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ROOFTOP SOLAR (RTS) DEVELOPMENT Policy Interpretation and Market Analysis

USAID Vietnam Low Emission Energy Program
Duc Nguyen, Renewable Energy Advisor



CONTENT

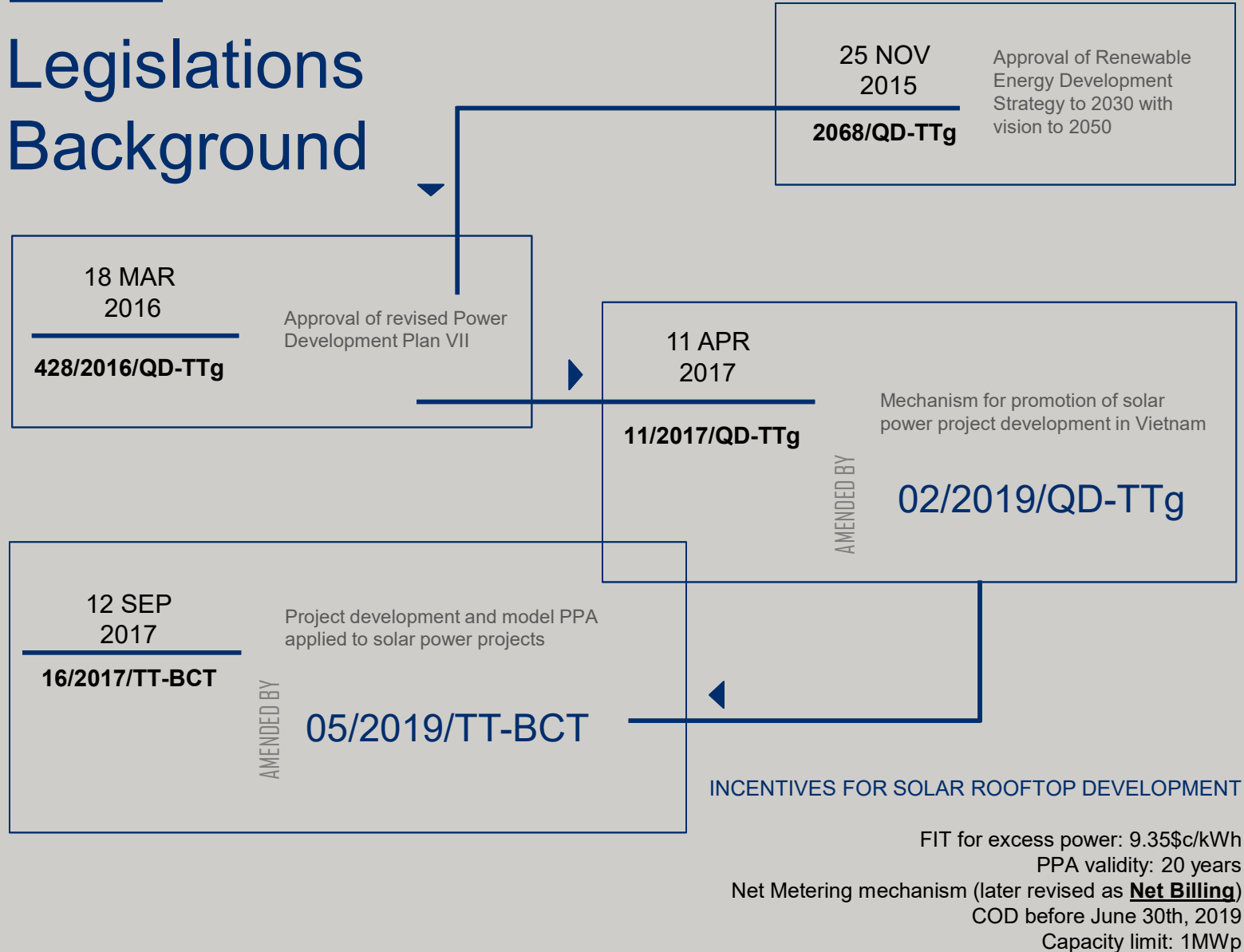
- **Section I. Background**
- **Section II. Decision 13 on Solar Development**
 - Decision Briefings
 - The Imperfections
- **Section III. Market Outlook**

