

2-1　日本での装置調整：66％達成。2014 年 10 月ころまでに 100％達成する見通し。

2-2　アルジェリア側への装置導入：0％達成。2015 年 2 月ころまでに 100％達成する見通し。

2-3　アルジェリア側 Si 還元プロセス確立：0％達成。2015 年 5 月ころまでに 100％達成する見通し。

（3）アウトプット 3 に係る活動

3-1　太陽電池パネルの調達と据付：既に 100％達成。

3-2　データの収集、課題と対策の整理：70％達成。2014 年 9 月までに 100％達成する見通し。

3-3　活用方法の検討：60％達成。2014 年 12 月までに 100％達成する見通し。

（4）アウトプット 4 に係る活動

4-1　測定装置の調達と据付：既に 100％達成。

4-2　データの収集、課題と対策の整理：60％達成。2015 年 9 月ころまでに 100％達成する見通し。

（5）アウトプット 5 に係る活動

5-1　WebELS システムを活用するインフラの構築。指導員の養成：80％達成。2014 年 5 月には 100％達成する見通し。

5-2　USTO-MB に開設するサハラソーラーエネルギー研究センター（SSERC）における上記研究支援とともに、WebELS を活用した地球規模エネルギー分野の研究者育成支援：80％達成。2015 年 11 月には 100％達成する見通し。

（6）アウトプット 6 に係る活動

6-1　日本アルジェリア国際会議を毎年開催：80％達成。2015 年 5 月には 100％達成する見通し。

３－２　評価結果の要約

（1）妥当性

アルジェリアの産業構造は、炭化水素関連産業に大きく依存している。しかし、将来的には炭化水素資源の枯渇、それに伴う産業の衰退が懸念される。アルジェリア政府は、「公共投資新 5 カ年計画」にて、炭化水素依存からの脱却、及び太陽光エネルギーをはじめとした再生可能エネルギー導入の推進を示している。そのなかでも、アルジェリアの広大な砂漠の砂を活用し、太陽光発電を推進していく本プロジェクトはアルジェリアのニーズに合致している。

また、日本の対アルジェリア援助方針は、産業構造の多様化を目的に、特に、産業基盤の整備を促進するため、基盤技術の強化及び産業人材育成の側面で技術協力を行う内容となっており、プロジェクト目標は対アルジェリアの援助方針と合致している。

（2）有効性

アウトプットの達成状況・見込み：

【アウトプット 1】

指標：2015 年で硅砂シリカ（SiO_2）を原料とする新還元法によるシリコン純度において、硼素・リン濃度が 10ppm 以下になる。

実験室レベルではシリカ、Si 還元両面において指標の目標値（硼素・リン濃度が 10ppm 以下）を達成している。通関に長時間を要したため、機材の到着が遅れたが、アルジェリアにおいても実験が進められており、徐々に指標の目標値に達しつつある。

【アウトプット 2】

指標：テストプラントを構築し、その Si 生産能力を Si 1t/ 年以上。

2014 年 4 月現在、弘前大学にて Si 還元炉の調整を行っている。また留学生、研修員を受入れ、アルジェリアへ設備を移転させた後、適切に設備を運用できるよう、人材開発も行っている。テストプラントは 2015 年 2 月ころにアルジェリア側に搬送される見込みである。なお、USTO-MB はテストプラントの据付に必要なスペースを確保できる見込みとなっている。今後、電気工事、配管工事を実施する計画である。

【アウトプット 3】

指標：太陽電池の性能（効率、耐久性）の定量的データ蓄積のために、太陽電池の種類が 2 種以上で、運用期間が 2 年以上。

通関に長時間を要し、機材の設置が遅れた。2013 年 12 月、サイーダ大学に 5 種類の太陽電池パネルを設置した。データ（電気、気象データ）は毎月 USTO-MB の関係者が収集し、日本側に送付している。そのデータを基に、2014 年から砂漠地域における太陽電池運用に係る分析を、アルジェリア・日本両国により行っている。

【アウトプット 4】

指標：超伝導ケーブル配管をめざしたアルジェリアにおける地中温度の継続的記録（延べ 100 日以上）。

通関に 3 カ月を要し、機材の設置が遅れた。しかし 2013 年 9 月に地中温度測定用機材を設置し、地中温度の測定を開始した。一時期機材の不調により 11 月から 2 カ月のデータが消失したが（明確な原因は不明）、その後はアルジェリア側の機材メンテナンスも適切に行われ、測定が行われおり、既に 100 日以上の計測は完了した。今後夏場（8 月ころ）のデータを含め複数年計測することにより、超伝導導入に向けた課題が明確になる。現状では、地下 2.75m レベルであれば超伝導ケーブル運用上問題ないという結果になっている。

【アウトプット 5】

5-1 指標：WebELS サーバ、会議システムの導入。

WebELS サーバは、USTO-MB、サイーダ大学に設置され、アルジェリアでもシステム（学習用、会議用共に）は使用可能である。

5-2 指標：E-learning によるエネルギー工学講義の実践延べ人数年間 8 名以上。博士学生教育延べ 5 名（以上）

USTO-MB におけるエネルギー工学講義の延べ人数は、研修スタッフ 14 名、管理者クラス 5 名、Ph.D 学生 10 名の計 29 名。その他 WebELS を用いた会議を 5 回実施しており、多数の関係者により活用されている。

【アウトプット 6】

指標：日本アルジェリア国際会議を毎年開催。

2014 年まで、毎年行われており、アルジェリア側も非常に高い関心をもって会議に参加している。

プロジェクト目標の達成状況・見込み

プロジェクト目標の達成を検証する 2 つの指標は部分的に実現された。これらの指標、

及び達成状況は以下のとおりである。

指標 1）：ソーラーブリーダー（ソーラーシリコン工場＋ Si 太陽光発電所）の検証状況

【達成状況】

本プロジェクトのコアの技術は高純度シリカ、シリカ還元プロセスである。日本・アルジェリア両国で実験が進められ、Si を得ており、Si 還元技術は実証されている。ただ現在は実験室レベルで実験が行われている。今後ソーラーブリーダーが実現していくためには、Si 還元テストプラントがアルジェリアに設置される計画にあるので、実験規模を拡大した上で、実験成果を高めていくことが求められる。併せて、更なる研究資金の調達、また研究者とともに民間企業との協力を得て技術を進展させていくことが望まれる。

指標 2）：地球エネルギー新体系の基礎研究、人材開発の基礎確立状況

【達成状況】

現地での共同研究とともにアルジェリアからの留学生（14 名）、短期研修生を東京大学、弘前大学、国立情報学研究所などで受け入れており、アルジェリア側の C/P は日本での研修を通じ着実に人材育成が行われてきている。また研究に必要な設備、WebELS のシステムも徐々に整備されている。併せて、USTO-MB は、本プロジェクトでの支援内容の継続するため、太陽光、超電導に関する修士・博士課程を設置した。加えて、博士課程の学生も本プロジェクトの研究に参加した。このようにアルジェリア側の人材開発の基礎も人的・物的面で整備されてきている。

（3）効率性

投入：

2013 年 1 月に発生したアルジェリア人質事件、また、通関手続きに時間を要し、機材調達が遅れたことが要因となり、活動は遅れ、一部のアウトプット（成果 1、3、4）に達成の遅れが生じている。

なお、日本人専門家の派遣については各分野において適切な専門家が配置され、派遣期間も適切な時期に行われている。供与機材の調達に関しては通関手続きに時間を要したため遅れが生じ、その結果、実験、気象データ収集等が実施されないなど、一部活動に遅れが生じる要因となったが、質・量とも適切な機材が供与されている。

また、本邦研修に関しては、現地での活動が限られるなか、プロジェクト目標の達成に向け、本邦研修、留学生を有効に活用している。特に、本邦研修で日本の研究に触れることにより、C/P のモチベーションが高まったことが確認されている。その結果、各活動の推進に大きく寄与している。

アルジェリア側の投入に関しても、アルジェリア側の C/P はすべての活動において適正な人数が配置されており、共同研究を実施するにあたり十分な能力を有している。またアルジェリア側の負担事項については、アルジェリア側が適切に予算措置を行われている。

活動：

USTO-MB、サイーダ大学とも既存の研究室を活用し、共同研究が進められている。また研究内容についても日本側の実施機関で研究が行われており、蓄積された研究結果を活用している。

本プロジェクトで実証されている技術は本プロジェクト開始前から東京大学を中心に進められており、専門性及び信頼性が非常に高い。その点でアルジェリア側から技術的な信頼を得ている。

USTO-MB の建物は日本の建築家（丹下健三）により設計され、その後も「オラン科学技術大学プロジェクト（1989 ～ 1992 年）」、「同フォローアップ協力（2007 年）」が実施され、ラボラトリーに実験機材が導入され、機材は現在も活用されている。かかる長年の日本との良好な協力関係を基に本プロジェクトは実施されており、プロジェクトの成果創出に寄与している。

加えて、日本・アルジェリア両国間のコミュニケーションが良好になりプロジェクトの効率性の向上に貢献している。その要因は以下の 3 点ある。

①留学生、短期研修制度により派遣された C/P を通じ、現地の状況の理解が進んだ。

② C/P の英語能力の向上が進んだ（英会話学校に通い、英語学習に励む C/P もいる）。

③プロジェクト調整員が配置された。

（4）インパクト

プロジェクト活動及び研究成果発表を通じ一部、正のインパクトが生じている。

論文など研究発表を通じ、ソーラーブリーダーの成果が発表されている。その結果、エネルギー関連の民間企業、及びその周辺国（チュニジア）のみならずトルクメニスタン、モンゴルなどからも研究成果について注目を集めてきている。

（5）持続性

1） 政策面

アルジェリアでは、「公共投資政策」の基、太陽光を含めたエネルギーの多角化を推進している。またアルジェリアの産業構造、エネルギー構造から鑑みてもソーラーブリーダーの実現と併せ太陽光エネルギーの推進が求められている。かかる状況下、プロジェクト終了後も政策支援は継続される見込みである。

2） 財政面

現在、アルジェリア側の負担事項は適切に行われており、今後も本研究をすべく、研究者配置、機材の運営維持管理について、適切に予算措置がなされていく計画にある。

3） 組織面

サイーダ大学の研究者の多くは USTO-MB 出身者であり、元々研究者同士の交流は活発に行われている。また再生可能エネルギー開発センター（CDER）アドゥラルもアルジェリアの再生可能エネルギー研究機関の役割を負っている。かかる体制の下、日本側も本プロジェクトの研究は継続し実施していく予定にある。また、USTO-MB は、研究者養成のための修士課程（太陽光・超伝導分野）の設立を行ってきている。将来的にも現在 2 つ設置されている研究室を統合し、ソーラーブリーダーの研究拠点として活用していく構想を有している。そのため、これらプロジェクト関係機関は本プロジェクト完了後も連携を保ちつつ共同研究が進められていくことが期待される。

4） 技術面

本プロジェクトでの共同研究を通じ、各分野の研究者の育成は行われており、着実に

研究内容が進展している。本プロジェクト終了後も、WebELS 等のシステムを活用し、共同研究を実施していくこととなっており、技術的なフォロー体制は整備されつつある。

３－３　効果発現に貢献した要因

（1）計画内容に関すること

特になし。

（2）実施プロセスに関すること

USTO-MB の学長及び副学長が本プロジェクトに強い関心を寄せており、また日本側研究者とアルジェリアの研究者も、今までの活動を通じ強固な信頼関係を構築している。このような状況下、日本人専門家も積極的に研究発表を行っており USTO-MB 全体だけでなく他の機関（サイーダ大学、CDER アドゥラル）のプロジェクトの認識度は非常に高い。このような強固なトップマネジメントの下、活発に研究成果の発表を行うなど積極的な情報発信を行うことにより、「タテ」と「ヨコ」との両輪の強固な体制で、プロジェクトが遂行されている。

日本人専門家派遣による現地活動期間は非常に限られているが、そのなかでも各活動において、e メールやプロジェクトで導入された WebELS を活用し共同研究を通じて技術移転が順調になされている。実験器具を自ら製作し実験を行うなど、各活動において C/P の自発的な行動が確認できる。加えて、本邦研修、留学生受入れを通じ共同研究は進められ、特に本邦研修などで日本の研究の現場に触れることにより、C/P のモチベーションが非常に高まった。そのうえで、供与機材が徐々に設置されることにより実際研究がアルジェリア側でも実施できるような体制が整った。組織的にも、太陽光電池、超伝導にかかる修士・博士課程を設置するなど、研究者育成の体制づくりを行っている。C/P の高いモチベーションと資機材の充実、また体制面の整備により、プロジェクト目標達成に向け着実に共同研究は進んでいる。このような状況は、プロジェクトの効果発現に寄与している。

３－４　問題点及び問題を惹起した要因

（1）計画内容に関すること

特になし。

（2）実施プロセスに関すること

2011 年 3 月の東日本大震災、及び 2013 年 1 月のアルジェリアでの日本人誘拐殺人事件によりプロジェクトの実施に遅れが生じた。

３－５　結論

中間レビュー調査時点において、本プロジェクトで支援を行っている研究内容は、ソーラーブリーダー（ソーラーシリコン工場及び Si 太陽光発電所）の検証、及び地球エネルギー新体系の基礎研究、人材開発の基礎確立、に寄与している。プロジェクトの活動推進にあたっては、日本人専門家との強い信頼関係の上に構築されたアルジェリア側の高いモチベーションと、USTO-MB の学長を中心とした強いリーダーシップがプロジェクト目標、各成果の達成に大き

く寄与している。
それゆえ、日本・アルジェリア側両国の強固な協力関係の下、本プロジェクト完了後も共同研究は遂行されていくことが期待される。

３－６　提言

（1）Si 還元テストプラント設置に係る準備（アウトプット 2）

2015 年 2 月ころに Si 還元テストプラントが据え付けられる予定にある。そのため、据付前にテストプラント可動用の電源の確保、配管工事、実験室床の耐荷重の確認を行う必要がある。また運営維持及び実験に必要な消耗品確保についてもアルジェリア側で確保されることが望ましい。

（2）ADSL 回線の導入（アウトプット 5）

ADSL 回線の導入を早急に行い、人材育成が更に効果的に行えるよう WebELS を適切に使用できる環境を整えることが望まれる。

（3）供与機材の安全管理（アウトプット 1、3、4）

日本から導入された供与機材の安全管理については引き続き、配慮することが望まれる。

（4）国際的なソーラーブリーダーワークショップやプロジェクト活動に関する広報活動を通じての研究成果の公表（アウトプット 6）

本プロジェクトの社会実装性を高めるため、今後も学会発表などを通じ、本プロジェクトの研究成果が発信されていくことが望ましい。また、研究成果が USTO-MB 内においても情報共有されることが望ましい。

３－７　教訓

地球規模課題対応国際科学技術協力（SATREPS）では、日本人専門家の派遣が限定的な場合、また C/P 機関の実験設備が充実していない場合も想定されることから、1）本邦研修にて実験を体験させる機会を提供する、またその後、2）できるだけ早い段階で供与機材を設置し、3）現地でも実験が行える環境を整備していくことが、成果を効率的に創出していくうえで重要である。

また、学長や副学長など C/P 機関のトップマネジメントからの十分な理解と支援を得ること、また研究成果などの情報発信を積極的に行うことにより、プロジェクトの活動が行いやすい環境づくりを行っていくことも重要である。

３－８　フォローアップ状況

該当なし。

Summary of the Mid-Term Review Results

<table>
<tr><td colspan="3">I. Outline of the Project</td></tr>
<tr><td colspan="2">Country:
The People’s Democratic Republic of Algeria</td><td>Project title:
Sahara Solar Energy Research Center Project</td></tr>
<tr><td colspan="2">Issue/Sector: Renewable Energy</td><td>Cooperation scheme: Technical Cooperation (SATREPS)</td></tr>
<tr><td colspan="2">Division in charge: Industrial Development and Public Policy Department</td><td>Total cost: JPY 300,000,000</td></tr>
<tr><td rowspan="2">Period of Cooperation</td><td rowspan="2">(R/D):
November, 2011 to November, 2016
(Extension):
(F/U) :
(E/N) (Grant Aid)</td><td>Partner Country’s Implementing Organization:
University of Science and Technology of Oran “Mohamed Boudiaf (USTO-MB), Saida University, Renewable Energy Development Cente (CDER) Adrar</td></tr>
<tr><td>Supporting Organization in Japan:
Tokyo University, Tokyo Institute of Technology, Hirosaki University, Chubu University, National Institute of Informatics, National Institute for Materials Science, etc.</td></tr>
<tr><td colspan="3">Related Cooperation:</td></tr>
</table>

1. Background of the Project

The economy of the People’s Democratic Republic of Algeria (hereinafter referred to as “Algeria”) has been in strong condition with increasing oil and natural gas export due to surge of energy price in recent years. Thus both trade and current balance surplus have expanding continuously. Since 2005, the GDP per capita has achieved more than 10% in surplus and also is becoming middle-income country level with around $ 4,000 per capita.

However, employment absorption rate of this sector is only 2% of the total. Such sectional economic structure to the same sector (occupied about 98% of export, approximately 50% of GDP and approximately 75% of revenue of Algeria) become factors of social anxiety such as expansion of income inequality and social disparities and so on.

President Abdelaziz Bouteflika won the presidential election three times consecutively and has established the "Algeria National Action Plan 2009". The plan takes up diversification of industry and the human resource development for the diversification as high priority issue, and the plan draw up various policies toward the correction of disparities such as 1) expansion of opportunities for practical professional education 2) of higher education (increasing the number of undergraduate student up to two million and 50% increase of the professors in five years), and 3) job creation for three million people

In particular, the plan emphasizes on the science and technology.100 billion Dinars (about 130 billion yen worth) plans to be granted for scientific research over five years.

At the same time, in the field of the mainstay energy sector, Algerian government plans to figure out the overall picture oil and natural gas of Algerian national energy resources (new mining sites and reserves) and to carry on research study aimed to strategic utilization. In addition, as a priority research topics Algerian government takes up aggressive research development (such as development of policy and regulations, promotion of research and development, and industrialization) related to next generation renewable energy such as solar power generation in view to promote diversification of energy.

Particularly, solar power generation is placed as the most important issue in terms of promoting science and technology, formulating and creating new jobs opportunity, and industries, in addition expanding local power supply network and stable power supply.

Internationally, in the absence of energy committee in Africa, Algerian government advocated an establishment of African Energy Commission (African Energy Commission: AFREC) (the headquarters is located in Algiers), and realized the commission taking over the seven years this Commission. It has become a driving force to promote mutually complementary cooperation and integration of energy in continent scale.

In addition, Algerian government proposed clean development mechanism in the region based on three components such as 1) reduction of flare gas by devising and implementation of trans-Sahara gas pipeline project linking from Niger and Nigeria to Algeria, 2) securing resources for solar power and improvement of energy efficiency and 3) strengthening network of intra-African research institutions. Algerian government functions as a base to spread new technology to African countries and of natural energy supply. Moreover in the COP-new phase development, Algerian government plays a leading role for search of global warming prevention measures in Africa as African Group chairman.

In this circumstance, Algerian government has positioned "solar power generation" as the top priority field for next generation energy, thus Algerian government requested assistance to Japan which owes advanced technology in this field, through the "global issues corresponding international science and technology cooperation".

The project has a purpose to verify the possibility of sustained expansion of solar breeder (solar power plants and solar silicon factory), and to establish basic research of new earth energy system (performance of solar cells, introduction of a superconducting cable) and to establish basic human resources development. The project consists of six supporting fields such as 1) thermodynamic process of silicon manufacturing, 2) silicon manufacturing test plant, 3) capacity of solar cells, 4)operation of high-temperature superconducting cable, 5) Web-Based E-Learning System introduction, 6) Holding a workshop of Sahara solar energy technology development. The project has been carried out with USTO-MB, Saida University and CDER Adrar as a counterpart (C/P) organization. The project has implemented in the plan for five years from November 2010 to November 2015, currently one expert in long-term expert as a project coordinator has been dispatched.

In the respect of five years period cooperation, the objective of this mid-term review is to lead recommendation to the project activities in the future as well as evaluate and confirm the Activities and Outputs.

2. Project Overview

(1) Project Purpose

To verify the feasibility of sustainable scaling up of the solar breeder concept (construction of Si solar cell plants and solar power plants) and to establish basic research and education for new global energy supply system.

(2) Outputs

[Output 1]

To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production.

[Output 2]
To construct a Si production test plant from sand and to establish Si reduction process in Algeria.
[Output 3]
To find problems and solutions in the use of solar cells in the desert by accumulating quantitative data about cell performance such as efficiency and reliability and to find new applications of solar energy in this area.
[Output 4]
To point out problems with operation of high critical temperature superconducting cable system and to find out solutions for them.
[Output 5]
To establish bases for energy engineering education in the Africa area and to perform remote education by complex education system with the use of WebELS system which was developed in Japan.
[Output 6]
Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria.

(3) Inputs
Japanese side:
Dispatch of Experts: Twenty nine short-term experts/researchers and one long-term expert (Project Coordinator)
Equipment *( )Number of procurement in the project:
Scanning Electron Microscope(SEM-EDX) (1), Atomic Force Microscope (AFM) (1), Optical microscope(1), Deionized water (DIW) (1), Solar Panel monitoring(1), Weather monitor(1) and WebELS server(1)
Trainings in Japan: 14 persons
Total Cost: JPY 148,327,000 (by the end of March 2014)
Algerian side:
Assignment of counterpart personnel: Thirty six persons in total
Provision of facilities: Working spaces for Japanese experts and installation space for WebELS and for procured equipment in laboratories in USTO-MB
Local cost: Approximately 47,925,000 DA (as of middle of May, 2014)

II. Review Team

Members of Review Team	Mr. Kaoru Suzuki, Leader, Senior Advisor, Industrial Development and Public Policy Department, JICA Mr. Takayuki Kurita, Evaluation Analysis, Senior Consultant, ICONS Inc. Mr. Noboru Okada, Interpreter, Japan International Cooperation Center	
Period of Review	May 4 to 15, 2014	Type of Evaluation: mid-term review

III. Results of Review

1. Summary of Achievements

(1) Activities under Output 1

1-1 To design thermodynamics for Si production process: 100% had been achieved.
1-2 Purification of sands from the desert: 100% had been achieved.
1-3 To develop Si reduction techniques from the sands (SiO_2) in the desert (*solely in Japan) : 66% had

been achieved, and the activity expects to be 100% achieved by around October, 2014.