ROOFTOP SOLAR (RTS) DEVELOPMENT Policy Interpretation and Market Analysis

Section I. BACKGROUND

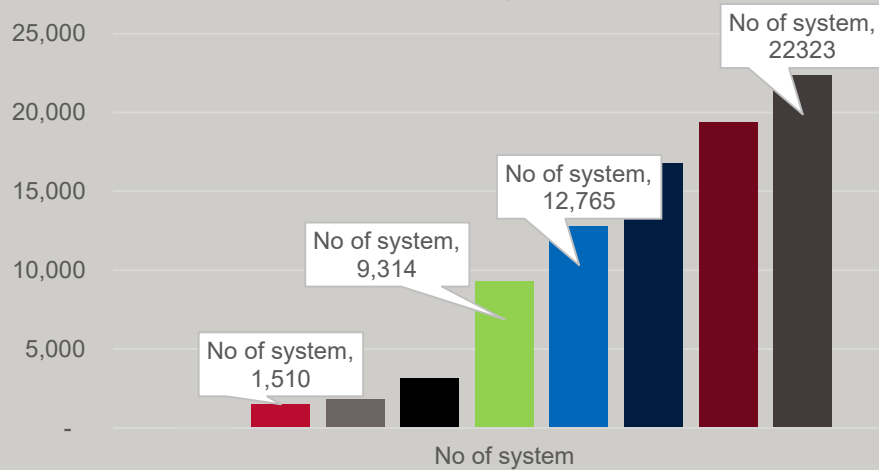


Legislations Background

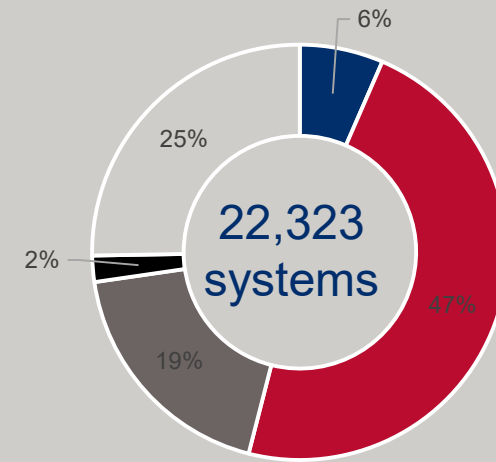


Market Achievement - 2019