(2) Activities under Output 2

2-1 To tune the reduction apparatus in Japan:
66% had been achieved, and the activity expects to be 100% achieved by around October, 2014.

2-2 To set up the reduction apparatus in Algeria:
0% had been achieved, and the activity expects to be 100% achieved by February, 2015.

2-3 To establish the Si reduction process in Algeria:
0% had been achieved, and the activity expects to be 100% achieved by February, 2015.

(3) Activities under Output 3

3-1 To get and set up solar panels: 100% had been achieved.

3-2 To collect the data and to find problems and solutions:
70% had been achieved and the activity expects to be 100% achieved by September, 2015.

3-3 To find applications: 60% had been achieved and the activity expects to be 100% achieved by December, 2015.

(4) Activities under Output 4

4-1 To get and set up measurement system: 100% had been achieved.

4-2 To collect and analyze data: 60% had been achieved and the activity expects to be 100% achieved by around September, 2015.

(5) Activities under Output 5

5-1 To establish infra-structure for the use of WebELS system and to educate instructors in Algeria: 80% had been achieved and the activity expects to be 100% achieved by May, 2014.

5-2 To support the research works in SSERC at USTO and to educate engineers in the field of global energy by the use of WebELS: 80% had been achieved and the activity expects to be 100% achieved by November, 2015.

(6) Activities under Output 6

6-1 Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria:
80% had been achieved and the activity expects to be 100% achieved by May, 2015.

2. Summary of Evaluation Results

(1) Relevance

Industrial structure of Algeria is heavily dependent on hydrocarbon-related industries. However, depletion of hydrocarbon resources, industry decline associated therewith are concerned in the future. In “Programme Quinquennal des Investissements Publics (2011-2014) ,, move away from hydrocarbon dependence, and the Algerian government, shows the promotion of renewable energy-based deployment, including solar energy. In the policy, the project which utilizes sand of vast desert in Algeria, and promotes solar power meets the needs of Algeria. Research of Superconducting field is the first trial in Algeria in particular, the expectations of the Algerian side is also high. Moreover, in order to promote the development of industrial infrastructure, Japanese cooperation policy for Algeria, has contents providing technical cooperation in the

two sides of the development of industrial human resources and strengthening of infrastructure technology for the purpose of diversification of industrial structure. Therefore the project purpose is consistent with the Japanese cooperation policy.

(2) Effectiveness

Achievement of the Outputs

[Output 1]

<Indicator of Output 1> "To obtain Si with a B/P concentrations of less than 10 ppm with the use of the new reduction method from SiO_2 in 2015" .

In laboratory level in Japan, both Silica and Si reduction have already achieved the indicators (Si with B/P concentration is less than 10ppm). In Algeria the experiment has been conducting in parallel and the results is achieving gradually to the indicator level.

[Output 2]

<Indicator of Output 2> "To construct a Si plant with a production rate of 1 ton/year".

As of April, 2014, the project has tuned Si reduction test plant at Hirosaki University. In addition, Hirosaki University accepted Algerian students and short-term trainees and they have had trainings to operate the test plant after the plant is transferred to Algeria. The test plant expects to be transported to Algeria and installed around February, 2015. In addition, USTO-MB haves sufficient space for installation of the test plant. Electrical and plumbing works plan to be conducted for the installation of the test plant.

[Output 3]

<Indicator of Output 3> "To obtain operational records of two types of solar cells at least for more than two years to accumulate quantitative data about cell performance such as efficiency and reliability".

It took a longer time to customs clearance, installation of equipment and the research for solar cell was delayed for two years. Consequently the project installed 5 types of solar cells at Saida University in December, 2013. Staff of USTO-MB collects the data (electric and meteorological data) since the installation of solar cell and send it to Japan every month. The project plans to find application for solar cell operation in desert area in both Algerian and Japanese side in parallel from 2015 based on the data.

[Output 4]

<Indicator of Output 4> "To obtain consecutive temperature data in the ground of Algeria for more than 100 days for burying the superconductor cables"

It took three months to customs clearance, installation of temperature measuring equipment was delayed. However, installing the underground temperature measuring equipment in September 2013, and the project started to measure the earth temperature. Data of two months from November has disappeared due to malfunction of the equipment for a while (a clear cause is unknown). However, equipment maintenance of the Algerian side is conducted properly, and the measurement has been performed, measurement of more than 100 days already achieved. By measuring for several years including summer season (around August) the future issues for superconducting introduction expects to be clear. At present, the project got a result that superconducting cable operation will not be problem for a depth of 2.75m underground level.

[Output 5]

<Indicator of Output 5>

5-1 "To introduce the WebELS server and the meeting system to USTO-MB"

WebELS server was installed at USTO and Saida University, and WebELS system can be utilized in Algeria (both for Leaning and for Meeting).

5-2 "To educate more than 8 engineers a year by the energy engineering course through E-learning and to educate 5 Ph.D. students in total"

Total number of people who have taken the energy engineering lecture in USTO-MB is, a total of 29, including 14 training staffs, 5 administrator class, 10 Ph.D. students. Moreover, the project has conducted a meeting 5 times with WebELS, which has been utilized by a number of stakeholders.

[Output 6]

<Indicator of Output 6> "Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria"

Sahara Solar Energy Workshop has been held every year until 2014, Algerian side also participated in the workshop.

Achievement of the Project Purpose

Two verification indicators set for achieving the Project Purpose are partially realized. Each indicator and their degree of achievements are as follows.

Indicator 1) "Current feasibility situation of sustainable solar breeding with solar power plants and cell production plants."

[Degree of achievement]

Core technologies of the project are Silica purification and Silica reduction process. The experiment has been conducted in Japan and Algerian side, Si is produced in both technologies, and Si reduction technology was verified. At present the experiments have been carried out at the laboratory level. In order that solar breeder is going to achieve the future, as a test plant plans to be installed in USTO-MB, scaling up the experiment, the project is required to enhance the results of the experiment. Furthermore, it is expected to develop a technology with further research funds and cooperation of researchers and private sectors.

Indicator 2) "Current situation of establishing basic research and education for new global energy supply system".

[Degree of achievement]

In addition to joint research in Algeria, the project has accepted students from Algeria (14 researchers) and short-term trainees in Tokyo University, Hirosaki University, and the National Institute of Informatics. The equipment needed for research, system of WebELS has also been improved gradually. In addition, USTO-MB has established master and Ph.D. program of photovoltaic technology and superconductivity technology to conduct continuous research. Thus, the basis for human resource development of the Algerian side now being deployed in human-physical plane.

(3) Efficiency

Efficiency of Inputs:

Due to 1) the hostage restraint incident happened in Algeria in January 2013 and 2) the delay of customs clearance, some activities delay regarding to Output 1, Output 3 and Output 4.

Regarding dispatch of Japanese experts, In each field of research, appropriate researchers are assigned. Also the experts are dispatched in proper timing and period. Regarding provision of equipment, as it took a long time for custom clearance, there were some cases that the project activities were delayed such as experiments and meteorological data collection had not been able to be conducted. However the equipment is provided properly in terms of quality and quantity.

Regarding training in Japan, as the activity in Algeria by Japanese experts is limited, the training in Japan and receiving students are utilized effectively in order to achieve the project purpose. In particular, it is confirmed that by being exposed to Japanese research in training in Japan, motivation of C/P is increased. These inputs contribute to promote each activity.

Regarding input from Algerian side, appropriate number of Algerian C/P has been assigned for every activities, the C/P also has sufficient capacity to implement cooperation research. In addition, Algerian C/P properly arranges the budget for the project to the issues under the Algerian responsibility.

Efficiency of Activities:

Both USTO-MB and Saida University utilize the existing laboratories for collaborative research. Also the research content is being investigated in Japanese implementing organizations that utilize the accumulated research results. Research being verified in the project has been implemented to the Tokyo University; the superiority of Japanese technology is high and reliable.

Building of USTO-MB was designed by a Japanese architect (Kenzo Tange). Japanese government had implemented "Project for the University of Science and Technology of Oran" (1989-92), and the follow-up cooperation (2007) thereafter. The experimental equipment which was installed in the laboratory under these previous projects has been utilized until now. This project has been carried out on the basis of the good cooperation with Japan for many years, and these implementations contribute to the creation of project outputs.

In addition the improvement of the communication between Japan and Algeria that make it contribute for efficiency of the project. The following three factors are the reasons.

1) The understanding of the actual status in Algeria has been well-understood through the receiving students and short-term trainee from C/P.
2) English language ability of C/P is improved (There are some C/P who study at language school).
3) The Project coordinator has been assigned.

(4) Impact

Through the project activities and dissemination of the results of the research, positive impact is confirmed in some parts.

Effect of solar breeder project has been announced gradually through the presentation of the research such as international workshop and thesis. In the result, it commands the attention of not only domestic energy-related enterprises and surrounding countries such as Tunisia but also Turkmenistan and Mongolia.

(5) Sustainability

Policy and Other Support:

Based on "Programme Quinquennal des Investissements Publics", Algeria has promoted the diversification of energy, including solar energy. Therefore, it is expected that policy support is continued cooperation after the end of the project. Under the circumstances, the promotion of solar energy with realization of solar

breeder is required even in view of industrial structure, from the energy structure of Algeria.

Financial Aspects:

Currently matters burdened by Algerian side have been done properly, and budget of Algerian side plans to be arranged for assignment of researchers and equipment operation and maintenance.

Organizational Aspects:

As many of the researchers of Saida University are USTO-MB graduates, exchanges among researchers have been originally and actively carried out. CDER Adrar also plays a role of renewable energy research institutions in Algeria. Based on the structure, Japanese side also plans to continue the research of the project. In addition, USTO-MB has established master's and Ph.D. program for the training of researchers (in the fields of solar energy and superconductivity). Moreover USTO-MB has a concept to integrate two laboratories of USTO-MB in the future to utilize as a research base for solar breeder. Thus, it is expected that the cooperation research be conducting in progress while maintaining the cooperation even after completion of the project.

Technical Aspects:

Through cooperation research in the project human development of each field has been conducted, consequently research outputs have achieved. After completion of the project the cooperation research plans to be conducted and technical follow-up system is establishing gradually.

3. Factors That Promoted Realization of Effects

(1) Factors Relevant to Planning

None.

(2) Factors Relevant to the Implementation Process

Rector and vice rector of USTO-MB is strongly interested in the project, and researchers of Algeria and Japanese researchers have also built a strong relationship of trust through the project activities until now. Under such circumstances, the Japanese researchers have also made a presentation of research results actively. Therefore awareness of the project among other organization (such as Saida University, CDER Adrar) as well as whole USTO-MB is very high. Under such strong top management, by posting information such as that the project make presentation about research results actively, based on a strong system as “vertical” and “horizontal”, the project has been conducted.

Although the project activity period in Algeria is very limited, in each activity, technology have been transferred steadily through joint research between Algerian side and Japanese side utilizing e-mail and WebELS system installed in the project. Voluntary activities of C/P can be confirmed in each activity such as C/P manufacture necessary experiment equipment and conduct experiment of Si reduction. Joint research have been conducted through Training in Japan, the international students, joint research is progressing steadily. Particularly, motivation of C/P is increasing highly by experiencing Japanese research field site in training in Japan. Besides, system to conduct experiment in Algeria has been improved gradually through installation of procured equipment. Organizationally, Algerian side has been built a system of researcher training by establishing master and Ph.D. program in the field of solar energy and superconductivity. With high motivation of C/P, enhancement of equipment and organization strengthening, the joint research has

been conducted steadily toward the achievement of the project purpose achievement. These circumstances contribute to create the project output.

4. Factors that impeded realization of effects

(1) Factors Relevant to Planning

None.

(2) Factors Relevant to the Implementation Process

The project implementation delayed due to the Great East Japan Earthquake in March, 2011 and hostage restraint incident in January, 2013.

5. Conclusion

As of mid-term review, the research field which the project has supported is expected to contribute to verify the feasibility of sustainable scaling up of the solar breeder concept (construction of Si solar cell plant and solar power plants) and to establish the basement for research and educational activities on new global energy supply system.

In particular high motivation and leadership of Algerian side which has been built under the strong relationship with Japanese researchers has contributed to achieving project purpose and outputs.

Therefore even the completion of the project joint research expects to be conducted continuously under the framework of Japan and Algeria cooperation policy.

6. Recommendations

(1) Preparation to install Si reduction test plant (Output 2)

A Si reduction test plant schedules to be installed around February 2015. Therefore, it is necessary to secure electric power supply, to conduct plumbing work and to confirm load-bearing of laboratory floor before installation. Further, it is also expected to secure consumables required for the experiment and operation and maintenance.

(2) Installation of ADSL line (Output 5)

It is expected to improve environment that WebELS can be utilized properly by installing ADSL line immediately in order to conduct human resource development more effectively.

(3) Safety measure for equipment (Output 1, 3 and 4)

It is expected to take safety measure continuously for equipment which has been procured and installed under the project.

(4) Dissemination of the research result of the project continuously through international SSB workshop and Public Relation activities (Output 6)

In order to increase the social and economic impacts of the project, (through conference presentations), it is expected that research results of the project is announced in public and even within USTO-MB.

7. Lessons Learned

In SATREPS project, it is assumed that dispatch of Japanese experts is limited, and experiment equipment

is not sufficient of C/P organization. Therefore it is important 1) to give C/P opportunities to experience experiments and then 2) to install procured equipment in the early stage, and 3) to improve environment to conduct experiment in the C/P organization in order to achieve output effectively. Moreover, it is also important to create environment to conduct activities smoothly by obtaining understanding from a top of C/P organization and by proving information such as research results actively.

8. Follow-up Situation

(Not applicable)

第１章　中間レビュー調査の概要

１－１　調査の目的

本中間レビュー調査の目的は、「サハラを起点とするソーラーブリーダー研究開発」（以下、「本プロジェクト」）の目標達成度や成果等を分析し、本プロジェクトの残り期間での課題及び今後の方向性について確認し、合同中間レビュー報告書に取りまとめ、アルジェリア民主人民共和国（以下、「アルジェリア」と記す）側と合意することを目的とする。

なお、本調査の対象プロジェクトは、地球規模課題対応国際科学技術協力“Science and Technology Research Partnership for Sustainable Development：SATREPS”であり、科学技術振興機構（Japan Science and Technology Agency：JST）と連携して調査を行った。

具体的な目的は以下のとおり。

（1）プロジェクト開始から本中間レビュー調査までの実績と計画達成度を討議議事録（Record of Discussion：R/D）、プロジェクト・デザイン・マトリックス（Project Design Matrix：PDM）、活動計画（Plan of Operation：PO）に基づき、評価５項目（妥当性、有効性、効率性、インパクト、持続性）の観点から中間レビューを行う。

（2）プロジェクト後半部分の活動や方向性について、プロジェクト側に確認を行い、その結果を日本・アルジェリア両国政府及び関連当局に報告する。

１－２　調査団の構成

（1）JICA

担当分野	氏　名	所　属
団長 / 総括	鈴木　薫	独立行政法人国際協力機構産業開発・公共政策部　参事役
評価分析	栗田　貴之	株式会社アイコンズ　シニアコンサルタント
通訳（日仏）	岡田　登	一般財団法人日本国際協力センター

（2）JST

担当分野	氏　名	所　属
科学技術計画・評価１	山地　憲治	科学技術振興機構　地球規模課題国際協力室 研究主幹
科学技術計画・評価２	中村　牧生	科学技術振興機構　地球規模課題国際協力室 主任調査員

※　日本国内のみ参加。

１－３　調査日程

現地調査は 2014 年 5 月 3 日～ 5 月 16 日までの期間で実施された。

現地調査日程の概要は以下のとおりである。

日付		内　容
5 月 3 日	土	（栗田、岡田団員）成田発
4 日	日	→　オラン着
5 日	月	USTO-MB との協議、中間レビュー
6 日	火	USTO-MB との協議、中間レビュー
7 日	水	USTO-MB との協議、中間レビュー （鈴木団員）→　オラン着
8 日	木	USTO-MB 学長表敬、協議、中間レビュー、施設視察
9 日	金	資料整理
10 日	土	オラン発　→　サイーダ大学着 サイーダ大学学長表敬、協議、中間レビュー、施設視察 サイーダ大学発　→　オラン着
11 日	日	USTO-MB との協議、中間レビュー
12 日	月	第 3 回 JCC、合同評価報告書署名
13 日	火	第 4 回 Asia-Africa Sustainable Energy Forum（SSSEF）参加 （鈴木団員）オラン発　→　アルジェ着
14 日	水	（鈴木団員）高等教育・科学研究省、在アルジェリア日本大使館へ報告 （栗田、岡田団員）資料整理・報告書の作成
15 日	木	（鈴木団員）アルジェ発 （栗田、岡田団員）オラン発
16 日	金	→　成田着

第２章　中間レビュー調査の方法

２－１　調査の流れ

今回の中間レビュー調査は、JICA 事業評価ガイドライン改訂版「プロジェクト評価の実践的手法」及び「新 JICA 事業評価ガイドライン　第１版」に準拠して行った。中間レビュー調査の基になるマスタープランは、2011 年 8 月実施の詳細計画策定調査実施時にアルジェリア側と合意したものを使用した。中間レビュー調査に先立ち、プロジェクト関係文書（詳細計画策定時作成資料、本プロジェクト実施報告書）を整理・分析し、プロジェクト関係者への質問票調査及びインタビュー調査、また現地視察を行い、情報を収集した。

これらの情報を基に、合同評価報告書（案）を作成し、2014 年 5 月 12 日に開催された本プロジェクトの合同調整委員会（Joint Coordinating Committee：JCC）において、中間レビュー調査団から説明を行い、内容について確認・承認された。

2014 年 5 月 14 日にアルジェリア側責任省庁である高等教育・科学研究省（Ministry of Higher Education and Scientific Research）及び実施機関であるオラン科学技術大学（University of Science and Technology of Oran,“ Mohamed Boudiaf”：USTO-MB）とともに署名・交換を行った。

２－２　調査項目

２－２－１　プロジェクトの実績の確認

R/D、PO に沿ってプロジェクトの投入実績、アウトプット、プロジェクト目標が達成された度合いの検証を行った。

２－２－２　実施プロセスの検証

プロジェクトの実施課程全般をみる視点であり、活動が計画どおり行われているか、またプロジェクトのモニタリングやプロジェクト内のコミュニケーションが円滑に行われているか検証した。

２－２－３　レビュー項目ごとの分析

以下の評価 5 項目（妥当性、有効性、効率性、インパクト、持続性）の観点に基づいた収集データの分析を行った。

表－１　評価 5 項目

項目	視　点
妥当性 （Relevance）	プロジェクト目標や上位目標が、評価を実施する時点において妥当か（受益者のニーズに合致しているか、相手国の問題や課題の解決策として適切か、アルジェリアと日本側の政策との整合性はあるか、プロジェクトの戦略・アプローチは妥当か等）を問う視点。
有効性 （Effectiveness）	プロジェクト目標達成の見込みはあるか、アウトプットのプロジェクト目標への貢献度、目標達成の貢献・阻害要因、外部条件は何かなどを問う視点。

効率性 （Efficiency）	プロジェクトのアウトプット産出状況の適否、アウトプットと活動の因果関係、活動のタイミング、コスト等とそれら効果について問う視点。
インパクト （Impact）	上位目標達成の見込み、上位目標とプロジェクト目標の因果関係、正負の波及効果等を問う視点。
持続性 （Sustainability）	政策・制度面、組織・財政面、技術面、社会・文化・環境面、総合的自立発展性において、協力終了後もプロジェクトで発現した効果が持続しているか（あるいは持続の見込みはあるか）を問う視点。

２－３　情報収集・入手手段

現地調査に先立ち、プロジェクトの投入に関する情報提供を日本の研究代表機関に依頼した。さらに､主としてプロジェクトの実績プロセス・評価 5 項目に関する質問票を日本人専門家向け、またアルジェリア側カウンターパート（Counterpart：C/P）向け（英語、仏語）に作成し事前に配布した。また指標及び目標値設定、実施プロセスの確認と評価 5 項目に関する補足説明を収集するため、現地調査前に日本において日本人専門家に対して、また、現地においては、アルジェリア人研究者に対してインタビューを実施した。

第３章　プロジェクトの実績と現状

３－１　投入実績

基本計画に沿って、日本・アルジェリア国側双方からプロジェクトに対して投入がなされている。

(1) 日本側の投入

1) 日本人専門家の派遣

プロジェクト業務調整員として長期専門家が 1 名派遣されている。また、短期専門家については、プロジェクト開始後、中間レビュー調査まで延べ 29 名が合計 299 日間派遣されている。

2) 本邦研修

本邦研修参加者は、中間レビュー調査時点で 14 名となっている。受入れ先は東京大学、弘前大学、中部大学となっている。

3) 資機材の供与

付属資料１、レビュー報告書中の Annex-4：Inputs for the project、(3) Provision of Equipment under the project に記載した機材が供与された。