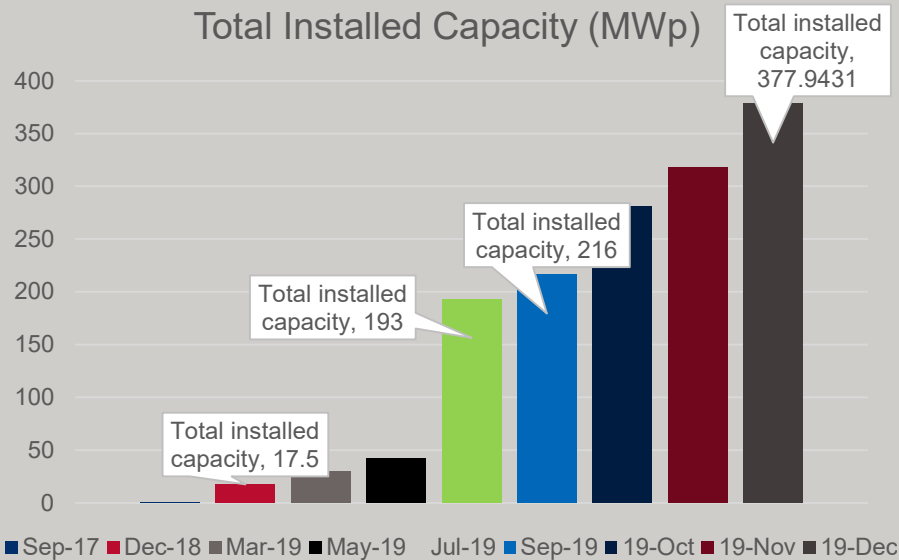
Total RTS system



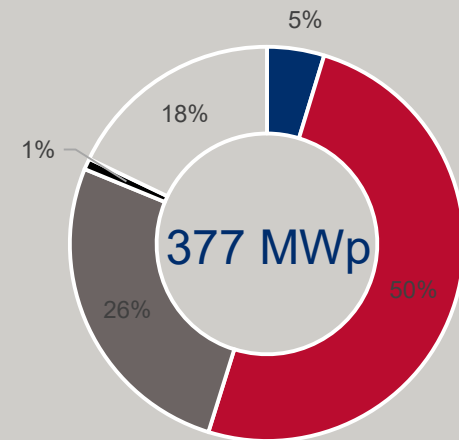
Total installed systems by location



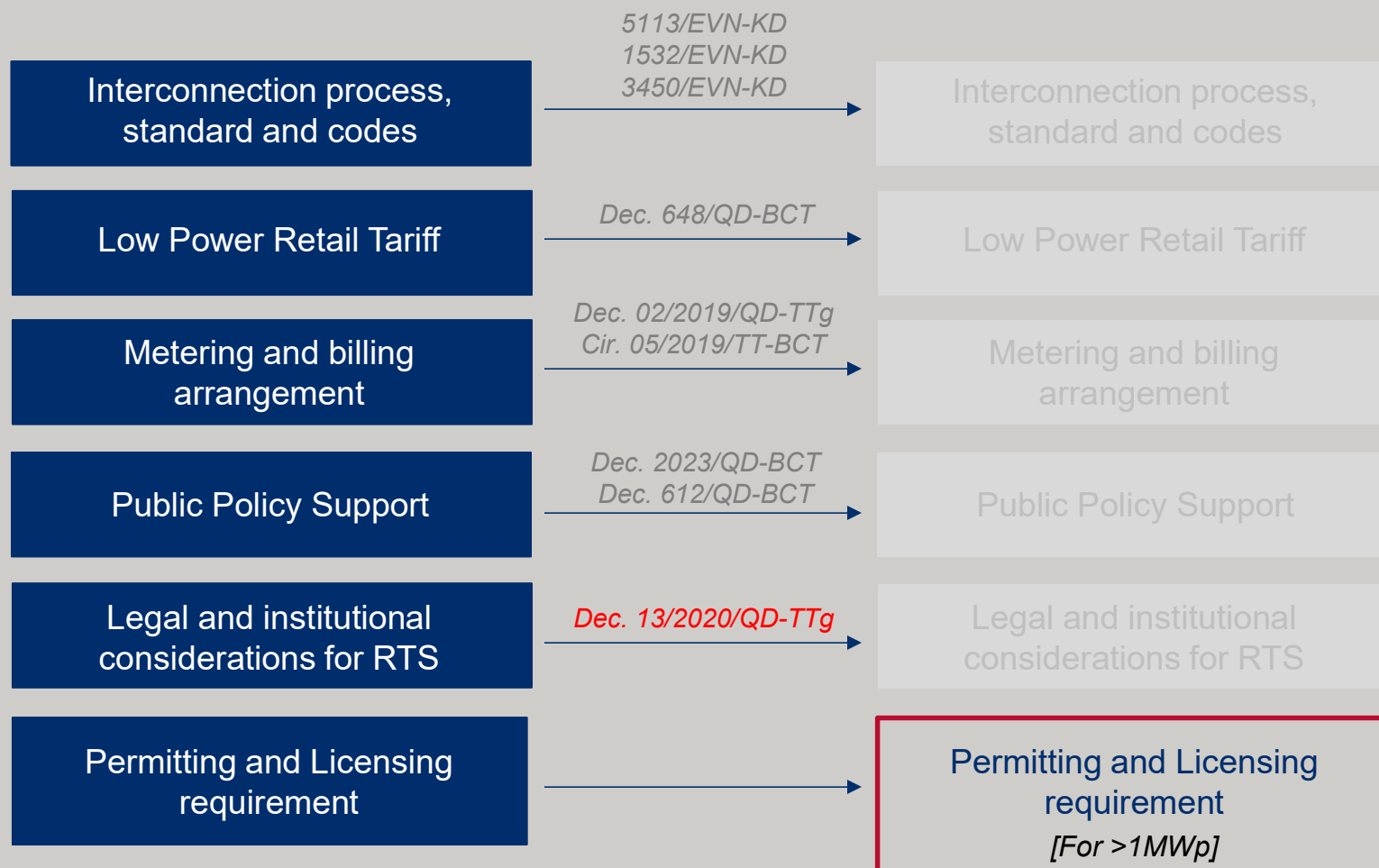
Total Installed Capacity (MWp)