4) 現地業務費

中間レビュー調査時点にて総額 2,315,876 ディナール（2012 年度 771,855 ディナール、2013 年度 1,455,745 ディナール、2014 年度 88,276 ディナール）が現地業務費として支出された。

(2) アルジェリアの側投入

1) カウンターパートの配置

USTO-MB、サイーダ大学、及び CDER アドゥラルから合計 36 名の C/P が各分野（Si 還元、太陽光、超伝導、WebELS）に配置され活動を実施している。

2) カウンターパート予算

アルジェリア側の現地業務費として 1,515,000 ディナール、また供与機材据付にかかる費用として 6,410, 149 ディナールが支出されている。加えて、プロジェクト活動実施に必要な機材として X 線回折計（40,000,000 ディナール）の購入を行っている。

３－２　成果の進捗と実績

３－２－１　アウトプットレベルの実績

各アウトプットの実績を以下に示す。

【アウトプット 1】
Si 製造の熱力学的プロセスデザインを行い、現在用いられている珪石ではなく、砂漠に豊富にある硅砂を原料とする Si 還元プロセス技術を開発する。

指　標	進捗状況
2015 年で硅砂シリカ（SiO_2）を原料とする新還元法によるシリコン純度において、硼素・リン濃度が 10ppm 以下。	進捗率[1]：80％
	Si 還元プロセスはアルジェリア側と共同で、東京工業大学（マイクロ波加熱による還元法）、弘前大学（高周波加熱による炭素熱還元法）、（独）物質・材料研究機構（水素ラジカルによる還元プロセス）で研究が進められており、これら研究は実証された。 実験室レベルではシリカ、還元シリコン両面において指標（硼素・リン濃度が 10ppm 以下）を達成している。 なお、アルジェリア側でも独自に本分野の研究は進められている。通関に長時間を要したため、機材の到着が遅れ、それに伴い実験開始が遅れたが、実験室レベルではシリカ、還元シリコン両面において指標（硼素・リン濃度が 10ppm 以下）を達成している。 併せて、各還元法について、C/P が自ら実験機材を製作するとともに、オラン近隣でも採掘可能な珪藻を用いて Si 還元実験を行っている。 本邦研修にて実際に実験を体験することにより、プロジェクト目標が明確に理解できるようになり、活動へのモチベーションが高まった、との証言が C/P からあった。

【アウトプット 2】 砂を原料とする Si 製造のテストプラント構築とアルジェリア側 Si 還元プロセスの確立	
指　標	進捗状況
テストプラントを構築し、その Si 生産能力を Si 1 t/ 年以上。	進捗率：30％
	アウトプット 1 の研究成果に基づき、Si 還元のスケールアップをめざし、現在、改良版（坩堝（るつぼ）のサイズが現行の 10 倍）の装置（テストプラント）の調整を弘前大学で行っている。テストプラントは 2015 年 2 月ころにアルジェリア側に搬送される見込みである。また弘前大学にて留学生、研修員を受入れ、アルジェリアへ設備を移転させた後、適切に設備を運用できるよう、人材開発も行っている。なお、USTO-MB はテストプラントの据付に必要なスペースを確保できる見込みとなっている。今後、テストプラント据付に向け、電気工事、配管工事を実施する計画である。

[1] 進捗率：中間レビュー調査時点の進捗状況から、中間レビュー調査団が判断した達成率を記載した。

【アウトプット 3】
各種太陽電池の性能（効率、耐久性）の定量的データを蓄積し、砂漠地域における太陽電池の活用法における課題と対策を整理する。また、この地域における太陽エネルギーの新しい活用法についての検討を行う。

指　標	進捗状況
太陽電池の性能（効率、耐久性）の定量的データ蓄積のために、太陽電池の種類が 2 種以上で、運用期間が 2 年以上。	進捗率：70％
	通関に長時間を要し、太陽光パネルなどの機材の設置が遅れた。2013 年 12 月、サイーダ大学に 5 種類の太陽電池パネルを設置した。データ（電気、気象データ）は毎月 USTO-MB の関係者がサイーダ大学を訪問のうえ収集し、日本側に送付している。データは約 1 年かけ蓄積する計画としている。そのデータを基に、2015 年から砂漠地域における太陽電池運用に係る分析を、アルジェリア・日本両国により行う予定としている。なお、サイーダ大学側でも供与された太陽光パネルと併せて自らの予算で太陽光パネルを 5 枚購入し、実験を行っている。 なお、砂漠地帯の太陽電池の活用方法の検討については、データを基に、今後、アルジェリア・日本両国の研究者により砂漠での太陽電池の管理・活用方法を検討する予定にある。なお、アルジェリア側の本分野にかかる研究は日本にて研修を受けた研修者が進めていく予定としている。

【アウトプット 4】
高温超伝導ケーブルシステム運用に関する問題点の摘出と対策の提示。

指　標	進捗状況
超伝導ケーブル配管をめざしたアルジェリアにおける地中温度の継続的記録（延べ 100 日以上）。	進捗率：80％
	通関に 3 カ月を要し、機材の設置が遅れた。しかし 2013 年 9 月に地中温度測定用機材を設置し、地中温度の測定を開始した。一時期機材の不調により 11 月から 2 カ月のデータが消失したが（明確な原因は不明）、その後はアルジェリア側の機材メンテナンスも適切に行われ、測定が行われおり、既に 100 日以上の計測は完了した。今後夏場（8 月ころ）のデータを含め複数年計測することにより、超伝導導入に向けた課題が明確になる。現状では、地下 2.75m レベルであれば超伝導ケーブル運用上問題ないという結果になっている。 ※　地中温度測定のデータ収集上は問題が生じていないが、データ送信について、本来は日本からもオンラインでのデータ確認が可能な機能を有していたが、不具合のためオンラインでのデータ確認は不可能な状況となっている。そのため、USTO-MB の関係者がサイーダ大学までデータ収集を行う必要が生じている。

【アウトプット 5】
アフリカ地域のエネルギー工学研究の拠点を形成し、日本発の多機能遠隔教育・情報交流システム：WebELS を活用した（複素エネルギー）遠隔教育・研究を行う。

指　標	進捗状況
5-1　WebELS サーバ、会議システムの導入。	進捗率：80％
	WebELS サーバは、USTO-MB、サイーダ大学に設置され、アルジェリアでもシステム（学習用、会議用共に）は使用可能である。 また、システムの運営維持に関しても、アルジェリア側の C/P は自らフランス語版、アラビア語版のマニュアルを作成しシステムの理解に努めている。また WebELS に関心がある他大学にて WebELS に関する講義を行うなど、C/P に対する指導を通じ既に十分な技術を有している。また運営維持に関する予算措置に関しても適切に実施されている。ただ、インターネット回線速度が十分ではないために WebELS の使用に支障をきたす場合がある。
5-2　E-learning によるエネルギー工学講義の実践延べ人数年間 8 名以上。博士学生教育延べ 5 名以上。	USTO-MB におけるエネルギー工学講義の延べ人数は、研修スタッフ 14 名、管理者クラス 5 名、Ph.D 学生 10 名の計 29 名。その他 WebELS を用いた会議を 5 回実施しており、多数の関係者により活用されている。 併せて、既に USTO-MB、サイーダ大学において Ph.D の審査、日本からの技術支援や会議開催などで WebELS が活用されている。最近は、パリ、リヨン、モロッコ、チュニジア、ブルキナファソ、シトラスブルグ、トゥルーズ、イギリス、南アフリカ等の研究者とのコミュニケーションにも使用されている。しかしアルジェリアのインターネットの通信速度の問題により十分に活用されていない。しかし ADSL 回線の導入工事が行われており、インターネットの通信速度が向上すれば、十分に活用されることが期待されている[2]。

【アウトプット 6】
サハラソーラーエネルギー技術開発ワークショップの開催（日本・アルジェリア交互）

指　標	進捗状況
日本アルジェリア国際会議を毎年開催。	進捗率：80％
	2013 年まで、毎年行われており、アルジェリア側も非常に高い関心をもって会議に参加している。なお、開催実績は以下のとおりである。

[2] ADSL は中間レビュー調査時点で回線の導入工事は完了したが、通信業者の最終調整が終了しておらず、使用が不可能な状況になっていた。

開催日	会議名	場所	参加者
2011 年 8 月 23 ～ 26 日	1st Asia-Arab Sustainable Energy Forum	日本 ウィンク愛知	90 名(アルジェリア側：10 名)
2012 年 5 月 15 ～ 16 日	2nd Asia-Arab Sustainable Energy Forum	アルジェリア USTO-MB	150 名（日本側：50 名）
2013 年 5 月 25 日	3rd Asia-Arab Sustainable Energy Forum	日本 弘前大学	延べ 150 名（アルジェリア側：10 名）
2014 年 5 月 13 ～ 14 日	4th Asia-Africa Sustainable Energy Forum	アルジェリア USTO-MB	149 名（日本側：20 名）

※　本プロジェクトの成果を更に多く広報すべく、2014 年からフォーラムの名称が、“Asia-Arab Sustainable Energy Forum”から“Asia-Africa Sustainable Energy Forum”に変更になった。

３－２－２　プロジェクト目標の達成度

本プロジェクトの目標は、1）Si 還元技術の確立及びその技術に基づくソーラーブリーダー実証、2）研究基盤の強化の 2 点となっている。

それぞれの指標にかかる達成状況を以下に示す。

【プロジェクト目標】
ソーラーブリーダー（ソーラーシリコン工場＋ Si 太陽光発電所）の持続的な拡大の可能性を検証し、地球エネルギー新体系の基礎研究、人材開発の基礎が確立される。

指　標	進捗状況
1. ソーラーブリーダー（ソーラーシリコン工場＋ Si 太陽光発電所）の検証状況。	ソーラーブリーダーの実現のため、本プロジェクトのコアとなる技術は高純度シリカ、シリカ還元プロセスである。日本・アルジェリア両国で実験が進められており、両技術でシリコンを得ており、Si 還元技術は実証されている。ただ現在は実験室レベルで実験が行われている。今後ソーラーブリーダーが実現していくためには、今後 Si 還元テストプラントがアルジェリアに設置される計画にあるので、同テストプラントを使用し実験規模を拡大したうえで、実験成果を高めていくことが求められる。併せて、更なる研究資金の調達、また研究者とともに民間企業との協力を得て技術を進展させていくことが望まれる。
2. 地球エネルギー新体系の基礎研究、人材開発の基礎確立状況。	現地での共同研究とともにアルジェリアからの留学生（14 名）、短期研修生を東京大学、弘前大学、国立情報学研究所などで受け入れている。アルジェリア側の C/P は日本での研修を通じ技術を習得し、アルジェリア側の各分野の実験の中心的な役割を果たしている。このように着実に人材育成が行

	われてきている。また研究に必要な設備、WebELS のシステムも徐々に整備されている。併せて、USTO-MB は、本プロジェクトでの支援内容を継続するため、太陽光、超伝導に関する修士・博士課程を設置した。加えて、博士課程の学生も本プロジェクトの研究に参加しており、若手研究者にも実験の場を提供し、若手研究者育成体制を整えている。このように本プロジェクトを通じアルジェリア側の人材開発の基礎も人的・物的面で整備されてきている。

第4章　評価5項目によるレビュー結果

中間レビュー調査の目的は、プロジェクトが効果発現に向けて順調に実施されているかを検証し、プロジェクトの計画の修正、またプロジェクト実施体制の改善に役立てることである。現状と成果に基づき、プロジェクトの中間時点における評価である点に鑑み、5つの評価クライテリアのなかで、妥当性、有効性と効率性を特に重点的にレビューした。またインパクトや持続性については、今後の実現可能性や、その見込みについて検討した。

4－1　妥当性

(1) アルジェリア政府の政策との妥当性

アルジェリア国は豊富な石油、ガス等の資源を有し、近年のエネルギー価格高騰を背景に貿易収支、経常収支とも黒字幅は拡大を続け、2005年以降は対GDP比10%以上の黒字を達成、1人当たりGDPも4,000米ドル前後と中進国入りしつつある。しかしながら、アルジェリア国の産業構造は、石油天然ガス収入対歳入比率が69%（2011年データ）と、炭化水素関連産業に大きく依存しており、GDPに占める割合（2011年数値）を部門別にみると、農業で9.4%、工業部門で4.3%、商業サービス部門でも28%と、炭化水素部門（約35%）との比較では依然割合は小さい。そのため、アルジェリアの経済は世界の原油価格の変動に大きく影響を受ける非常に脆弱な構造となっている[3]。将来的にも炭化水素資源の枯渇､それに伴う産業の衰退が懸念される。アルジェリア政府は､「公共投資新5カ年計画」にて、炭化水素依存からの脱却、及び太陽光エネルギーをはじめとした再生可能エネルギー導入の推進を示している。そのなかでも、本プロジェクトはアルジェリアに広大に広がる砂漠の砂からシリコンを還元し、太陽電池パネルの材料とし、太陽電池パネルを製造し、砂漠に設置し、送電していくことにより太陽光発電を推進し、将来的にエネルギー問題の克服、また産業の多角化を目的としていることから、アルジェリアのニーズと合致している。

本プロジェクトで対象としているUSTO-MBは高等技術者育成を目的とした機関であり、電気関係の研究も実施され、本プロジェクト開始前から本プロジェクトの研究内容にはかかわってきている。またサイーダ大学はUSTO-MBの卒業生を研究者として多く受け入れているなど強い連携をもっている。また地理的にも砂漠に近いことから太陽電池、超伝導の機材設置を設置し気象測定また機材の機能測定を行うには適切な位置にある。

また再生可能エネルギー開発センター（CDER）アドゥラルはアルジェリアの再生可能エネルギーの研究機関であり、本プロジェクトの研究内容は正に合致をしている。特に超伝導分野はアルジェリアで初めての試みであり、アルジェリア側の期待も高い。

(2) 日本のODA政策との妥当性

日本のアルジェリアの援助方針は、上記の「公共投資新5カ年」をはじめとしたアルジェリアの投資・開発計画に沿って、日本企業との連携を考慮しつつ実施されている。そのなかで産業構造の多様化を目的に、特に、産業基盤の整備を促進するため、基盤技術の強化及び産業人材の育成の側面での技術協力を行う内容となっている。プロジェクト目標はかかる側

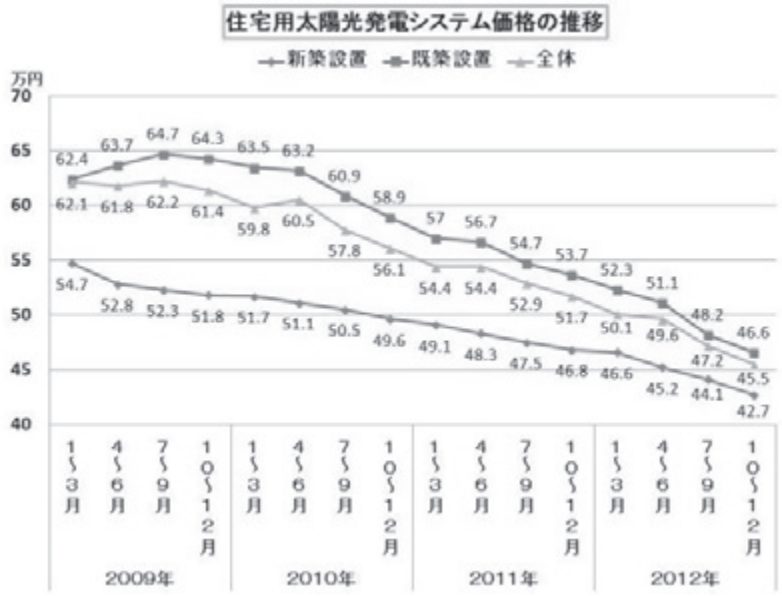
[3] 出所：一般財団法人海外投融資情報財団ウェブサイト

面へのアプローチを含んでいるとともに、またソーラーブリーダーの実現に向けては、日本企業をはじめとした民間企業の活用が必要であることから、対アルジェリアの援助方針と合致している。

４－２　有効性

プロジェクトにおいて最もコアとなるSi還元技術は実証されており、太陽光、超伝導についても必要なデータが収集され、課題などが把握されつつある。また共同研究を通じて機材も整備され、人材育成も着実に行われている。さらに、留学生、短期研修生の受入れ、プロジェクト調整員が配置されたことにより、アルジェリア・日本両国間のコミュニケーションがより円滑になった（C/Pのなかには自ら英会話学校に通い、日本人専門家とのコミュニケーション向上に努めている者もいる）。加えて、USTO-MBは博士課程の学生を本プロジェクトの研究に参加させ、若手研究者の育成を図るとととともに本プロジェクト開始後にUSTO-MBに太陽光､超伝導の修士・博士課程を設置するなどアルジェリア側の本研究に対する高い意欲が人材開発に大きく寄与している。今後はソーラーブリーダー構想の持続的な実現のため課題克服に向けての検証が行われていくことが望まれる。

アルジェリアにとどまらず、周辺地域からも本プロジェクトが高い注目を集めていること。注目が集まることにより､民間企業､他の研究者の協力が得られる可能性が高まり､ソーラーブリーダーの研究推進に寄与することが期待される。ソーラーブリーダー推進に向けてはシリコン及び太陽電池の市場動向が大きく左右される可能性がある。現在、太陽電池が注目を浴びていることから、生産量は増加しているものの中国製品などにより下落傾向にある。

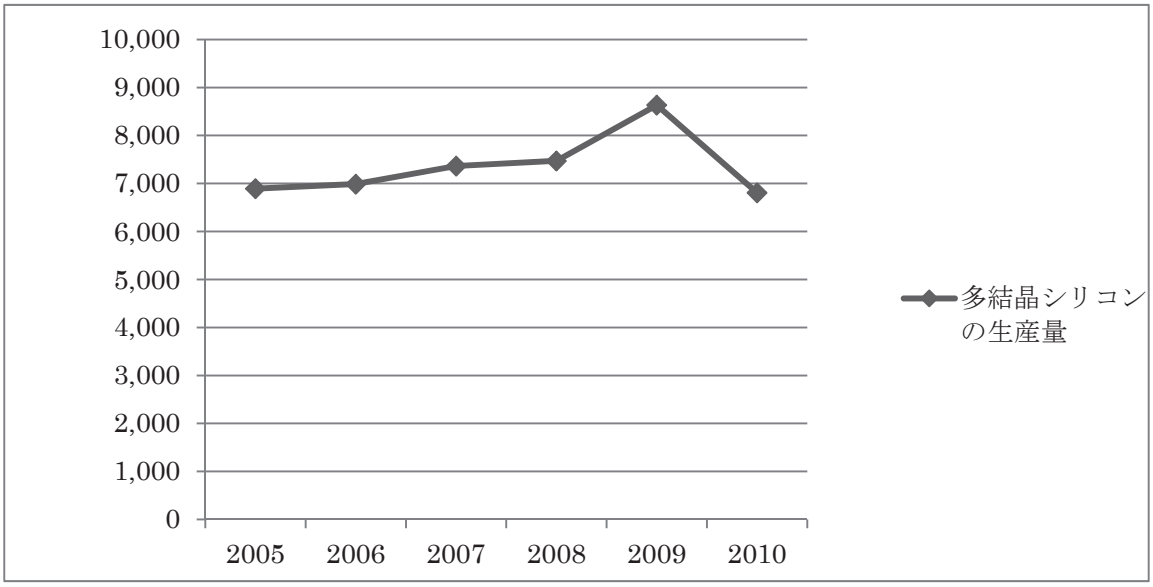


出所：太陽光発電普及拡大センターの資料

図－１　日本国内における住宅用太陽光発電システム価格の推移

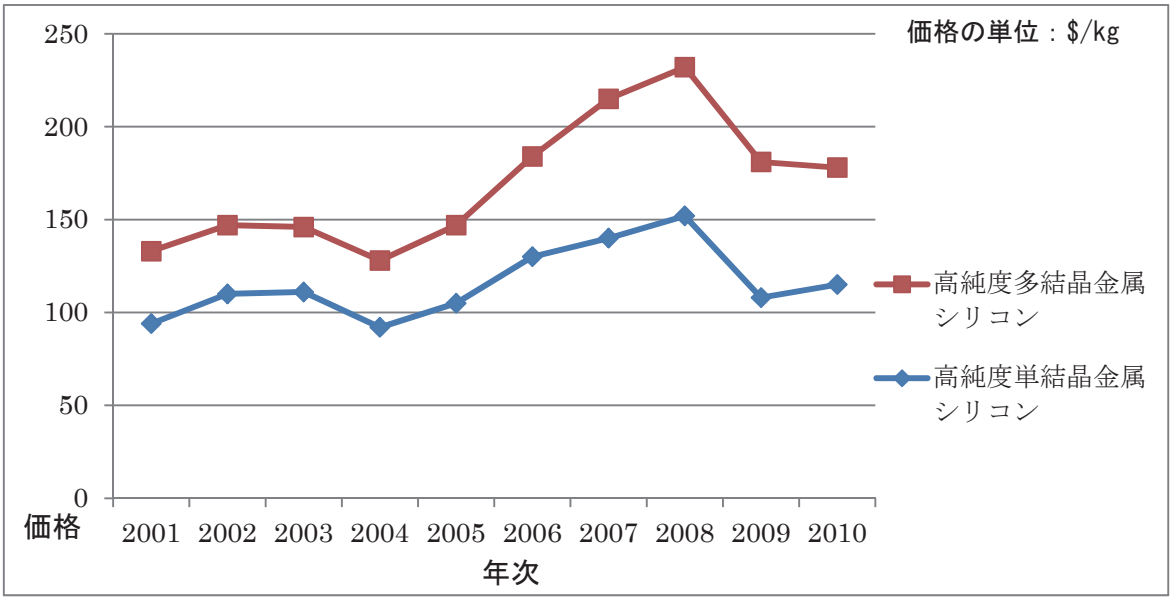
また太陽電池の原料となるシリコン（ソーラーグレード）の市場は2009年､単結晶シリコン（半導体用、太陽電池用）生産量6,344 tに対し多結晶シリコン（太陽電池用）生産量は8,633 tと若

干上昇傾向にあった（図－２）。一方、価格については太陽電池パネルの普及から、ニーズ、生産量が伸び、上昇傾向にあったが 2000 年後半から下落傾向にある〔参考までに国内のシリコン輸入価格推移を示す（図－３）〕。今後も市場価格が下落する場合は民間企業、研究者からの協力を得ることが困難になり、ソーラーブリーダーの実現に向けては阻害要因となり得る。



出所：新金属協会シリコン部会

図－２　日本国内　多結晶シリコンの生産量



出所：独立行政法人 石油天然ガス・金属鉱物資源機構

図－３　日本におけるシリコン系中間製品の輸入価格

加えて、2013 年 1 月に発生したアルジェリア人質事件のような治安上の問題により共同研究が停止することなった場合は、プロジェクトの活動が停止せざるを得なくなり、プロジェクト目標の達成に支障が生じることとなる。

４－３　効率性

2013 年 1 月に発生したアルジェリア人質事件、また通関手続きに時間を要し、機材調達が遅れたことが要因となり、活動は遅れ、一部のアウトプット（アウトプット 1、3、4）に活動の遅れが生じている。徐々に遅れを取り戻し、アウトプット達成に向け、日本・アルジェリア両国にて活動が進められている。

日本人専門家が多忙のため、現地での活動が限られる状況にあるが、プロジェクト目標の達成に向け、本邦研修、留学生を有効に活用している。特に、本邦研修では、C/P が日本の研究に触れることにより、プロジェクト目標の意味をより深く理解し、モチベーションが高まったことが確認されている。その後、実験機材なども徐々に現地に据え付けられ、アルジェリアにおいても実験可能な環境が整い活動が推進されている。

アルジェリア側も、本プロジェクトで支援を行っている各分野（シリコン還元、太陽電池パネル、超伝導、WebELS 等）に適切に C/P を配置している。また、アルジェリア側の負担事項についても、例えば、機材設置のための工事費用、アルジェリアにおけるセミナーの実施費用等、適切な金額、タイミングにて予算措置を取っている。

本プロジェクトで実証が行われているソーラーブリーダーに関する技術は、本プロジェクト開始前から東京大学を中心に進められており、専門性及び信頼性が非常に高い。その点でアルジェリアの研究者から技術的な信頼を得ており、かかる技術的な信頼がプロジェクトの効率的な推進に寄与している。

また、組織的にも USTO-MB の建物は日本の建築家（丹下健三氏）により設計され、その後も「オラン科学技術大学プロジェクト（1989 ～ 1992 年）」、「同フォローアップ協力（2007 年）」が実施され、実験機材が導入された。これら支援で導入された機材は USTO-MB の研究者が適切にメンテナンスを行い、現在も活用されている。かかる長年の日本との良好な協力関係をもとに本プロジェクトは実施されており、この点も本プロジェクトの成果創出に寄与している。

４－４　インパクト

日本・アルジェリア両国の研究者は論文など研究発表を積極的に行っており、これら活動を通じ、ソーラーブリーダーの成果が発表されている。その周辺国（チュニジア）のみならずトルクメニスタンなどからも注目を集めている。なお、参考までにトルクメニスタン大使が本プロジェクトに関心を示した講演に関する新聞記事を掲載する（東京大学鯉沼教授ご提供）。

また、本プロジェクトの活動として 2010 年から“Asia-Arab Sustainable Energy Forum”が実施されているが、2014 年からは“Asia-Africa Sustainable Energy Forum”と名称を変更し、周辺国だけでなくアフリカ、ヨーロッパ諸国、国際的ドナーからも参加者を集め、また分野も太陽光を含めた再生可能エネルギー分野を中心とした環境問題、経済等幅広く研究交流を進めている。

科学技術協力に期待

弘大 トルクメン大使が講演

弘前大学は10日、弘大創立50周年記念会館でトルクメニスタンのグルバンマメット・エリャソフ特命全権大使(54)を講師に招き、「科学技術協力への期待～トルクメニスタン国の紹介」と題して特別講演会を開いた。

中央アジアに位置するトルクメニスタンは、天然ガスの埋蔵量が世界4位と恵まれ、国土の約8割が砂漠。弘大北日本新エネルギー研究所が砂漠の砂から太陽光発電に必要なシリコンを作る研究をしていることから講演会開催につながった。

エリャソフ大使は、同国の歴史や、同国では手織りのじゅうたんが盛んに生産されていることなどを紹介した。同国が保健衛生、医学用植物、天然資源の活用に関心が高いことを示した上で、「トルクメニスタンと弘大との協力関係が始まることを期待したい」と話し、今後、科学技術をはじめ、多分野で弘大と連携していく意向を示した。(佐藤彩乃)

トルクメニスタンを紹介するエリャソフ特命全権大使

inあおもり2014」にゲスト出演する。(三上すみ子)

各地の放射線量(原子力規制委集計)

	事故前の最大値	10日午前9時
札幌市	0.105	0.030
青森市	0.102	0.035
盛岡市	0.084	0.022
仙台市	0.051	0.046
秋田市	0.086	0.035
山形市	0.082	0.046

学術連携呼び掛け

トルクメニスタン大使エリャソフ氏

弘大で講演会 経済や産業など紹介

駐日トルクメニスタン特命全権大使のグルバンマメット・エリャソフ氏の特別講演会が10日、弘前大学創立50周年記念会館で開かれた。エリャソフ氏は同国の経済や産業について紹介。弘大と同国間での学術・科学技術の連携、協力を呼び掛けた。

トルクメニスタンについて紹介するエリャソフ氏

弘大では、サハラ砂漠の砂で太陽電池の原料となるシリコンを製造し、ソーラーパネルで発生した電力を、超伝導電線で世界中へ送電する、日本とアルジェリアの大学の共同プロジェクトに参画。トルクメニスタンでも新エネルギーなどに関する他国との連携を考えていることから、講演会を主催した。

トルクメニスタンは中央アジアに位置し、日本の約1・3倍に当たる48万8000平方キロの国土を有する。そのうち7割以上をカラクム砂漠が占める。

エリャソフ氏は天然ガス田埋蔵量が世界第4位を誇ることや、手織り絨毯産業が栄えていることを紹介。日本との関わりとして、同国のテクノパークに日本の研究室が設置される予定であることを説明した。

エリャソフ氏は「弘前大学との協力関係が始まることを期待している」とし、弘大に同国の薬用植物について記載された書籍を寄贈。弘大はリンゴジュースや弘大のうちわ、木皿などを贈った。(成田真…)

ウクライナ

武力回避し対話解決

米ロ外相 東部めぐり電話会談

【ワシントン、モスクワ時事】ケリー米国務長官とラブロフ・ロシア外相は9日、緊迫するウクライナ東部の情勢をめぐって2回にわたり電話会談を行った。ロシア外務省によると、両外相はデモを続けるロシア系住民らの強制排除を含め、いかなる武力衝突も回避し、対話による緊張緩和を目指すことで一致した。

米国務省のサキ報道官によると、ケリー長官は最初の電話でラブロフ氏に「懸念」を表明し、ウクライナ東部の混乱へのロシアの関与を指摘した。また、来週に予定されているウクライナ、欧州連合(EU)を含めた4者会合についても協議した。ケリー長官は、ウクライナ暫定政権のヤツェニュク首相とも電話で会談。暫定政権がデモ隊との対話を模索していること…

東奥日報(2014 年 4 月 11 日付)	陸奥日報(2014 年 4 月 11 日付)

図－４　トルクメニスタン大使による弘前大学での講演に関する新聞記事

４－５　持続性

(1) 政策面

アルジェリアでは、「公共投資政策(2010 ～ 2014 年)」の下、石油、ガス等炭化水素に偏重したアルジェリアのエネルギー構造から、太陽光を含めた再生可能エネルギーの導入推進

等エネルギーの多角化を推進している。また、アルジェリアの経済は炭化水素に偏重しており産業構造の多角化もめざしている。このようにエネルギー構造、産業構造から鑑みてもソーラーブリーダーの実現と併せて太陽光エネルギーの推進が求められている。そのため、協力終了後も政策支援は継続される見込みである。

(2) 財政面

中間レビュー調査時点にて、アルジェリア側の負担事項は適切に行われており、今後も本研究をすべく、研究者配置、機材の運営維持管理について、適切に予算措置がなされていく計画にある。

(3) 組織面

本プロジェクトの対象はUSTO-MBとサイーダ大学、CDERアドゥラルとなっているが、サイーダ大学の研究者の多くはUSTO-MBの出身者であり、元来研究者同士の交流は活発に行われている。またCDERアドゥラルもアルジェリアの再生可能エネルギー研究機関の役割を負っている。本プロジェクトにおいても、本プロジェクトに関する会議をこれら関係者間で毎月行い、情報・技術交流を行っている。かかる体制は、本プロジェクト終了後も継続され、日本側も本プロジェクトの研究は継続し実施していく予定にある。

また、USTO-MBは、若手研究者育成のため太陽光・超伝導分野の修士課程（2年）、博士課程（2年）を設立した。なお、2014年における学生数は、修士課程（M1）13名、(M2）20名、博士課程（D2）8名、（D1）6名となっている。

さらに、将来的にも現在USTO-MBに2つ設置されている研究室を統合し、ソーラーブリーダーの研究拠点として活用していく構想を有している。そのため、これらプロジェクト関係機関は本プロジェクト完了後も連携を保ちつつ共同研究が進められていくことが期待される。

(4) 技術面

本プロジェクトでの共同研究を通じ、各分野の研究者の育成は行われており、着実に研究内容が進展している。また、機材供与を通じ実験設備も整えられ、またアルジェリア側も自らの予算で機材を購入し、また実験機材を製作するなど実験設備も充実してきている。本プロジェクト終了後も、WebELS等のシステムを活用し、共同研究を実施していくこととなっており、技術的なフォロー体制は整備されつつある。

第５章　結論と提言

５－１　結論

中間レビュー調査時点において、本プロジェクトで支援を行っている研究内容は、ソーラーブリーダー（ソーラーシリコン工場及びSi太陽光発電所）の検証、地球エネルギー新体系の基礎研究、及び人材開発の基礎確立に寄与している。プロジェクトの活動推進にあたっては、日本人専門家との強い信頼関係のうえに構築されたアルジェリア側の高いモチベーションと、USTO-MB学長を中心とした強いリーダーシップがプロジェクト目標、各成果の達成に大きく寄与している。

それゆえ、日本・アルジェリア両国の強固な協力関係の下、本プロジェクト完了後も共同研究は遂行されていくことが期待される。

５－２　提言

（1）Si還元テストプラント設置に係る準備（アウトプット2）

2015年2月ころにSi還元テストプラントが据え付けられる予定にある。そのため、据付前にテストプラント可動用の電源の確保、配管工事、実験室床の耐荷重の確認を行う必要がある。また、運営維持及び実験に必要な消耗品確保についてもアルジェリア側で確保されることが望ましい。

（2）ADSL回線の導入（アウトプット5）

アルジェリア・日本両国を中心とした研究者間のコミュニケーション、情報共有を円滑に行っていくためには本プロジェクトで導入されたWebELSは有用な手段であるが、ADSL回線の導入を早急に行い、人材育成が更に効果的に行えるようWebELSを適切に使用できる環境を整えることが望まれる。

（3）供与機材の安全管理（アウトプット1、3、4）

日本から導入された供与機材が適切に運用されるため、特に屋外に設置されている太陽光パネルなど盗難防止等安全管理については引き続き、配慮することが望まれる。

（4）国際的なソーラーブリーダーワークショップやプロジェクト活動に関する広報活動を通じての研究成果の公表（アウトプット6）

本プロジェクトの社会実装性を高めるためには、他の研究者や民間企業の協力が不可欠である。そのためには、今後も学会発表などを通じ、本プロジェクトの研究成果が発信されていくことが望ましい。また、研究成果がUSTO-MB内においても情報共有されることが望ましい。

５－３　教訓

地球規模課題対応国際科学技術協力（SATREPS）では、日本人専門家（研究者）の派遣が限定的な場合、また実施機関の実験設備が充実していない場合も想定されることから、1）本邦研修にて実験を体験させる機会を提供する、またその後、2）できるだけ早い段階で供与機材を設置し、

3）現地でも実験が行える環境を整備していくことが、成果を効率的に創出していくうえで重要である。

また、USTO-MB を含むアルジェリア研究機関の学長や副学長など実施機関のトップマネジメントからの理解・支援を得ること、また研究成果などの情報発信を積極的に行うことにより、プロジェクトの活動が行いやすい環境づくりを行っていくことも重要である。

付　属　資　料

１．合同中間レビュー報告書

The Joint Mid-Term Review Report
on
Japanese Technical Cooperation (SATREPS) for
Sahara Solar Energy Research Center Project
in the People's Democratic Republic of Algeria

Oran, Algeria
12 May 2014

Mr. Kaoru SUZUKI
Leader
Japanese Mid-term Review Team
Senior Advisor to the Director General (Energy)
Industrial Development and Public Policy Department
Japan International Cooperation Agency

Mr. Arezki Saidani
Director of Cooperation and Inter-Universities Exchanges,
Ministry of Higher Education and Scientific Research,
The People's Democratic Republic of Algeria

Pr. DERDOUR Aïcha

Prof. Aicha DERDOUR
Rector,
University of Science and Technology of Oran, Mohamed Boudiaf (USTO-MB)

TABLE OF CONTENTS

Annexes

Annex-1: PDM (Project Design Matrix)

Annex-2: Evaluation Grid

Annex-3: PO (Plan of Operation)

Annex-4: Inputs for the Project (Japanese side)

(1) List of Japanese Researcher dispatched

(2) Record of Japanese Researcher dispatched

(3) Provision of Equipment under the project

(4) Local cost by Japanese side

Annex-5: Inputs for the Project (Algerian side)

(1) List of Counterpart (C/P) researcher

(2) Local expense

(3) Local expense for equipment installation work

Annex-6: Output (List of literature under the project)

Abbreviations

CDER	Renewable Energy Development Center
C/P	Counterpart
GoJ	Government of Japan
JCC	Joint Coordinating Committee
JFY	Japanese Fiscal Year
JPY	Japanese Yen
JICA	Japan International Cooperation Agency
JST	Japan Science and Technology Agency
M/M	Minutes of Meeting
PDM	Project Design Matrix
PO	Plan of Operation
R/D	Record of Discussion
SATREPS	Science and Technology Research Partnership for Sustainable Development
USTO-MB	University of Science and Technology of Oran "Mohamed Boudiaf"

1. OUTLINE OF THE MID-TERM REVIEW

1-1. Background of the Review

The Japanese Technical Cooperation for "Sahara Solar Energy Research Center Project" (hereinafter referred to as "the project") in accordance with the Agreement on Technical Cooperation between the Government of Japan (GoJ) and the Government of the People's Democratic Republic of Algeria signed on December 7, 2004 was launched in November 2010. Since the project has reached the halfway point, Japan International Cooperation Agency (JICA) has determined to conduct a mid-term review study for the purpose of reviewing the achievements of activities of the project, evaluating them, and suggesting directions for latter half period of the project.

1-2. Objectives of the Review

The objectives of the Mid-term Review are:

(1) To identify the extent of achievement of the project purpose and outputs based on the R/D, the PDM, and the PO;
(2) To identify the positive issues and negative issues, if any, for project implementation;
(3) To evaluate the Project in terms of the five criteria (relevance, effectiveness, efficiency, impact and sustainability); and
(4) To make recommendations on necessary measures for improvement of the Project.

1-3. Methods of the Review

The Mid-term Review is conducted:

(1) jointly by Algerian and Japanese review teams (hereafter referred to as "the Joint Review Team");
(2) by collecting data and information through;
    i) examining the reports and documents prepared by the Project.
    ii) interviewing Japanese experts/researchers, Algerian counterparts (C/Ps), and authorities concerned.
    iii) observing the Project sites.
(3) by assessing the degree of achievement of the Project; and
(4) by analyzing the overall achievement based on the five evaluation criteria listed below
    i) Relevance: It measures the extent to which the Project is consistent with the priorities and policies of the target group, Government of Algeria and GoJ.
    ii) Effectiveness: It concerns the extent to which the Project purpose has been achieved, in relation to the outputs produced by the Project.
    iii) Efficiency: It measures the outputs in relation to the inputs, in terms of timing, quality and quantity.
    iv) Impact: It refers to direct and indirect, positive and negative impacts caused by implementing the Project.
    v) Sustainability: This is to question whether the Project effects will be sustained after the Project, focusing on institutional, financial and technical aspects.

Please see attached Evaluation Grid (Annex-2) for reference.

1-4. Members of the Joint Review Team

(1) Japanese team

Mr. Kaoru SUZUKI	Leader Senior Advisor to the Director General (Energy), Industrial Development and Public Policy Department, Japan International Cooperation Agency (JICA)
Mr. Takayuki KURITA	Evaluation Analysis Consultant,ICONS International Corporation
Mr. Noboru OKADA	Interpreter

(2) Algerian team

Prof. Aicha Derdour	Rector, USTO-MB
Prof. Boudgene Stambouli Amine	Professor, Lecturer and Researcher, USTO-MB
Prof. Flazi Samir	Leader of Superconductivity, USTO-MB
Dr. Ali Tahri	Leader of PV system, USTO-MB
Prof. Saad Hamzaoui	Leader of Silica reduction, USTO-MB

1-5. Schedule of the Review

The Mid-Term Review was conducted from 4th May to 4 15th May 2014 for carrying out the following activities:

Schedule of Mid-Term Review of the Japanese Technical Cooperation for "Sahara Solar Energy Research Center (SSERC) in Algeria"

No.					Remarks
1	5/4	Sun	Arrive at Oran (Kurita and Okada)		Oran (K/O)
2	5/5	Mon	USTO-MB Meeting with Project Member Interview with Prof. Amine Boudghene Stambouli	Interview with Mr. Mustapha Abdelatif Visit to WebELS meeting room, saver room	Oran (K/O)
3	5/6	Tue	Interview with Prof. Flazi Samir and Dr. Tahri Ali, Associate Professor regarding solar panel and superconductivity Interview with Dr. Bendella Fatima regarding WebELS	Interview with member of Silica reduction team Visit a laboratory of of Silica reduction team	Oran (K/O)
4	5/7	Wed	Interview with Prof. A. Kaddour, Deputy Project Manager for Logistics Interview with Prof. Aicha DERDOUR, Rector of USTO-MB	Arrival at Oran (Suzuki) Interview with Dr. R. Kessas, Deputy Project Manager for Monitoring of Project Management	Oran (K/O/S)
5	5/8	Thu	Courtesy call to USTO-MB (Rector and Vice Rector) Interview and visit to laboratory		Oran (K/O/S)
6	5/9	Fri	Preparation of Mid-Term Review Report		Oran (K/O/S)
7	5/10	Sat	Visit to Saida University Courtesy call to Rector, visit to activity site Leave from Saida		Oran (K/O/S)
8	5/11	Sun	Joint Mid-Term Review Meeting (USTO-MB)		Oran (K/O/S)

			(Algerian CP(USTO-MB+Saida University + CDER, Adrar) + Japanese CP (Pr. Sumiya, Dr. Itaka, Dr. Tsubouchi)		
9	5/12	Mon	3rd Joint Coordinating Committee (JCC)		Oran (K/O/S)
10	5/13	Tue	4th AASEF	Oran to Alger by domestic air	Oran (K/O) Alger (S)
11	5/14	Wed	4th AASEF	Report to MHESR Report to Embassy of Japan	Oran (K/O) Alger (S)
12	5/15	Thu	Departure from Oran	Report to JICA Algeria Departure from Alger	

1-6. List of Personnel Visited by the Joint Review Team

<USTO-MB>

Prof. Aicha Dedour	Rector
Dr. Boudgene Stambouli Amine	Professor, Lecturer and Researcher
Dr. R. Kessas	Vice Rector in charge of External Relations and Cooperation, USTO-MB
Prof. S. Hamzaoui	Leader of Silica reduction
Prof. Flazi Samir	Leader of Superconductivity
Dr. A. Tahri	Leader of PV system
Dr. Bendella Fatima, Lecturer	Leader of WebELS
Prof. Kaddour Abdelhafid	Dean of Electrical Engineering Faculty (Logistics Manager)
Mr. Chali Abderkhadel	General Secretary of Electrical Engineering Faculty
Prof. Berrached Nasr Eddine	Vice Rector of Planning (Coordinating Manager)
Prof. Bouamrane Rachid	Vice-Rector of Research and Post-graduation
Mr. Mustapha Abdelatif	Responsible of network

<Saida University>

Prof. Berrezoug Belgoumene	Rector
Prof. Y. Miloud	Professor Lecturer
Dr. M. Mostefai	Lecturer
Dr. A. Miloudi	Lecturer
Dr. A. Zahaf	Lecturer

<Japanese Experts/Researchers>

Dr. Hideomi Koinuma	Tokyo University
Dr. Haruki Ueno	National Institute of Informatics
Dr. Sataro Yamaguchi	Chubu University
Dr. Makoto Hamabe	Chubu University
Dr. Kenji Itaka	Hirosaki University
Dr. Masatomo Sumiya	National Institute for Materials Science
Dr. Kenta Tsubouchi	Tokyo University
Ms. Yukiko MBOW	JICA Project Coordinator

2. OUTLINE OF THE PROJECT

2-1. Background of the Project

The economy of the People's Democratic Republic of Algeria (hereinafter referred to as "Algeria") has been in strong condition with increasing oil and natural gas export due to surge of energy price in recent years. Thus both trade and current balance surplus have expanding continuously. Since 2005, the GDP per capita has achieved more than 10% in surplus and also is becoming middle-income country level with around $ 4,000 per capita.