Total installed capacity by location



Outstanding & Responsive Actions



Section II.

DECISION 13 ON SOLAR DEVELOPMENT



New Decision Briefings

1 unified nationwide FiT

Provide separate guidance and **new definition** of RTS

Allow **other electricity off-takers**

Allow **private PPA**

Net billing mechanism

Monthly payment

1 MWp

“speed bump”

One Unified Tariff

No.	Description	Tariff for Zone I	
		VND/ kWh	USc/ kWh
1	Ground mounted projects	1,620	7.09
2	Floating projects	1,758	7,69
3	Rooftop solar power projects	1,943	8.38

Note: Applied for projects sell excess power to EVN grid and achieve COD from 1/07/2019 until 31/12/2020

New definition of RTS

Rooftop solar power system means:

- A solar power system with photovoltaic panels
- Installed on the roofs of **civil works or industrial works (*)** and
- Has a capacity of **less than or equal to 1 MWp** and
- **Directly or indirectly** connected to Electricity purchaser with
- Connection **voltage of 35 kV or less.**

Note: Reference to Circular 03/2016/TT-BXD

New Definition of Electricity Off-taker

Electricity Off-takers:

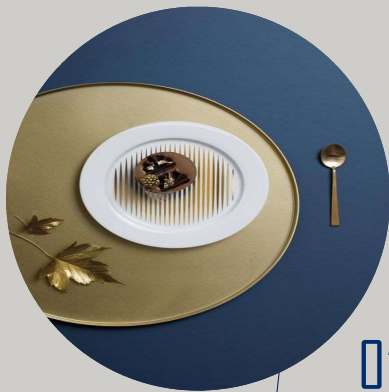
- *Purchaser means Electricity of Vietnam (EVN) or its authorized member unit or **an organization, individual buying electricity from the Electricity Seller** or an organization taking over the rights and obligations of the above-mentioned organizations as prescribed by law*
- *Seller means **an organization, individual operating in the field of solar power generation** or an organization, individual taking over the rights and obligations of the above organizations and individuals as prescribed by law.*

Open Business Model

Allow rooftop solar power system to:

- *Sell part or all of the electricity produced to the Purchaser being:*
 - *EVN **OR***
 - *An organization or other individuals in case of not using EVN grid*
- *Formally accept private B2B PPA*

The Imperfections



01. LOWER FIT

02. 1MWP THRESHOLD

03. LATE ISSUE DATE

04. SHORT EFFECTIVENESS

- Reduce readiness;
- Into another gold rush;
- Concern on system price;
- Concern on EPC quality/construction safety

Section III.