However, employment absorption rate of this sector is only 2% of the total. Such sectional economic structure to the same sector (occupied about 98% of export, approximately 50% of GDP and approximately 75% of revenue of Algeria) become factors of social anxiety such as expansion of income inequality and social disparities and so on.

President Abdelaziz Bouteflika won the presidential election three times consecutively and has established the "Algeria National Action Plan 2009". The plan takes up diversification of industry and the human resource development for the diversification as high priority issue, and the plan draw up various policies toward the correction of disparities such as 1) expansion of opportunities for practical professional education 2) of higher education (increasing the number of undergraduate student up to two million and 50% increase of the professors in five years), and 3) job creation for three million people

In particular, the plan emphasizes on the science and technology.100 billion Dinars (about 130 billion yen worth) plans to be granted for scientific research over five years.

At the same time, in the field of the mainstay energy sector, Algerian government plans to figure out the overall picture oil and natural gas of Algerian national energy resources (new mining sites and reserves) and to carry on research study aimed to strategic utilization. In addition, as a priority research topics Algerian government takes up aggressive research development (such as development of policy and regulations, promotion of research and development, and industrialization) related to next generation renewable energy such as solar power generation in view to promote diversification of energy.

Particularly, solar power generation is placed as the most important issue in terms of promoting science and technology, formulating and creating new jobs opportunity, and industries, in addition expanding local power supply network and stable power supply.

Internationally, in the absence of energy committee in Africa, Algerian government advocated an establishment of African Energy Commission (African Energy Commission: AFREC) (the headquarters is located in Algiers), and realized the commission taking over the seven years this Commission. It has become a driving force to promote mutually complementary cooperation and integration of energy in continent scale.

In addition, Algerian government proposed clean development mechanism in the region based on three components such as 1) reduction of flare gas by devising and implementation of trans-Sahara gas pipeline project linking from Niger and Nigeria to Algeria, 2) securing resources for solar power and improvement of energy efficiency and 3) strengthening network of intra-African research institutions. Algerian government functions as a base to spread new technology to African countries and of natural energy supply. Moreover in the COP-new phase development, Algerian government plays a leading role for search of global warming prevention measures in Africa as African Group chairman.

In this circumstance, Algerian government has positioned "solar power generation" as the top priority field for next generation energy, thus Algerian government requested assistance to Japan which owes

advanced technology in this field, through the "global issues corresponding international science and technology cooperation".

The project has a purpose to verify the possibility of sustained expansion of solar breeder (solar power plants and solar silicon factory), and to establish basic research of new earth energy system (performance of solar cells, introduction of a superconducting cable) and to establish basic human resources development. The project consists of six supporting fields such as 1) thermodynamic process of silicon manufacturing, 2) silicon manufacturing test plant, 3) capacity of solar cells, 4)operation of high-temperature superconducting cable, 5) Web-Based E-Learning System introduction, 6) Holding a workshop of Sahara solar energy technology development. The project has been carried out with USTO-MB, Saida University and CDER Adrar as a counterpart (C/P) organization. The project has implemented in the plan for five years from November 2010 to November 2015, currently one expert in long-term expert as a project coordinator has been dispatched.

In the respect of five years period cooperation, the objective of this mid-term review is to lead recommendation to the project activities in the future as well as evaluate and confirm the Activities and Outputs.

2-2. Summary of the Project

The Project design is stipulated as follows:

(1) Project Purpose

To verify the feasibility of sustainable scaling up of the solar breeder concept (construction of Si solar cell plants and solar power plants) and to establish basic research and education for new global energy supply system.

(2) Outputs

(2)-1 Output 1

To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production.

(2)-2 Output 2

To construct a Si production test plant from sand and to establish Si reduction process in Algeria.

(2)-3 Output 3

To find problems and solutions in the use of solar cells in the desert by accumulating quantitative data about cell performance such as efficiency and reliability and to find new applications of solar energy in this area.

(2)-4 Output 4

To point out problems with operation of high critical temperature superconducting cable system and to find out solutions for them.

(2)-5 Output 5

To establish bases for energy engineering education in the Africa area and to perform remote education by complex education system with the use of WebELS system which was developed in Japan.

(2)-6 Output 6

Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria .

3. ACHIEVEMENTS OF THE PROJECT

3-1. Achievement of Inputs

Please see Annex-3 and Annex-4.

3-1-1. Japanese Side

(1) Dispatch of Experts

Twenty nine short-term experts/researchers and one long-term expert (Project Coordinator) were dispatched. Total assigned days by middle of May 2014 are 299 days.

(2) Counterpart (C/P) Training in Japan

Twenty five persons in total were trained in Japan.

(3) Provision of Equipment

The equipment listed in the Annex-3 (3) were provided by Japanese side. They are basically in good condition and sufficiently utilized for the Project activities.

(4) Local Cost Expense

A total of 2,315,876 DA (771,855DA in 2012 of JFY, and 1,455,745DA in 2013 of JFY, 88,276DA of JFY. 2014) have been spent for have been spent for the project activity and management in Japanese side.

3-1-2. Algerian Side

(1) Assignment of Counterpart (C/P) Personnel

A total of thirty-six persons USTO-MB, Saida University and CDER Adrar have been assigned as C/P personnel for the Project.

(2) Facilities and Equipment

Working space or rooms for Japanese researchers as well as laboratories for the project are provided by USTO-MB.

(3) Local Cost Expenditure

1,515,000 DA for local expense and 6,410, 149DA for expense of installation work for equipment procured, and 40,000,000DA for X-ray diffractometer under the project have been spent for the Project activities.

3-2. Achievement of Activities

The Project has undertaken many activities. The following tables show the activities and their achievement.

3-2-1. Activities

Activities in PDM	Status of Activities	Accomplish -ment
1.1 To design thermodynamics for Si production process.	- The project calculated Gibbs energy for potential process and demonstrated the effectiveness of the hydrogen radical. In addition the project analyzed the probability of separation conditions of the desert sand, and subjected to impurity analysis by gravity concentration.	100% completed.
1.2 Purification of sands from the desert	- Based on the achievement of Activity 1-1, the project obtained sand in various points of the Sahara, and the project analyzes the impurity concentration with various type of analyzers. Moreover the project purified silica highly. A new research axe is now under development at Hamzaoui's laboratory through the experiment using diatoms.	100% completed.
1.3 To develop Si reduction techniques from the sands (SiO2) in the desert (*solely in Japan)	- In cooperation with Algeria, Si reduction process research has conducted at Tokyo Institute of Technology (reduction method using microwave heating), Hirosaki University (carbothermal reduction method by high-frequency induction heating) and National Institute for Materials Science (reduction process by hydrogen radicals). These researches have been verified. In addition, USTO-MB in parallel have conducted research following each process of Si reduction manufacturing necessary experiment equipment by them.	66% completed (expect to be completed by October, 2015).
2.1 To tune the reduction apparatus in Japan	- Based on the research results of Activity 1-3, currently, the project have adjusted improved version of the test plant(the size of the crucible is 10 times more than the current plant) to aim to scale up.	66% completed (expect to be completed by October, 2015).
2.2 To set up the reduction apparatus in Algeria	- After the adjustment of the test plant in Japan, and the project plans to transport the test plant to Algeria. Currently, the project plans to install the test plant in Algeria in February 2015. Algerian side has already secured space necessary to install a Si reduction test plant. Furthermore USTO-MB plans to conduct electric work and plumbing work in the future.	0% completed (expect to be completed by February,2015.)
2.3 To establish the Si reduction process in Algeria	- Through tuning work of the test plant, the project has carried out personnel training, and a system to continue to study has been developed gradually even after the transfer of the test plant to Algeria. However, since the test plant is a made-to-order, it should be considered how the test plants are maintained in Algeria.	0% completed (expect to be completed byMay,2015.)
3.1 To get and set up solar panels	- Five (5) types of solar cell (866W) were installed at Saida University in December, 2013 (delayed for 2 years compared with the original plan).	100% completed.
3.2 To collect the data and to find problems and solutions	- Staff of USTO-MB has collected the data(electric and meteorological data) since the installation of solar cell, and sends it to Japan every month. The project plans to accumulate the data for 1 year (or for 6 months).	70% completed (expect to be completed by September, 2015).
3.3 To find applications	- In the future, the project plans to examine the management and utilization method of the solar cell in desert by both Algerian researchers and Japanese researchers in parallel on the basis of the data. - The research in Algeria will be conducted by researchers who participated in training in Japan.	60% completed (expect to be completed by September, 2015).
4.1 To get and set up measurement system	- The measuring device was procured, and the device was installed at Saida University in September 2013.	100% completed.
4.2 To collect and analyze data	- The data collection was started from September 2013. The measurement device was failed in November, 2013, there is a loss of data at one time. However the data collection is performed by the replacement of the device currently. The maintenance has been made possible in Algeria side receiving support from Japanese researchers.	60% completed (expect to be completed by September, 2014.)
5.1 To establish infra-structure for the use	- WebELS system has been installed at USTO-MB, and Saida University already. (The Ver.7.3 currently) the software has	80% completed (expect to be

<table>
<tr><td>of WebELS system and to educate instructors in Algeria</td><td>also been updated if necessary.
- Regard to operation and maintenance of the system, C / P of the Algerian side has developed a manual of French, Arabic version by himself and C/P conducted guidance at other university which is very interested in WebELS. Thus C / P of the Algerian side has sufficient technology already through guidance. In addition budgetary arrangement is also properly implemented for the operation and maintenance.</td><td>completed by June,2014).</td></tr>
<tr><td>5.2 To support the research works in SSERC at USTO-MB and to educate engineers in the field of global energy by the use of WebELS</td><td>- WebELS have been utilized for examination of Ph.D, technical support and for a meeting, conference with C/P and Japanese researchers already in USTO-MB and Saida University. Currently WebELS is utilized for communication with other researchers in other countries such as Paris, Lyon, Morocco, Tunisia, Burkina Faso, citrus Burg, Toulouse, United Kingdom, South Africa. However WebELS system has not been fully utilized due to a problem of communication speed of the Internet in Algeria. However installation of the ADSL line work has been carried out. Therefore if the communication speed of the internet is improved, the system expects to be fully utilized.</td><td>80% completed (expect to be completed by June,2014).</td></tr>
<tr><td>6.1 Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria</td><td>Sahara Solar Energy Workshop has been held annually. Record of the workshop is as follows.
<table>
<tr><th>Date</th><th>Name of the workshop</th><th>Location</th><th>No. of Participants</th></tr>
<tr><td>23 - 26 August, 2011</td><td>1st Asia-Arab Sustainable Energy Forum</td><td>Aichi, Japan</td><td>90(10 from Algeria)</td></tr>
<tr><td>15-16 May, 2012</td><td>2nd Asia-Arab Sustainable Energy Forum</td><td>USTO-MB, Algeria</td><td>150(50 from Algeria)</td></tr>
<tr><td>25 May, 2013</td><td>3rd Asia-Arab Sustainable Energy Forum</td><td>Hirosaki Univ., Japan</td><td>Total 150 (10 from Algeria)</td></tr>
<tr><td>13-14 May, 2014</td><td>4th Asia-Africa Sustainable Energy Forum</td><td>USTO-MB, Algeria</td><td>Total 149 (20 from Japanese side)</td></tr>
</table></td><td>80% completed (expect to be completed by the completion of the project).</td></tr>
</table>

3-3. Achievement of Outputs

The status of achievements of the Project Outputs in terms of verification indicators as per PDM is shown as follows.

Narrative Summary	Verification Indicators	Achievements
Output1: To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production.	1. To obtain Si with a B/P concentrations of less than 10 ppm with the use of the new reduction method from SiO2 in 2015	- In laboratory level in Japan, both Silica and Si reduction have already achieved the indicators (Si with B/P concentration is less than 10ppm). As it took a longer time to customs clearance, installation of equipment was delayed. In Algeria the experiment has been conducting in parallel and the results is achieving gradually to the indicator level.
Output 2: To construct a Si production test plant from sand and to establish Si reduction process in Algeria.	2. To construct a Si plant with a production rate of 1 ton/year	- As of April, 2014, the project has tuned Si reduction test plant at Hirosaki University. In addition, Hirosaki University accepted Algerian students and short-term trainees and they have had trainings to operate the test plant after the plant is transferred to Algeria. The test plant expects to be transported to Algeria and installed around February, 2015. In addition, USTO-MB has expected to be

		able to ensure the space and required for installation of the test plant. In the future, it is required to conduct electrical work and plumbing.
Output 3: To find problems and solutions in the use of solar cells in the desert by accumulating quantitative data about cell performance such as efficiency and reliability and to find new applications of solar energy in this area.	3. To obtain operational records of two types of solar cells at least for more than two years to accumulate quantitative data about cell performance such as efficiency and reliability	- It took a longer time to customs clearance, installation of equipment and research for solar cell was started with delay for two years. Consequently the project installed five (5) types of solar cells at Saida University in December, 2013. Staff of USTO-MB collects the data and sends it to Japan every month. - The project plans to find application for solar cell operation in desert area in both Algerian and Japanese side in parallel from 2015 based on the data.
Output 4: To point out problems with operation of high critical temperature superconducting cable system and to find out solutions for them.	4. To obtain consecutive temperature data underground of Algeria for more than 100 days for burying the superconductor cables	- It took three months to customs clearance, installation of temperature measuring equipment was delayed. However, installing the underground temperature measuring equipment in September 2013, and the project started to measure the earth temperature. Data of two months from November has disappeared due to malfunction of the equipment for a while (a clear cause is unknown). However, equipment maintenance of the Algerian side is conducted properly, and the measurement has been performed, measurement of more than 100 days already achieved. By measuring for several years including summer season (around August) the future issues for superconducting introduction expects to be clear. At present, the project got a result that superconducting cable operation will not be problem for a depth of 2.75m underground level.
Output 5. To establish bases for energy engineering education in the Africa area and to perform remote education by complex education system with the use of WebELS system which was developed in Japan.	5.1 To introduce the WebELS server and the meeting system to USTO-MB 5.2 To educate more than 8 engineers a year by the energy engineering course through E-learning and to educate 5 Ph.D. students in total	- WebELS server was installed at USTO-MB and Saida University, and WebELS system can be utilized in Algeria (both for Leaning and for Meeting). - Total number of people who have taken the energy engineering lecture in USTO-MB is, a total of 29, including 14 training staff, 5 administrator class, 10 Ph.D. students. Moreover, the project has conducted a meeting five (5) times with WebELS, which has been utilized by a number of stakeholders.
Output 6. Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria (2011-2016).	6. Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria (2011-2016)	- Sahara Solar Energy Workshop has been held every year until 2014, Algerian side also participated in the workshop. The detail is mentioned in the column of "Activity"

3-4. Achievement of Project Purpose

Status of indicators that measure attainment level of the project purpose is show as follows.

Narrative Summary	Verification Indicators	Achievements
Project Purpose: To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production	1. Current feasibility situation of sustainable solar breeding with solar power plants and cell production plants.	- Core technologies of the project are Silica purification and Silica reduction process. The experiment has been conducted in Japan and Algerian side, Si is produced in both technologies, Si reduction technology was verified. At present the experiments have been carried out at the laboratory level. In order that solar breeder is going to achieve the future, as a test plant plans to be installed in USTO-MB, scaling up the experiment, the project is required to enhance the results of the experiment. Furthermore, it is expected to develop a technology with further research funds and cooperation of researchers and private sectors.
	2. Current situation of establishing basic research and education for new global energy supply system.	- In addition to joint research in Algeria, the project has accepted students from Algeria (14 researchers) and short-term trainees in Tokyo University, Hirosaki University, and the National Institute of Informatics. The equipment needed for research, system of WebELS has also been improved gradually. In addition, USTO-MB has established master and Ph.D program of photovoltaic technology and superconductivity technology to conduct continuous research. Thus, the basis for human resource development of the Algerian side now being deployed in human-physical plane.

4. PROJECT IMPLEMENTATION PROCESS

4-1. Project Implementation and Monitoring System

As of Mid-term review, a total of 29 Japanese researchers (short term) were dispatched for a total of 299 days. In addition, a project coordinator (long term) has been dispatched for project management. As there were some cases that dispatch of experts is delayed by influence of restraint of hostage restraint incident in January 2013, the delay of equipment installation because of custom clearance and Graet East Japan Earhquake, 2011. The project activities have been conducted in order to catch up at present, trouble have not occurred.

Although the project activity period in Algeria is limited, the project has conducted the research utilizing WebELS and e-mail. In addition results of the research have announced through meetings such as JCC, workshops (in Algeria and Japan), and thesis.

4-2. Relationship among the stakeholders

Rector of USTO-MB is strongly interested in the project, and researchers of Algeria and Japanese researchers have also built a strong relationship of trust through the project activities until now.

Even in period which the project activities have not been conducted in Algeria, researchers of Algeria and Japan have frequent communication using WebELS which was installed under the project and e-mail. Through such exchanges, joint research has been carried out smoothly.

Each activity has been conducted smoothly under USTO-MB including Saida University and CDER Adrar.

As many researchers in Saida University graduated from USTO-MB, they have very strong cooperation. Under the cooperation, information sharing is also frequently conducted between USTO-MB and Saida University.

4-3. Ownership of the Algerian Side

Adequate number of C/Ps is assigned in each activity. Moreover there is no big personnel change. Therefore, the activities have been carried out smoothly at the time of the Mid-term review. In addition regarding matters to be burdened by Algerian side such as expense for installation work of experiment equipment, Algerian side properly makes budgetary arrangement and expense.

Rector of USTO-MB shows deep understanding and high interests in the project. In addition the Japanese researchers have also made a presentation of research results actively. Therefore awareness of the project among other organization (such as Saida University and CDER Adrar) as well as whole USTO-MB is very high. Therefore not only USTO-MB, but also Saida University, CDER Adrar and each C/Ps show high interest in the project. They participate in the activity by their own.

4-4.Technology Transfer

Although the project activity period of Japanese researchers in Algeria is very limited, in each activity, technologies introduced under the project have been transferred steadily through joint research between Algerian side and Japanese side utilizing e-mail and WebELS system installed in the project. Voluntary activities of C/P can be confirmed in each activity such as C/P manufacture necessary experiment equipment and conduct experiment of Si reduction. Joint research have been conducted through Training in Japan the international students, joint research is progressing steadily towards the achievement of the project goals.

5. RESULTS OF THE EVALUATION

5-1. Relevance

The project is still relevant in view of consistency with Algerian development policies, Japanese ODA policies, and the needs of C/P organizations as follows:

(1) Relevance to Algerian society and development policies

Industrial structure of Algeria is heavily dependent on hydrocarbon-related industries. However, depletion of hydrocarbon resource, and industry decline associated therewith are concerned in the future. By demonstrating the solar breeder, the project is not only for the purpose of diversification of industry, but also to overcome the energy problem, are consistent with the needs of Algeria.

In "Programme Quinquennal des Investissements Publics", the movement away from hydrocarbon dependence, the Algerian government decided the promotion of renewable energy-based deployment, including solar energy. In the policy, the project which utilizes sand of vast desert in Algeria, and promotes solar power meets the needs of Algeria.

(2) Relevance to Japanese ODA policies

In order to promote the development of industrial infrastructure, Japanese cooperation policy for Algeria, has contents providing technical cooperation in the two sides of the development of industrial human resources and strengthening of infrastructure technology for the purpose of diversification of industrial structure. Therefore, the project's purpose is consistent with the Japanese cooperation policy.

(3) Consistency with needs of C/P organizations

USTO-MB is an institution for the purpose of higher science and technology training. Research of electrical science and technology also been implemented in USTO-MB, and USTO-MB has been involved in the targeting research of the project before the project started. Also Saida University has a strong cooperation with USTO-MB and Saida University is located close to desert area, which is in the proper location to install solar cell and measurement equipment for superconducting.

As CDER Adrar is a research institute of renewable energy in Algeria, research contents of the project correspond exactly.

In order to achieve the project purpose, to the center of USTO-MB, proper cooperation research system is established with Saida University and CDER Adrar. In order to achieve the project purpose, the project has necessary and sufficient contents.

In addition, research being verified in the project has been implemented to the center of the University of Tokyo, the superiority of Japanese technology is high. Research of Superconducting field is the first trial in Algeria in particular, the expectations of the Algerian side is also high.

5-2. Effectiveness

At the time of the Mid-term review, there is no change in direction to promote renewable solar energy in Algerian side and status of the project in the field of higher education of Algeria. Therefore, each index is set properly, and by achieving these indices of PDM, the project purpose expects to be achieved. By achieving each Output, the project purpose expects to be achieved.

Si reduction technology, which is the core technology in the project, was verified. In addition, regarding research of solar and high critical temperature superconducting cable system, data collection has been implemented. Moreover, through the collaborative research, the equipment was installed and human resource development has also been steadily conducted.

The project purpose has focused on two main points of view in the indicators. Contribution factors and hindering factors for these two indicators are as follows; The project will be implemented according to the following points.

1) Analysis of the possibilities of sustainable expansion of solar breeders. Type and quality of assistance (Si reduction process, plant setting, performance test of solar battery superconducting cable).

[Contributing factors]
The project has attracted high attention not only from Algeria but also from surrounding countries. Due to this high attention, possibility to obtain cooperation from private sector and other researchers will increases. Consequently, such high interest expects to contribute to the promotion of solar research breeder.

[Hindering factors] Market trends in solar cells and silicon.
Currently, solar cell market is in a downward trend due to the excess of Chinese products. In addition the price of silicon is also in a downward trend since the second half of 2000. These points may become a disincentive to obtain the cooperation from private sector and researchers. Therefore, the point gives significant impact on the development of solar breeder in the future.

2) Establishment of a basis of human resource development of solar breeder.

[Contributing factors]
By receiving students and short-term trainee from Algeria and arranging a project coordinator, communication between Algeria and Japan got more smoothly. Moreover, high motivation for the project of the Algerian side significantly contribute to human resource development such as that 1) USTO-MB promote development of young researchers by participating students of Ph.D. program to the research implemented under the project, and 2) USTO-MB established master's and Ph.D. program in the field of the superconducting to USTO-MB after the project started.

[Hindering factors]
To stop the joint research by security issues such as Algeria hostage crisis.

5-3. Efficiency

Although input from Japanese side was delayed (due to delay of equipment provision), inputs from both Japanese and Algerian sides have been appropriately done in terms of quality and quantity in general as of the Mid-term review.

5-3-1. Efficiency of Inputs from Japanese Side

Due to 1) the hostage restraint incident happened in Algeria in January 2013 and 2) the delay of customs clearance, some activities delay regarding to Output 1, Output 3 and Output4.

(1) Dispatch of Japanese Experts

In each field of research, appropriate researchers are assigned. Also the experts are dispatched in proper timing and period.

(2) Provision of Equipment

As it took a long time for custom clearance, there were some cases that the project activities were delayed such as experiments and meteorological data collection had not been able to be conducted. However the equipment is provided properly in terms of quality and quantity.

(3) C/P Trainings in Japan

As the activity in Algeria is limited, the training in Japan and receiving students are utilized effectively in order to achieve the project purpose. In particular, it is confirmed that by being exposed to Japanese research in training in Japan, motivation of C / P is increased. These inputs contribute to promote each activity.

5-3-2. Efficiency of Inputs from Algerian Side

(1) Assignments of Counterparts

As mentioned above, appropriate number of Algerian C/P has been assigned for every activities, the C/P also has sufficient capacity to implement cooperation research.

(2) Local Cost Expenditures

Algerian C/P properly arranges the budget for the project to the issues under the Algerian responsibility.

5-3-3. Efficiency of Activities

Both USTO-MB and Saida University utilize the existing laboratories for collaborative research. Also the research content is being investigated in Japanese implementing organizations that utilize the accumulated research results.

[Contributing Factors]

Building of USTO-MB was designed by a Japanese architect (Kenzo Tange). Japanese government had implemented "Project for the University of Science and Technology of Oran" (1989-92), and the follow-up cooperation (2007) thereafter. The experimental equipment which was installed in the

laboratory under these previous projects has been utilized until now. This project has been carried out on the basis of the good cooperation with Japan for many years, and these implementations contribute to the creation of project outputs.

In addition the improvement of the communication between Japan and Algeria that make it contribute for efficiency of the project. The following three factors are the reasons.

(1) The understanding of the actual status in Algeria has been well-understood through the receiving students and short-term trainee from C/P.

(2) The improvement of English language ability of C/P(There are some C/P who study at language school)

(3) The Project coordinator has been assigned.

5-4. Impact

Through the project activities and dissemination of the results of the research, positive impact is confirmed in some parts.

Effect of solar breeder project has been announced gradually through the presentation of the research such as international workshop and thesis. In the result, it commands the attention of not only domestic energy-related enterprises and of but also surrounding countries such as Tunisia but also Turkmenistan and Mongolia.

5-5. Sustainability

As of the Mid-term review, sustainability in the project is high in terms of policy and other support, financial aspect, and organization aspect of Algerian side.

5-5-1. Policy and Other Supports

Based on "Programme Quinquennal des Investissements Publics", Algeria has promoted the diversification of energy, including solar. Therefore, it is expected that policy support is continued cooperation after the end of the project. In addition, the promotion of solar energy with realization of solar breeder is required even in view of industrial structure, from the energy structure of Algeria.

5-5-2. Financial Aspects

Currently matters burdened by Algerian side have been done properly, and budget of Algerian side plans to be arranged for assignment of researchers and equipment operation and maintenance.

5-5-3. Organizational Aspects

As many of the researchers of Saida University are USTO-MB graduates, exchanges among researchers have been originally and actively carried out. CDER Adrar also plays a role of renewable energy research institutions in Algeria. Based on the structure, Japanese side also plans to continue the research of the project. In addition, USTO-MB has established master's and Ph.D. program for the training of

researchers (in the fields of solar and superconducting). Moreover USTO-MB has a concept to integrate two laboratories of USTO-MB in the future to utilize as a research base for solar breeder. Thus, it is expected that the cooperation research be conducting in progress while maintaining the cooperation even after completion of the project.

5-5-4. Technical Aspects

Through cooperation research in the project human development of each field has been conducted, consequently research outputs have achieved. After completion of the project the cooperation research plans to be conducted and technical follow-up system is establishing gradually.

5-6. Conclusions

As of mid-term review, the research field which the project has supported is expected to contribute to verify the feasibility of sustainable scaling up of the solar breeder concept (construction of Si solar cell plant and solar power plants) and to establish the basement for research and educational activities on new global energy supply system.

In particular high motivation and leadership of Algerian side which has been built under the strong relationship with Japanese researchers has contributed to achieving project purpose and outputs.

Therefore even the completion of the project joint research expects to be conducted continuously under the framework of Japan and Algeria cooperation policy.

6. RECOMMENDATIONS

Based on the findings, the Mid-term Review Team would like to raise some matters (regarded as) necessary for further improving the Project implementation for the rest of the Project duration.

(1) Preparation to install Si reduction test plant (Output 2)
A Si reduction test plant schedules to be installed around February 2015. Therefore, it is necessary to secure electric power supply, to conduct plumbing work and to confirm load-bearing of laboratory floor before installation. Further, it is also expected to secure consumables required for the experiment and operation and maintenance.

(2) Installation of ADSL line (Output 5)
It is expected to improve environment that WebELS can be utilized properly by installing ADSL line immediately in order to conduct human resource development more effectively.

(3) Safety measure for equipment (Output 1, 3 and 4)
It is expected to take safety measure continuously for equipment which has been procured and installed under the project.

(4) Dissemination of the research result of the project continuously through international SSB workshop and Public Relation activities (Output 6)
In order to increase the social and economic impacts of the project, (through conference presentations), it is expected that research results of the project is announced in public and even within -MB.

Annex-1: PDM (Project Design Matrix)

	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Project Purpose			
To verify the feasibility of sustainable scaling up of the solar breeder concept (construction of Si solar cell plants and solar power plants) and to establish basic research and education for new global energy supply system	1 To demonstrate the feasibility of sustainable solar breeding with solar power plants and cell production plants	Annual report Abstract of the meetings	Algerian government keeps collaborative research scheme.
	2 To establish basic research and education for new global energy supply system	Annual report Abstract of the meetings	
Project Outputs			
1 To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production	1 To obtain Si with a B/P concentrations of less than 10 ppm with the use of the new reduction method from SiO2 in 2015	Elemental analysis by EDX or ICP	Requirement for purity of solar silicon remains unchanged.
2 To construct a Si production test plant from sand and to establish Si reduction process in Algeria	2 To construct a Si plant with a production rate of 1 ton/year	Integrated production volume and data of the elemental analysis	
3 To find problems and solutions in the use of solar cells in the desert by accumulating quantitative data about cell performance such as efficiency and reliability and to find new applications of solar energy in this area	3 To obtain operational records of two types of solar cells at least for more than two years to accumulate quantitative data about cell performance such as efficiency and reliability	Data log file of the solar cells	
4 To point out problems with operation of high critical temperature superconducting cable system and to find out solutions for them	4 To obtain consecutive temperature data in the ground of Algeria for more than 100 days for burying the superconductor cables	Temperature data log file	
5 To establish bases for energy engineering education in the Africa area and to perform remote education by complex education system with the use of WebELS system which was developed in Japan	5-1 To introduce the WebELS server and the meeting system to USTO	Confirmation of system operation	
	5-2 To educate more than 8 engineers a year by the energy engineering course through E-learning and to educate 5 Ph.D. students in total	Log file of WebELS	
6 Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria (2011-2016)	6 Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria (2011-2016)	Submission of the abstract of the meeting	

Project Activities	Inputs			
	Japanese side		Algerian side	
1 1 To design thermodynamics for Si production process	Experts		Counterparts Personnel	
1 2 Purification of sands from the desert	Leader	Dr.Hideomi Koinuma Dr.Hiroshi Fujioka Dr Kosuke Kurokawa Dr.Haruki Ueno Dr.Yasubumi Furuya Dr.Hiroyuki Sato Dr.Takashi Matsuura Dr.Masatomo Sumiya Dr.Takuya Hashimoto Dr.Sakutaro Yamaguchi Dr.Junichi Shimoyama Mr.Yojiro Kitamura Dr.Kenji Itaka Dr. Masayuki Kamimoto Dr. Izumi Nakai Dr. Takashi Oozeki Dr. Toshio Kawahara Dr. Makoto Hamabe Dr. Kazuhiro Nagata Dr. Miyuki Hayashi Dr.Kenta Tsubouchi Dr. Arjudin John Berena	Deputy PJ Manager: Prof.Amine Boudghene Stambouli Deputy PJ Manager: Rachid Kessas(Vice-rector) SOG-Si research: Prof.Saad Hamzaoui, Dr. Mokhtar Zerdali, Prof. Towfik Sahraoui, Dr. Mohamed Adnane PV system evaluation (efficiency and durability): Dr. Ali Tahli, Dr.Salim Bouzhar, Dr. Amine Daoud, Dr. Mohamed Draou, Dr. Mohamed Sadok, Dr Ahmed Mehdaoui, Dr Miloud Yahia, Dr Mohamed Mostefai, Dr Abdallah Miloudi Feasibility study for grid connection: Prof. Samir Flazi, Dr Milod yahia, Dr Mohamed Mostfai, Dr. Mohamed Draou, Dr Abdallah Miloudi Local PV application and other problems :. Prof.Samir Flazi, Prof. Yahia Miloud, Dr. Miloudi Abdallah, Dr. Mohamed Mostefai, Dr. Mohamed Draou, Dr Messaoud Hamouda, Dr Soltana Daoud E-Learning(Web-ELS) system: Dr.Zekuiya Khiat, Dr Fatima Bendella, Dr. Mustapha Abdelatif , Dr Zahaf Ahmed	Researchers in USTO continues to educate engineers and students.
1 3 To develop Si reduction techniques from the sands (SiO_2) in the desert (*solely in Japan)				
2 1 To tune the reduction apparatus in Japan				
2 2 To set up the reduction apparatus in Algeria				
2 3 To establish the Si reduction process in Algeria				Pre-conditions
3 1 To get and set up solar panels				Public security in Algeria remains unchanged
3 2 To collect the data and to find problems and solutions	Administration	Project Coodinator	Administrative staff, Secretary	
3 3 To find applications	Equipment	Scanning Electron Microscope-EDX Impurity Analysis System Atomic Force Microscope DI Water Generator Ball Mill Reduction Apparatus Solar Panels Weather-monitoring System Server and Meeting System *Transportation fee for the equipment from Japan to Algeria *Necessary expenses for the counterpart training in Japan Note: Provision of the equipment may be changed due to its priority or JICA's budgetary allocation.	Office space and Facilities -Office for the Japanese Experts -Space for the Equipments provided by JICA *Necessary expenses for the Project activities and utilities	
4 1 To get and set up measurement system				
4 2 To collect and analyze data				
5 1 To establish infra-structure for the use of WebELS system and to educate instructors in Algeria				
5 2 To support the research works in SSERC at USTO and to educate engineers in the field of global energy by the use of WebELS				
6 Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria				

Annex-2: Evaluation Grid

Evaluation Grid for the technical cooperation for Sahara Solar Energy Research Center Project

Implementation Process

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
	Main Question	Sub-question				
Achievements of the Project purpose	To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production		1. Current feasibility situation of sustainable solar breeding with solar power plants and cell production plants.	Study record of solar breeding with solar power plants and cell production plants.	Annual Report Abstract of the meetings	Document review Questionnaire Interview
			2. Current situation of establishing basic research and education for new global energy supply system.	Current Study activity situation of new global energy supply system.	Annual Report Abstract of the meetings	
				Current situation of human resource development on solar breeding.	Annual Report Abstract of the meetings	
Achievement of Outputs	1. To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production.		To obtain Si with a B/P concentrations of less than 10 ppm with the use of the new reduction method from SiO2 in 2015	Study results of Si reduction.	Elemental analysis by EDX or ICP	Document review Questionnaire Interview
	2. To construct a Si production test plant from sand and to establish Si reduction process in Algeria.		To construct a Si plant with a production rate of 1 ton/year	Demonstration results of the test plants.	Integrated production volume and data of the elemental analysis	
	3. To find problems and solutions in the use of solar cells in the desert by accumulating quantitative data about cell performance such as efficiency and reliability and to find new applications of solar energy in this area.		To obtain operational records of two types of solar cells at least for more than two years to accumulate quantitative data about cell performance such as efficiency and reliability	Operation data of solar cells.	Data log file of the solar cells	

	4. To point out problems with operation of high critical temperature superconducting cable system and to find out solutions for them.		To obtain consecutive temperature data in the ground of Algeria for more than 100 days for burying the superconductor cables	Temperature data.	Temperature data log file	
	5. To establish bases for energy engineering education in the Africa area and to perform remote education by complex education system with the use of WebELS system which was developed in Japan.		5-1 To introduce the WebELS server and the meeting system to USTO	Record of system operation	Confirmation of system operation	
			5-2 To educate more than 8 engineers a year by the energy engineering course through E-learning and to educate 5 Ph.D. students in total	Log record of WebELS.	Log file of WebELS	
	6. Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria (2011-2016).		Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria (2011-2016)	Abstract of the meeting	Submission of the abstract of the meeting	
Input	Japanese side	Dispatch of Expert (amount, timing and period and specialty)	Amount, quality and timing of input	Expert list	Progress Report Opinions of persons concerned	Information on project management
		Equipment and materials		Equipment list		
		Local cost		Result data		
		Timing, period, contents and participants of trainings		Result data		
		Others (if any)				
	Algerian side	Arrangement of C/P (Name, job title, organization)		C/P list	Algerian C/P	Information request
		Facility and equipment Operation cost Others		Result data	Algerian C/P	

Implementation Process

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
	Main Question	Main Question				
Record of the activity	1-1 To design thermodynamics for Si production process.		Comparison with the planned and actual schedule of the activities	Degree of achievement,	Progress Report Opinions of persons concerned	Document review Questionnaire Interview
	1-2 Purification of sands from the desert.					
	1-3 To develop Si reduction techniques from the sands (SiO2) in the desert (*solely in Japan).					
	2-1 To tune the reduction apparatus in Japan.					
	2-2 To set up the reduction apparatus in Algeria.					
	2-3 To establish the Si reduction process in Algeria.					
	3-1 To get and set up solar panels.					
	3-2 To collect the data and to find problems and solutions.					
	3-3 To find applications.					
	4-1 To get and set up measurement system.					
	4-2 To collect and analyze data.					
	5-1 To establish infra-structure for the use of WebELS system and to educate instructors in Algeria					
	5-2 To support the research works in SSERC at USTO and to educate engineers in the field of global energy by the use of WebELS					
	6 Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria					
	Are there differences between planed and actual schedule of activities? If the activity is conducted as planned, what was the factor?		Confirmation of causes if there are differences.	Opinions of persons concerned	Progress Report, Interview	
Technical transfer	Are there any problems in technical transfer?		Confirmation of the appropriateness of the technical transfer for C/P. Who do what in Technical transfer? (Appropriateness of the role division).	Method of technical transfer, role division Opinions of persons concerned	Progress Report, Interview, Questionnaire	Document review Questionnaire Interview

			Evaluation of technical transfer, good point, point to be improved and to be changed.			
Relationship among the stakeholders	Relationship between the experts and C/P	Whether trusting relationship is fostered. Whether they are satisfied with each other.	Confirmation if trusting relationship is fostered	Opinions of persons concerned	Results of interview	Interview
		Communication of the experts and C/P	Confirmation of the communication	Confirmation of frequency in communication among stakeholders	Results of interview	Interview
	Role division and collaboration between stakeholders	Role division, chain of command, collaboration and information sharing among USTO, Saida University and CDER Adrar, information sharing	Confirmation of system for chain of command and role division	Project chart Stipulation of role division among stakeholders Opinions of persons concerned	Progress Report Results of interview	Document review Questionnaire Interview
		Situation of collaboration and role division, among USTO, Saida University and CDER Adrar. Involvement of other organizations.	Confirmation of situation -in role division among USTO, Saida University and CDER Adrar in Technical transfer. -in collaboration with commercial establishment such as enterprises.	Situation of collaboration Opinions of persons concerned	Progress Report Results of interview	
Ownership	C/P implements proactively the project.	The number of C/P allocated is enough? The C/P participate in the project actively?	Situation of C/P arrangement and their activities.	Opinions of persons concerned	Activity results Opinions of persons concerned	
		Recognition of implementation organization on the project.	Degree of Recognition of implementation organization on the project	Opinions of persons concerned	Results of interview	
		Degree of participation and recognition of target groups.	Degree of participation and recognition of target groups	Opinions of persons concerned	Results of interview	
		Budget of Algerian side is arranged and disbursed as planned?	Confirmation budget plan, results of Algerian side	Results Opinions of persons concerned	Information on project management, Results of interview	

Other factors that affect implementation	Is there any factors that affect efficiency of the process?	Confirmation of problem, factors that affect output on implementation.			

Relevance

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
Necessity	Does Project Purpose correspond with the needs of the target area and society?		Confirmation of the relation between the needs and the project purpose	Needs of Algeria and targeted area.	Development plan of Algeria Results of interview	Document review Interview
Relevance of approach	Is the project strategy appropriate for development issues in targeted fields and sectors of Algeria?	Are implementation structure, the division of roles, and collaboration among stakeholders appropriate?	Appropriateness of -Project approach -Project logic Segregation with the possibility of synergy with other donor assistance.	Evaluation results of similar project Opinions of persons concerned	Progress Report Result of interview	Document review Interview
		Is the content of support (Si reduction process, cell performance test, operation of high critical temperature superconducting cable system, education with the use of WebELS) is appropriate? Is it necessary and sufficient?				
	Does Japan have comparative advantage in technical cooperation in this field?		Confirmation of how experience of Japanese Science and Technology Research partnership for Sustainable Development(SATREPS) project and other countries are utilized.	Possibility and methodology of utilizing results and achievement in past SATREPS project.	Progress Report, Detailed design survey report of the project	Document review
	Others	Have there have been any changes in the project environment in few years?	Confirmation of the events that might have effect the Project	Change of important assumption and environment surrounding the project and their affect	Progress Report Results of interview	Document review, Interview

Effectiveness

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
	Main Question	Sub-question				
Prospect of the Project purpose achievement	The prospect of the Project Purpose achievement		Confirmation of Indicators of the project purpose		Progress Report Relevant documents, etc. Results of interview	Document review Interview
	Is the target level of Project Purpose indicators appropriate?		Comparison with the baseline data Comparison with the target level of similar projects	Indicators of other project Opinions of persons concerned		
Causality of Outputs and Project Purpose	Do/did Outputs contribute to achievement of Project Purpose?		Whether it is reasonable to consider the achievement of the outputs lead to the achievement of the Project purpose.	PDM, Opinions of persons concerned Actual achievement of the Project	Progress Report Results of interview with parties concerned	Document review Interview
	Are there any changes in the important assumption for achieving the project purpose? Any effects by the assumptions?	[the important assumptions] Requirement for purity of solar silicon remains unchanged.	Confirmation of the important assumptions	Policy-related documents Opinions of persons concerned	Development policy documents Results of interview	Document review Interview
		Whether there is any other external factors	Confirmation of external factors			
	What are hindering and contributing factors for the achievement of the Project purpose	What are factors that affect positively or negatively to the possibility of sustainable expansion of solar breeder (Solar silicon factory + Si photovoltaic power plant)?	Analysis of the possibilities of sustainable expansion of solar breeders. Type and quality of assistance (Si reduction process, plant setting, performance test of solar battery superconducting cable)	Actual achievement of the Project	Progress Report, Related reports including papers Results of interview	Document review Interview
		What are hindering and contributing factors for forming a basis of human resource development of solar breeder?	Relational analysis of the hindering/contributing factors and the content of the assistances of the Project			
		Whether there is any other hindering and contributing factors	The presence of hindering and contributing factors for			

			achievement of the Project purpose			

Efficiency

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
	Main Question	Sub-question				
The achievement of the outputs	The level of outputs in relation to the inputs	Whether outputs are achieved. If not, what are reasons?	Comparison between achievement and plan	The degree of the achievement of the plan, timing Opinions of persons concerned	Progress Report Results of interview	Document review Interview
		Appropriateness of the level of target value of indicators	Appropriateness of the target level of the indicators	The degree of the achievement at present Causal relation to the project purpose		
Causal relation	Are activities enough to generate Outputs?	Are activities enough to generate Outputs?	Analysis on relation between activities and outputs	Opinions of persons concerned	Progress Report Results of interview	Document review Interview
	Whether Inputs were/are appropriate, considering the achieved outputs	Whether the following Inputs were/are appropriate; The number, expertise, timing and dispatch duration of Japanese experts.	Confirmation of the appropriateness	Actual dispatch of Japanese experts Opinions of persons concerned	Progress Report Related documents Results of interview	Document review Interview
		Whether the following Inputs were/are appropriate; Specification, type, quantity, timing of installation of equipment	Confirmation of the appropriateness	List of equipment delivered Opinions of persons concerned		
		Whether the following Inputs were/are appropriate; The number of participants, qualification, area, content, duration, timing of training in Japan/Algeria	Confirmation of the appropriateness	Actual number of trainees Opinions of persons concerned		
		Whether the following Inputs were/are appropriate; The number, allocation status and capacities of C/P staff of Algeria	Confirmation of the appropriateness	The status of allocation of C/P staff Opinions of persons concerned		
		Whether the following Inputs were/are appropriate; Operational costs from Japan	Confirmation of the appropriateness	Actual operational costs Opinions of parties		

				concerned		
		Whether the following Inputs were/are appropriate; Budget allocation from Algeria	Confirmation of the appropriateness	Actual project expenses Opinions of persons concerned		
Other factors that affect efficiency	Utilization of local resources	Whether the Project utilize the existing organizations, facilities and so on.	Confirmation of the utilization status	Progress Report Opinions of persons concerned	Progress Report related documents Results of interview	Document review Interview
		Whether the Project utilize the outcomes of the past relevant projects	Confirmation of the utilization status			
	Whether there is any other factors that affect efficiency		Whether there is any hindering or contributing factors			

Impact

Evaluation Items	Evaluation Question	Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
Unintended effects	Is there any positive and negative effects?	Check if there is any positive and negative effect	Opinions of persons concerned	Parties concerned	Questionnaire Interview
	Is there any positive and negative effect due to issues such as gender, environment, human rights, poverty, ethnicity, socio-economic status?		Assumed effects, impacts (gender, human rights, environment, etc.), measures against the assumed negative impacts		

Sustainability

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
	Main Question	Sub-question				
Policy and Institutional Aspects	Is there a high possibility for continuation of the policy support after the end of the Project?		Check if it is highly likely that the policy continuously supports the activities after the termination of the Project.	Plans at policy level, strategies	Progress Reports Related documents Interview results	Document review Interview
Organizational Aspects	Implementation and cooperation systems are likely to be maintained after the end of the Project? Is there any gap between the roles in the Project and the roles and functions of the implementation organizations?		Analysis of the prospect based on the current situations and issues.	Organizational structures of organizations concerned Opinions of persons concerned		
Financial Aspects	Is the budget for the project activities secured? What is the future plan for that?		Check if the budget for the project activities is secured.	Financial situations Opinions of persons concerned		
Technical Aspects	Have the capacities of USTO, Saida University, CDER Adrar been strengthened enough so that they are able to continue their activities after the end of the Project?		Check the degree of understanding, the current issues and measures for them.	Opinions of persons concerned		
Society, Culture, and Environmental Aspects	Is there any possibility which obstructs Sustainability due to lack of attention to society, culture, and environmental aspects?		If the Project gives an attention to vulnerable groups.	Opinions of persons concerned		

Others

Evaluation Items	Evaluation Question		Basis for Judgment & Method	Data Required	Data Sources	Data Collection Method
	Main Question	Sub-question				
Point to consider until the completion of the project	Necessity to review contents of input, activity and output.			Related information	PDM Progress Reports Interview results	
	What are points to consider until the completion of the project?				Progress Report Related documents Interview results	

Annex-3 : Plan of Operation (PO)

	Activities	Target FY of Japan	Schedule (from MM/2010 to MM/2015)																				Venue	Responsibility		Inputs	
			FY2011				FY2012				FY2013				FY2014				FY2015					Algerian side	Japanese side	Item	Institution
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4					
1	To develop Si reduction process not from the widely used silica stone but from abundant sand in the desert by designing new thermodynamics for Si production	Output 1																									
1-1	To design thermodynamics for Si production process																						J	-	Dr Kurosawa Dr Maeda Dr Hashimoto	-	-
1-2	Purification of sands from the desert																						J&A	Prof Saad Hamitaouc* Dr Mokhtar Zerdali Dr Tewfik Sahraoui Dr Mohamed Adnane	Dr Kurosawa Dr Hanada Dr Hakai Dr Suzuya Dr Matsuura Dr Tsubouchi	SEM-EDX ICP AFM DI water generator Ball mill	USTO
1-3	To develop Si reduction techniques from the sands (SiO_2) in the desert (*solely in Japan)																						J	-	Dr Furuya Dr Sato Dr Kamimoto Dr Saka Dr Nagata Dr Hayashi Dr Tsubouchi	-	-
2	To construct a Si production test plant from sand and to establish Si reduction process in Algeria	Output 2																									
2-1	To have the reduction apparatus in Japan																						J	-	Dr Furuya Dr Sato Dr Kamimoto Dr Saka Dr Nagata Dr Hayashi Dr Tsubouchi	Reduction apparatus	Himeji Univ → USTO
2-2	To set up the reduction apparatus in Algeria																						A	Prof Saad Hamitaouc* Dr Mokhtar Zerdali Dr Tewfik Sahraoui Dr Mohamed Adnane	Dr Furuya Dr Sato Dr Kamimoto Dr Saka Dr Nagata Dr Hayashi Dr Tsubouchi	Reduction apparatus	Himeji Univ → USTO
2-3	To establish the Si reduction process in Algeria																						A		Dr Furuya Dr Sato Dr Kamimoto Dr Saka Dr Nagata Dr Hayashi Dr Tsubouchi	Reduction apparatus	USTO
3	To find problems and solutions in the use of solar cells in the desert by accumulating quantitative data about cell performance such as efficiency and reliability and to find new applications of solar energy in this area	Output 3																									
3-1	To get and set up solar panels																						A	Prof Samir Flazi* Dr Abdallah Mekaka Dr Aimine Daoud Dr Mohamed	Dr Kurokawa Dr Otsuki	Solar panels	UNPO,Saida
3-2	To collect the data and to find problems and solutions																						A	Dr Ali Nasri* Prof Yahia Meddad Dr Salim Bettahar Dr Abdallah Mekaka Dr Aimine Daoud Dr Mohamed Mostefai Dr Mohamed Djeroui Dr Mohamed Salah	Dr Kurokawa Dr Otsuki	Solar panels	USTO
3-3	To find applications																						A	Dr Salim Bettahar Dr Aimine Daoud Dr Mohamed Mostefai Prof Yahia Meloui Dr Abdallah Mekaka Dr Ali Nasri	Dr Kurokawa Dr Otsuki	-	USTO,Saida
4	To point out problems with operation of high Tc superconducting cable system and to find out solutions for them	Output 4																									
4-1	To get and set up measurement system																						A	Prof Samir Flazi* Dr Salim Bettahar Prof Yahia Meloui Dr Abdallah Mekaka Dr Mohamed Mostefai	Dr Yamaguchi Dr Shimojima Dr Kanehara Dr Hamabe	Weather-monitoring system.	USTO,Saida
4-2	To collect and analyze data																						A	Prof Samir Flazi* Dr Salim Bettahar Prof Yahia Meloui Dr Abdallah Mekaka Dr Mohamed Mostefai	Dr Yamaguchi Dr Shimojima Dr Kanehara Dr Kawabe	Weather monitoring system	USTO,Saida
5	To establish bases for energy engineering education in the Africa area and to perform remote education by complex education system with the use of WebELS system which was developed in Japan	Output 5																									
5-1	To establish infra-structure for the use of WebELS system and to educate instructors in Algeria																						A	Dr Zerouaya Khiat* Dr Fatima Benbrahim Dr Zahraf Ahmed Mr. Mostapha	Dr Ueno Dr Tavena	Server and testing system	USTO
5-2	To support the research works in SSEHC at USTO and to educate engineers in the field of global energy by the use of WebELS																						J&A	All Members and Dr Soltana Daoud	Dr Kawano Dr Kurokawa Dr Furuya Dr Sato Dr Ueno Dr Higuchi Dr Hachimaki Dr Suzuya Dr Saka	Server and testing system.	USTO,Saida
6	Organizing Annual Sahara Solar Energy Workshop alternately in Japan and Algeria	Output 6																					J&A	All Members	Dr Kawano Dr Kurokawa Dr Furuya Dr Sato Dr Ueno Dr Tavena Dr Hachimaki Dr Suzuya Dr Saka Mr Matsuura	-	USTO,Saida

J :Japan
A :Algeria

Annex-4 : Inputs for the project

(1)List of Japanese Researcher dispatched

No.	Name	Office affiliated
1	Dr. Hideomi Koinuma	The University of Tokyo (Leader of the Japanese Expert Team/ Research Director)
2	Dr. Hiroshi Fujioka	The University of Tokyo
3	Dr. Kosuke Kurokawa	Tokyo Institute of Technology
4	Dr. Haruki Ueno	National Institute of Informatics
5	Dr. Yasubumi Furuya	Hirosaki University
6	Dr. Hiroyuki Sato	Hirosaki University
7	Dr. Takashi Matsuura	University College London
8	Dr. Masatomo Sumiya	National Institute for Materials Science
9	Dr. Takuya Hashimoto	Nihon University
10	Dr. Sataro Yamaguchi	Chubu University
11	Dr. Junichi Shimoyama	The University of Tokyo
12	Mr. Yojiro Kitamura	Institute for Arab Economics Research
13	Dr. Kenji Itaka	Hirosaki University
14	Dr. Masayuki Kamimoto	Hirosaki University
15	Dr. Izumi Nakai	Tokyo University of Science
16	Dr. Takashi Oozeki	Advanced Industrial Science and Technology
17	Dr. Toshio Kawahara	Chubu University
18	Dr. Makoto Hamabe	Chubu University
19	Dr. Kazuhiro Nagata	Tokyo University of the Arts***
20	Dr. Miyuki Hayashi	Tokyo Institute of Technology
21	Dr. Kenta Tsubouchi	The University of Tokyo
22	Dr. Arjuile John Berena	National Institute of Informatics
23	Dr. Kazuki Morita**	The University of Tokyo
24	Dr. Masayoshi Shimizu**	Shimizu Densetsu Kogyo Co., Ltd.
25	Dr. Jiro Momoi**	Chubu University

New entry persons**: Dr. Kazuki Morita, Dr. Masayoshi Shimizu, Dr. Jiro Momoi

Change of Affiliation***: Dr. Nagata; Tokyo Institute of Technology →Tokyo University of the Arts

Annex-4 : Inputs for the project

(2) Record of Japanese Researcher dispatched

Name of researcher	Date of Departure	Date of arrival	Period (Day)	Office affiliated	Job title	In charge
Hideomi KOINUMA	03/05/2011	12/05/2011	10	The University of Tokyo	Guest Professor	Leader Analysis of the raw materials of desert sand
Izumi NAKAI	04/05/2011	11/05/2011	8	Tokyo University of Science	Professor	Analysis of desert sand
Yojiro KITAMURA	03/05/2011	12/05/2011	10	Institute for Arab Economies research	Director General	industry-academia collaboration ; industry-university collaboration
Hideomi KOINUMA	09/11/2011	15/11/2011	7	The University of Tokyo	Guest Professor	Leader Analysis of the raw materials of desert sand
Yojiro KITAMURA	09/11/2011	03/12/2011	25	Institute for Arab Economies research	Institute of Head	Industry-academia collaboration ; industry-university collaboration
Takashi MATSUURA	09/11/2011	01/12/2011	23	University College London	Engineer	Research for clean device process
Hideomi KOINUMA	09/03/2012	21/03/2012	13	The University of Tokyo	Guest Professor	Leader Analysis of the raw materials of desert sand
Hiroshi FUJIOKA	09/03/2012	14/03/2012	6	The University of Tokyo	Professor	Research for basic properties of the solar cell element of silicon raw materials from the sand of desert
Kenji ITAKA	09/03/2012	17/03/2012	9	Hirosaki University	Associate Professor	Research for basic properties of the solar cell element of silicon raw materials from the sand of desert
Masatomo SUMIYA	13/05/2012	19/05/2012	7	National institute for Materials Science	Principal Researcher	Basic research of Si solar cell manufacturing process
Yojiro KITAMURA	13/05/2012	19/05/2012	7	Institute for Arab Economies research	Institute of Head	Industry-academia collaboration ; industry-university collaboration

Name of researcher	Date of Departure	Date of Arrival	Period (Day)	Office affiliated	Job title	In charge
Kenta TSUBOUCHI	13/05/2012	19/05/2012	7	The University of Tokyo	Project Researcher	Research and experiment on Si raw material supply from desert
Kenji ITAKA	13/05/2012	19/05/2012	7	Hirosaki University	Associate Professor	Research for basic properties of the solar cell element of silicon raw materials from the sand of desert
Izumi NAKAI	13/05/2012	18/05/2012	6	The University of Tokyo of	Professor	Analysis of the raw materials of desert sand
Makoto HAMABE	13/05/2012	20/05/2012	8	Chubu University	Associate Professor	Research of application to desert environment of superconducting DC transmission technology
Hideomi KOINUMA	13/05/2012	20/05/2012	8	The University of Tokyo	Guest Professor	Leader Analysis of the raw materials of desert sand
Hideomi KOINUMA	10/11/2012	17/11/2012	8	The University of Tokyo	Guest Professor	Leader Analysis of the raw materials of desert sand
Kenta TSUBOUCHI	09/11/2012	14/11/2012	6	The University of Tokyo	Project Researcher	Research and experiment on Si raw material supply from desert
Kenji ITAKA	09/11/2012	14/11/2012	6	Hirosaki University	Associate Professor	Research for basic properties of the solar cell element of silicon raw materials from the sand of desert
Yojiro KITAMURA	09/11/2012	18/11/2012	10	Institute for Arab Economies research	Institute of Head	Industry-academia collaboration ; industry-university collaboration
Satarou YAMAGUCHI	13/11/2012	24/11/2012	12	Chubu University	Professor	Research of application to desert environment of superconducting DC transmission technology

Name of researcher	Date of Departure	Date of arrival	Period (Day)	Office affiliated	Job title	In charge
Makoto HAMABE	21/09/2013	28/09/2013	8	Chubu University	Associate Professor	Research of application to desert environment of superconducting DC transmission technology
Masayoshi SHIMIZU	10/11/2013	23/11/2013	14	SEAVAC	President	High purity of silicon technology development
Hideomi KOINUMA	10/11/2013	23/11/2013	14	The University of Tokyo	Guest Professor	Leader Analysis of the raw materials of desert sand
Satarou YAMAGUCHI	14/11/2013	25/11/2013	12	Chubu University	Professor	Research of application to desert environment of superconducting DC transmission technology
Toshio KAWAHARA	14/11/2013	25/11/2013	12	Chubu University	Professor	Research of application to desert environment of superconducting DC transmission technology
Kousuke KUROKAWA	30/11/2013	10/12/2013	11	Tokyo Institute of Technology	Professor	Research and analysis of photovoltaic solar cells usage in desert environment
Takashi OOZEKI	30/11/2013	10/12/2013	11	National Institute of Advanced Industrial Science and Technology	Senior researcher	Review and analysis of photovoltaic solar cells use in the desert environment
Masayoshi SHIMIZU	19/01/2014	25/01/2014	7	Shimizu Densetsu Kogyo	President	High purity of silicon technology development
Kenta TSUBOUCHI	19/01/2014	25/01/2014	7	The University of Tokyo	Project Researcher	Research and experiment on Si raw material supply from desert
Total days of dispatching			299			

Annex-4 : Inputs for the project
(3) Training in Japan

Name	Office affiliated	Title	Place of training	Field of training	Date started	Date ended	Duration
Boudgene Stambouli Amine	USTO	Professor	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	Local PV Application	17/08/11	28/08/11	12
Benharrats Nassira	USTO	Vice Rector	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	Material chemistry	17/08/11	28/08/11	12
Flazi Samir	USTO	Professor	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	Grid connection and HTcSC	17/08/11	28/08/11	12
Zerdali Mokhtar	USTO	Lecturer	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	SOG-Si research	17/08/11	28/08/11	12
Bettahar Salim	USTO	Lecturer	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	Local PV Application	17/08/11	28/08/11	12
Khiat Zekuiya	USTO	Lecturer	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	WEB-ELS and PV system	17/08/11	28/08/11	12
Miloud Yahia	Saida University	Professor	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	Local PV Application	17/08/11	28/08/11	12
Draou Mohamed	CDER, Adrar	Lecturer	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	PV system	17/08/11	28/08/11	12

Name	Office affiliated	Title	Titre of training	Field of training	Date started	Date ended	Duration
Habib Zahmani Abdeldjelil	USTO	Lecturer	Mega-solar in Hokuto City, NIMS, The University of Tokyo Kashiwa Campus, Institute of Industrial Science, the University of Tokyo, 1st AASEF, Chubu University, Center of Applied Superconductivity and	PV system	17/08/11	28/08/11	12
Osamnia Mohomed	USTO	Lecturer	National Institute of Informatics	WEB-ELS	15/01/12	17/03/12	63
Cheuki Zegadi	USTO	Ph.D	The University of Tokyo Kashiwa Campus, NIMS, Experiment Facility, Shimizu Densetsu Kogyo Co., Ltd.	Plasma Reduction	29/09/12	05/12/12	68
Tahril Ali	USTO	Lecturer	National Institute of Advanced Industrial Science and Technology (AIST)	PV system	29/09/12	05/12/12	68
Yaichi Mohamed Ben Tahar	URER-MS Adrar	Researcher	National Institute of Advanced Industrial Science and Technology (AIST)	PV system	29/09/12	05/12/12	68
Benghabrite Sihem	USTO	Ph.D	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Tokyo University of	Thermal Reduction/ Characterizati on	29/09/12	05/12/12	68
Mustapha Abdellatif	USTO	Master	National Institute of Informatics	WEB-ELS	29/09/12	05/12/12	68
Zahaf Ahmed	Saida University	Lecturer	National Institute of Informatics	WEB-ELS	29/09/12	05/12/12	68
Boudgene Stambouli Amine	USTO	Professor	The University of Tokyo Kashiwa Campus, NIMS, National Institute of Advanced Industrial Science and Technology (AIST), NII, Tokyo University of Science, North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, JST, The Embassy of Algeria, Hirosaki	Local PV Application	26/11/12	05/12/12	10
Kessas Rachid	USTO	Vice Rector	The University of Tokyo Kashiwa Campus, NIMS, National Institute of Advanced Industrial Science and Technology (AIST), NII, Tokyo University of Science, North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, JST, The Embassy of Algeria, Hirosaki	Material chemistry	26/11/12	05/12/12	10
Boudgene Stambouli Amine	USTO	Professor	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University	Local PV Application	03/05/13	10/05/13	8
Kessas Rachid	USTO	Vice Rector	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University	Material chemistry	03/05/13	10/05/13	8
Flazi Samir	USTO	Professor	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University	Grid connection and HTcSC	03/05/13	10/05/13	8
Hamzaoui Saad	USTO	Professor	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University,	SOG-Si research	03/05/13	10/05/13	8

Name	Office affiliation	Title	Place of training	Field of training	Date started	Date ended	Duration
Tahri Ali	USTO	Associate p	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University	PV system	03/05/13	10/05/13	8
Khiat Zekuiya	USTO	Lecturer	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University,	WEB-ELS and PV system	03/05/13	10/05/13	8
Miloud Yahia	USTO	Professor	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University	Local PV Appl	03/05/13	10/05/13	8
Hamouda Messaoud	URER-MS Adrar	Associate p	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University,	Local PV Appl	03/05/13	10/05/13	8
Yassaa Noureddine	CDER	Director	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Hirosaki University, AIST, NIMS	research and development in the fields of renewable energy	03/05/13	10/05/13	8
Boucetta Abderahmane	USTO	Master	Tokyo University, North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, NIMS	SOG-Si research	22/06/13	30/06/13	9
Benioub Rabie	USTO	Ph.D	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki	Thermal Reduction	31/08/13	06/11/13	68
Cherif Fillali	USTO	Ph.D	North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki	Thermal Reduction	31/08/13	06/11/13	68
Dahmani Fatima Zohra	USTO	Ph.D	The University of Tokyo Kashiwa Campus, NIMS	Sand Purification and Plasma Reduction	31/08/13	06/11/13	68
Medeghri Shahazed	USTO	Master	The University of Tokyo Kashiwa Campus, NIMS	Sand Purification and Plasma Reduction	31/08/13	06/11/13	68
Baba Ahamed Lives	USTO	Ph.D	Experiment Facility, Shimizu Densetsu Kogyo Co., Ltd.	Microwave Reduction	31/08/13	06/11/13	68
Fatima	USTO	Lecturer	National Institute of Informatics	WEB-ELS	31/08/13	06/11/13	68
Miloudi Abdallah	Saida University	Professor	Chubu University, Center of Applied Superconductivity and Sustainable Energy Research(CASER)	Superconductivity	31/08/13	06/11/13	68
Hamzaoui Saad	USTO	Professor	Shimizu Densetsu Kogyo Co., Ltd., North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Toei Scientific	SOG-Si research	24/01/14	01/02/14	9
Zerdali Mokhtar	USTO	Lecturer	Shimizu Densetsu Kogyo Co., Ltd., North Japan Research Institute for Sustainable Energy(NJRISE), Hirosaki University, Toei Scientific	SOG-Si research	24/01/14	01/02/14	9

Annex-4 : Inputs for the project

(4) Local cost by Japanses side

For	Amount of expense
Bank Charge	6,947
Air fair (Oran - Alger)	7,345
International mail	6,300
Car rental	44,000
Card printing	1,000
Travel expense	19,200
Car rental	29,835
Car rental	28,080
Prepaid Card for mobile phone	19,000
Car rental	27,000
Appurtenances for the project office	2,685
Air fair (Oran - Alger)	3,683
Card printing	1,600
Appurtenances for the project office	55,320
Appurtenances for the project office	6,695
Appurtenances for the project office	49,000
Appurtenances for the project office	28,500
Car rental	15,795
Travel expense	19,200
Car rental	17,000
Car rental	29,000
Prepaid Card for mobile phone	31,200
Cost for security	214,300
Air fair (Oran - Alger)	14,690
International mail	7,450
Travel expense	16,012
Car rental	15,795
International mail	15,216
Appurtenances for the project office	26,350
Car rental	10,530
Travel expense	3,127
Air fair (Oran - Alger)	7,345
Travel expense	15,418
Car rental	10,530
International air fare	286,446
Car rental	32,000
Expense for communication	22,200
Car rental	35,100
Appurtenances for the project office	14,450
Printing of pamplet	70,000
Air fair (Oran - Alger)	7,344
Travel expense	15,585
International mail	21,113
Appurtenances for the project office	9,454
Car rental	21,500
Air fair (Oran - Alger)	7,344
International mail	7,048
Travel expense	15,817
Car rental	140,400

For	Amount of expense
Car rental	11,000
Travel expense	28,504
Appurtenances for the project office	718
Car rental	2,500
Appurtenances for the project office	34,387
Car rental	9,000
Travel expense	3,148
Expense for communication	15,300
Air fair (Oran - Alger)	22,052.00
Travel expense for C/P	14,243
Car rental	26,325
Car rental	20,000
Car rental	10,530
Travel expense	27,697
Travel expense	14,528
Travel expense	14,528
Travel expense	3,033
Car rental	15,795
Car rental	22,500
International mail	7,169
Expense for communication	9,200
Appurtenances for the project office	600
Appurtenances for the project office	5,600
Air fair (Oran - Alger)	3,682
Travel expense	63,310
Car rental	38,000
Appurtenances for the project office	1,600
Car rental	210,600.00
Car rental	26,500
Car rental	17,550
Travel expense	26,182
Appurtenances for the project office	4,070
Expense for communication	6,800
Car rental	15,000
Car rental	20,050
Travel expense	2,875
Car rental	4,000
Appurtenances for the project office	1,185
Expense for communication	7,800
Expense for communication	15,446
Car rental	6,000
Expense for communication	6,000
Printer Tonar	4,000
Appurtenances for the project office	1,920
Car rental	4,000
Total	2,315,876

Annex-5 : Input for the project (Algerian side)

(1) Counterpart list

No.	Project Position	Name	Organization
1	Project Director	Mr. A. Saidani	Director of Cooperation and Inter-Universities Exchanges,
2	Project Manager	Prof. A. Derdour	Rector of USTO-MB
3	Deputy Project Manager for Research	Prof. A. B. Stambouli	USTO-MB
4	Deputy Project Manager for Monitoring of Project Management	Dr. R. Kessas	Vice Rector in charge of External Relations and Cooperation, USTO-MB
5	Deputy Project Manager for Coordination	Prof. R. Bouamrane	Vice Rector in charge of Research and Post-graduation, USTO-MB
6	Deputy Project Manager for Logistics	Prof. A. Kaddour	Dean of Electrical Engineering Faculty, USTO-MB
7	C/P in the field of SOG-Si research	Prof. S. Hamzaoui*	USTO-MB
8	C/P in the field of SOG-Si research	Dr. M. Zerdali	USTO-MB
9	C/P in the field of SOG-Si research	Prof. T. Sahraoui	USTO-MB
10	C/P in the field of SOG-Si research	Dr. M. Adnane	USTO-MB
11	C/P in the field of PV system	Dr. A. Tahri*	USTO-MB
12	C/P in the field of PV system	Dr. A. Daoud	USTO-MB
13	C/P in the field of PV system	Dr. S. Battahar	USTO-MB
14	C/P in the field of PV system	Dr. M. Draou	URER-MS
15	C/P in the field of PV system	Dr. M. Sadok	URER-MS
16	C/P in the field of PV system	Dr. A. Mehdaoui	URER-MS
17	C/P in the field of PV system	Dr M. Hamouda	URER-MS
18	C/P in the field of PV system	M. Yaichi **	URER-MS
19	C/P in the field of PV system	Prof. Y. Miloud	Saida Univ.
20	C/P in the field of PV system	Dr. A. Miloudi	Saida Univ.
21	C/P in the field of PV system	Dr. M. Mostefai	Saida Univ.
22	C/P in the field of Feasibility study for grid connection	Prof. S. Flazi *	USTO-MB
23	C/P in the field of Feasibility study for grid connection	Dr. M. Draou	USTO-MB
24	C/P in the field of Feasibility study for grid connection	Prof. Y. Miloud	Saida Univ.
25	C/P in the field of Feasibility study for grid connection	Dr. M. Mostefai	Saida Univ.
26	C/P in the field of Local PV application and others	Prof. S. Flazi*	USTO-MB
27	C/P in the field of Local PV application and others	Prof. Y. Miloud	Saida Univ.
28	C/P in the field of Local PV application and others	Dr. A. Miloudi	Saida Univ.
29	C/P in the field of Local PV application and others	Dr. M. Mostefai	Saida Univ.

30	C/P in the field of Local PV application and others	Dr. M. Draou	URER-MS
31	C/P in the field of Local PV application and others	Dr. M. Hamouda	URER-MS
32	C/P in the field of WebELS	Dr. Zekuiya Khiat	USTO-MB
33	C/P in the field of WebELS	Dr. Fatima Bendella*	USTO-MB
34	C/P in the field of WebELS	Dr. Zahaf Ahmed**	Saida Univ.
35	C/P in the field of WebELS	Mr. Mustapha Abdelatif	USTO-MB
36	Economist	Dr Soltana Daoud	USTO-MB

* Team responsible and contact person
Resigned persons: Rahli Mostepha, Della Mohamed and Benasla Lahouaria
Dismissed person: Abdeljelil Habib Zahmani
New entry persons**: Zahaf Ahmed and Yaichi mohammed
PhD students: Siham benghabrit and Choucki Zegadi
New PhD course students (related to SSB project and headed by Prof. Flazi):

SI ALI Mokhtaria, FERGANI Ouanassa Samia, CHERFI Mohamed, BENIOUB Rabie, BEKKAR DJELLOUL SAIH Saiah, BEN AHMED DAHO Mounaim, AMEUR Abdelkader and DAHMANI Fatima Zohra.

Annex-5 : Input for the project (Algerian side)
(2) Local expense

Item	Contents of expense	Amount of cost	Remarks
Equipment transport cost and travel expense	Equipment transport cost to Saida University and installation cost related to WebELS.	100,000DA	Travel expense for equipment installation. From USTO to Saida University.
Academic meeting expenses	Fund support to 2nd AASEF	1,000,000DA	Held in Oran in May, 2012(for Saida University).
Travel expenses	Participation cost to Enersol-WSEF	200,000DA	For 3 persons. Held in Tunis in November, 2012.
Travel expenses	Participation to ICESD13	115,000DA	For 6 persons. Held in Adrar in February, 2013.
Travel expenses	Travel expense for C/P of CDER Adrar visiting	100,000DA	5time per year for one person
Travel expenses	CP travel expenses applied to the superconducting & PV	550,000DA	University of Saida Sep.-Dec, 2013, Jan, 2014
Travel expenses	Travel expense for C/P of CDER Adrar visiting	40,000DA	For 1 persons. 2 times per year
Travel expenses	For Algerian CP transport in Algeria	22,500DA	For Business Trip(Oran-Algiers)
Travel expenses	For Algerian CP transport in Algeria	1,000DA	Research Trip (Oran-Sig)
Repair expense	For RX inverter repair	45,000DA	Reduction of silica
	Total Amount	**1,515,000DA**	

Annex-5 : Input for the project (Algerian side)

(3) Local expense for equipment installation work (including procurement of equipment)

Name of Equipment	Installation place	Date of equipment	Amount
Installation for WebELS room(internet line)	USTO	25/09/12	2,500,000DA
Equipment for WebELS room(procurement for other apparatus)	USTO	25/09/12	760,149DA
Equipment for WebELS room(meeting tables and	USTO	01/11/12	85,000DA
Equipment for WebELS room	Saida University	29/07/12	500,000DA
Equipment for PV panels and weather monitoring laboratory	Saida University	28/02/13	100,000DA
Land provision of 1000m2	Saida University	14/01/12	1,000,000DA
Installation of Deionized water installment	USTO	05/03/13	1,400,000DA
Preparation for electron microscope room	USTO	03/2013	
Test reagent and others	USTO	04/03/13	50,000DA
Microwave oven	USTO	30/11/12	15,000DA
Installation of PC for Electrical engineering	USTO	01/11/2013	620,000DA
Electrical Engineering Laboratory	USTO	01/11/2013	200,000DA
Installation of ADSL Line for WebELS (for half year)	USTO	12/02/2014	235,512DA
PV Systems Laboratory Improvement Air conditioning installation	Saida University	01/12/2013	180,000 DA
PV system installation frame	Saida University	09/12/2013	120,000 DA
Installation of Fence for the PV system	Saida University	17/02/2014	500,000 DA
Reagent purchase for experimentation	USTO	01/07/2013	100,000DA
Improvement of AFM, SEM microscope room	USTO	25/10/2013	1,733,109DA
		Total Amount	**6,410,149DA**
Procurement of equipment			
Diffractometer	USTO	11/2014	400,000,000DA

Annex-6 Output (List of literature under the project)

No.	Title	Author	Year	Journal title
1.	*"Trends and Challenges of Sustainable Energy and Water Research in North Africa: Sahara Solar Breeder Concerns at the Intersection of Energy/Water"*	A. Boudghene Stambouli, Z. Khiat, S. Flazi, H. Tanemoto, M. Nakajima, H. Isoda, F. Yokoyama, S. Hannachi, K. Kurokawa, 5, M. Shimizu, H. Koinuma and N. Yassaa	2014	Renewable & Sustainable Energy Reviews, Vol. 30C
2.	*"Sustainable development by Sahara solar breeder plan: energy from the desert of Algeria, a green energy dream grows in the Sahara"*	A.B. Stambouli, S. Flazi and H. Koinuma	March – April 2013	Journal of Optoelectronics and advanced Materials, Vol. 15, No.3 - 4
3.	*"SSBFI: Sahara Solar Breeder Foundation, International"*	Koinuma H, Fujioka H, Hannachi S, Kitamura Y, Shimizu M, Kurokawa K, Stambouli A.B.	NA	2AJAS Proc in press
4.	"Sahara solar breeder project"	Koinuma H, Tsubouchi K, Itaka K, Stambouli A	2013	McGraw-Hill Yearbook of Science and Technology, 2013
5.	"A review on the renewable energy development in Algeria: Current perspective, energy scenario and sustainability issues"	A. B. Stambouli, Z. Khiat, S. Flazi, and Y. Kitamura	2012	Renewable & Sustainable Energy Reviews, 16(7)
6.	*"A primary study on a long-term vision and strategy for the realisation and the development of the Sahara Solar Breeder project in Algeria"*	A. B. Stambouli, H. Koinuma	2012	Renewable & Sustainable Energy Reviews, 16(1)
(Japanese side)				
1.	*"Cloud-based Automated Authoring System to Support E-Learning in Higher Education Under Low-Speed Internet"*	Mohamed Osamnia, Sila Chunwijitra, Arjulie John Berena, Hitoshi Okada and Haruki Ueno	2014	Submitted to the International Conference On Future Trends In Information and Communication Engineering. FTICE 2014, Bangkok. Thailand
2.	*"A Cloud-Based Multi-functional e-Meeting System by Flash-Based Multimedia Technology for Higher Education on the WebELS System"*	Mohamed Osamnia, Sila Chunwijitra, Arjulie John Berena, Hitoshi Okada and Haruki Ueno	December 2013	Proceedings of the 14th Pacific-Rim Conference on Multimedia, DOI 10.
3.	*"WebELS: Enabling e-Learning in Higher Education over Low Bandwidth Environment"*	Arjulie John Berena, Sila Chunwijitra, Mohamed Osamnia, Hitoshi Okada, H. Ueno	2013	Proceedings of the 21st International Conference on Computers in Education (ICCE 2013)

4.	*"Realizing e-Learning in Higher Education over Low Bandwidth Environment"*	Arjulie John Berena, Sila Chunwijitra, Mohamed Osamnia, Hitoshi Okada, H. Ueno	2013	Proceedings of the First Asian Conference on Society, Education and Technology (ACSET) 2013
5.	*"An Advanced Cloud-Based e-Learning Platform for Higher Education for Low Speed Internet"*	Sila Chunwijitra	September , 2013	Ph.D thesis, Department of Informatics, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies (SOKENDAI)
6.	*"Video Embedded Synchronization to Support On-Line Presentation for Higher Education on the WebELS System"*	Mohamed Osamnia, Sila Chunwijitra, Arjulie John Berena, Hitoshi Okada and Haruki Ueno	September 2013	Proceedings of the 3rd International Conference on Education, Research and Innovation (ICERI) 2013, Brunei Darussalam
7.	*"Advanced Content Authoring and Viewing Tools Using Aggregated Video and Slide Synchronization by Key Marking for Web-Based e-Learning System in Higher Education"*	Sila Chunwijitra, Arjulie John Berena, Hitoshi Okada, Haruki Ueno	August 2013	ICE Transactions on Information and Systems, Vol.E96.D No. 8
8.	*"Automatic Adaptation of Streaming Data for WebELS Meeting for Low-Speed Internet"*	Mohamed Osamnia, Arjulie John Berena, Sila Chunwijitra, Hitoshi Okada, Haruki Ueno, Khiat Zekuia	June 2013	IEICE Technical Report on Service Computing, vol. 113, no. 86, SC2013-5
9.	*"Shared Virtual Presentation Board for e-Meeting on the WebELS Platform"*	Arjulie John Berena, Sila Chunwijitra, Hitoshi Okada, Haruki Ueno	April 2013	Human-centric Computing and Information Sciences, DOI 10
10.	*"Combinatorial Nanoscience and Technology for Solid-State Materials"*	H. Koinuma, R. Takahashi, M. Lippmaa, S. Jeong, Y. Matsumoto, T. Chikyo, and S. Suzuki	2013	Handbook of Advanced Ceramics Chapter 11.1.11
11.	*"Effect of hydrogen radical on decomposition of chlorosilane source gases"*	M. Sumiya, T. Akizuki, K. Itaka, M. Kubota, K. Tsubouchi, T. Ishigaki, and H. Koinuma	2013	J. of Phys. Conference Series 441
12.	*"Advanced Content Authoring and Viewing Tools Using Aggregated Video and Slide Synchronization by Key Marking for Web-Based e-Learning System in Higher Education"*	S. Chunwijitra, A. J. Berena, H.Okada, H. Ueno	2012	IEICE Transactions on Information and Systems
13.	*"Shared Virtual Presentation Board for e-Meeting in Higher Education on the WebELS Platform,"*	A. J. Berena, S. Chunwijitra, H.Okada, H. Ueno	2012	Human -Centric Computing and Information Sciences, a Springer Open Journal

14.	*"Large Tunnel Magnetoresistance in Epitaxial Oxide Spin-Filter Tunnel Junctions"*	Harada, T; Ohkubo, I; Lippmaa, M; Sakurai, Y; Matsumoto, Y; Muto, S; Koinuma, H; Oshima, M	2012	Advanced Functional Materials, 22(21)
15.	*"Development of a new laser heating system for thin film growth by chemical vapor deposition",*	Fujimoto, E; Sumiya, M; Ohnishi, T; Lippmaa, M; Takeguchi, M; Koinuma, H; Matsumoto, Y	2012	Review Of Scientific Instruments, 83(9)
16.	*"Spin-Filter Tunnel Junction with Matched Fermi Surfaces",*	Harada, T; Ohkubo, I; Lippmaa, M; Sakurai, Y; Matsumoto, Y; Muto, S; Koinuma, H; Oshima, M	2012	Physical Review Letters, 109(7)
17.	*"Authoring Tool for Video-based Content on WebELS Learning System to Support Higher Education"*	Sila Chunwijitra,Arjulie John Berena, Hitoshi Okada, Haruki Ueno	2012	JCSSE 2012, May
18.	*"Field-effect transistors of the block co-oligomers based on thiophene and pyridine"*	Haemori, M; Itaka, K; Yamaguchi, J; Kumagai, A; Yaginuma, S; Fukumoto, H; Matsumoto, Y; Yamamoto, T; Koinuma, H	2012	Thin Solid Films, 520(13)
19.	*"Strong ferromagnetism in Pt-coated ZnCoO: The role of interstitial hydrogen"*	Shin, JM; Lee, HS; Cha, SY; Lee, S; Kim, JY; Park, N; Cho, YC; Kim, SJ; Kim, SK; Bae, JS; Park, S; Cho, CR; Koinuma, H; Jeong, SY	2012	Applied Physics Letters, 100(17)
20.	*"A study of the correlation between hydrogen content and magnetism in ZnCoO"*	Seunghun Lee, Bum-Su Kim, Seung-Wan Seo, Yong Chan Cho, Sung Kyu Kim, Jong Pil Kim, Il-Kyung Jeong, Chae Ryong Cho, Chang Uk Jung, Hideomi Koinuma, Se-Young Jeong	2012	J. App. Phys, 111(7)
21.	*" Ferromagnetic spin ordering in amorphous Co-doped InGaZnO based on the Co-H-Co complex"*	Lee, S; Kim, WK; Cho, YC; Seo, SW; Bae, JS; Cho, CR; Koinuma, H; Jeong, SY	2012	Epl, 98(1)
22.	*"Conductive and ferromagnetic contributions of H in ZnCoO using H-2 hot isostatic pressure"*	Cho, YC; Lee, S; Nahm, HH; Kim, SJ; Park, CH; Lee, SY; Kim, SK; Cho, CR; Koinuma, H; Jeong, SY	2012	Applied Physics Letters, 100(11)
23.	*"Influence of substrates on epitaxial growth of B-site-ordered perovskite La(2)NiMnO(6) thin films"*	Y. Sakurai, I. Ohkubo, Y. Matsumoto, H. Koinuma, M. Oshima	2011	Journal of Applied Physics, 110(6)
24.	*"Stable high conductive amorphous InGaZnO driven by hydrogenation using hot isostatic pressing"*	W. K. Kim, S. Lee, Y. C. Cho, H. Koinuma, S. Y. Jeong, J. M. Shin, C. R. Cho, J. S. Bae, T. Y. Kim, S. Park	2011	Applied Physics Letters, 98(12)

25.	*"Communication: The reason why +c ZnO surface is less stable than -c ZnO surface: First-principles calculation"*	S. Ito, T. Shimazaki, M. Kubo, H. Koinuma, M. Sumiya	NA	NA
26.	*"Modulation of the ferromagnetic insulating phase in Pr(0.8)Ca(0.2)MnO(3) by Co substitution"*	T. Harada, I. Ohkubo, M. Lippmaa, Y. Matsumoto, M. Sumiya, H. Koinuma, M. Oshima	2011	Physica Status Solidi-Rapid Research Letters, 5(1)
27.	*"Design of Suitable Meeting Management Model for WebELS Meeting to Meet the Business Situations"*	Sila Chunwijitra, Arjulie John Berena, Hitoshi Okada, Haruki Ueno	2011	The First International Conference on Advanced Collaborative Networks, Systems and Applications (COLLA 2011)
28.	*"Authoring Tool based on Flash Technology for WebELS Learning System to Support Higher Education"*	Sila Chunwijitra, Arjulie John Berena, Hitoshi Okada, Haruki Ueno	2011	Technical Committee on Knowledge-based Software Engineering (KBSE)
29.	*"e-Meeting Solution for Higher Education on the WebELS Platform"*	A.J. Berena, S. Chunwijitra, H. Ueno, Z. He, P. Sriprasertsuk	November 29-December 2, 2011	Proceedings of the International Conference on Education, Informatics, and Cybernetics 2011, Orlando, Florida
30.	*"Shared Virtual Presentation Board for e-Meeting on the WebELS Platform"*	A.J. Berena, S. Chunwijitra, H. Okada, H. Ueno	NA	Springer Open Journal - Human-centric Computing and Information Sciences
31.	WebELS: A M-Learning System Based on WebELS System	Zheng He, Haruki Ueno	2011	The 4th International Conference on Computer Science and Software Engineering (CSSE 2011)
32.	Internet-based On-line Distribution of Conference by WebELS	Ueno, H., Berena, A.J., Sriprasertsuk, P.	2011	1st Asia-Arab Sustainable Energy Forum (AASEF)
33.	「グリーンAIの期待と課題－環境・エネルギーの視点から」	上野晴樹	2011	第２５回人工知能学会全国大会論文集
34.	「クラウド型汎用e-Learningシステム WebELSによる国際会議のオンライン配信実験と評価」	上野晴樹	November, 2011	信学技報, vol. 111, no. 316
35.	「地球を救う革新的材料技術―ゼロエクセルギー酸化物の化学とサハラソーラーブリーダー計画―」	鯉沼秀臣	November, 2011	未来材料
(Algeria)				
1.	*"Chapter 18 entitled: Study of Hybrid Sustainable Energy System Based on PEM Fuel Cells and Photovoltaic-Module Power Generator"*	F.Z. Zerhouni and A.B. Stambouli	June 2013.	Sustainable ICTs and Management Systems for Green Computing book

2.	"*Chapter 27 entitled: Modeling and Simulation of a Stand-Alone Hydrogen Photovoltaic Fuel Cell Hybrid System*"	T. Benmessaoud and AB. Stambouli	2014	Handbook of Research on Novel Soft Computing Intelligent Algorithms: Theory and Practical Applications, A volume in the Advances in Computational Intelligence and Robotics
3.	"*A practical design sliding mode controller for DC–DC converter based on control parameters optimization using assigned poles associate to genetic algorithm*"	M. Benssada and AB. Stambouli	2013	Electrical Power and Energy Systems
4.	"*Comparative study on performance of cubic AlxGa1−xN/GaN nanostructures MODFETs and MOS-MODFETs*"	D. Bouguenna and AB. Stambouli	2013	Superlattices and Microstructures , 62C
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