MARKET OUTLOOK



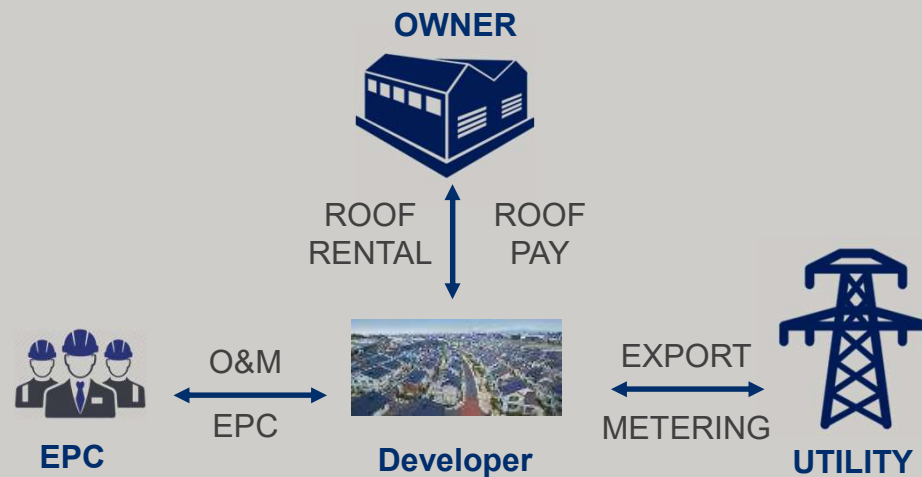
Conventional models

SELF-FINANCE



BANK LOANS

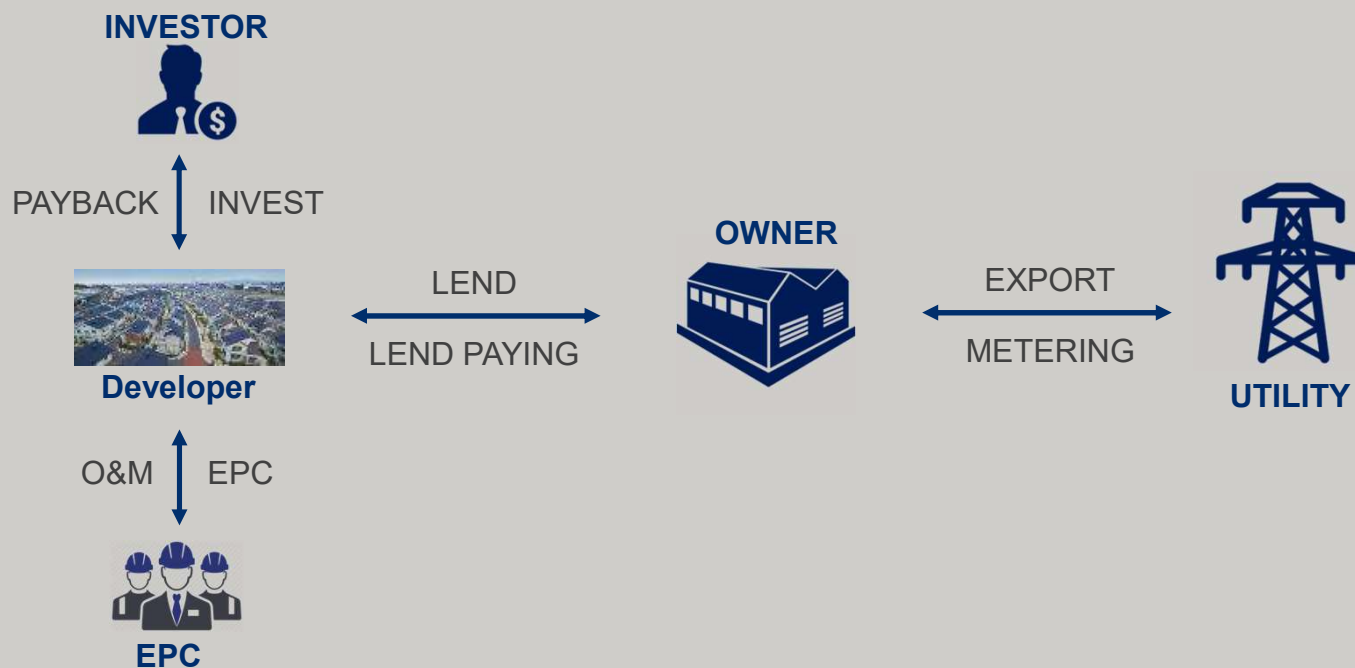
Modern Models | ROOF LEASE



DESCRIPTION

- The roof owner lease the roof to RTS developer and receive monthly payment
- RTS investor to invest, install, do O&M for the PV system and **sell all generated electricity to EVN**

Modern Models | **LEASING** Private PPA

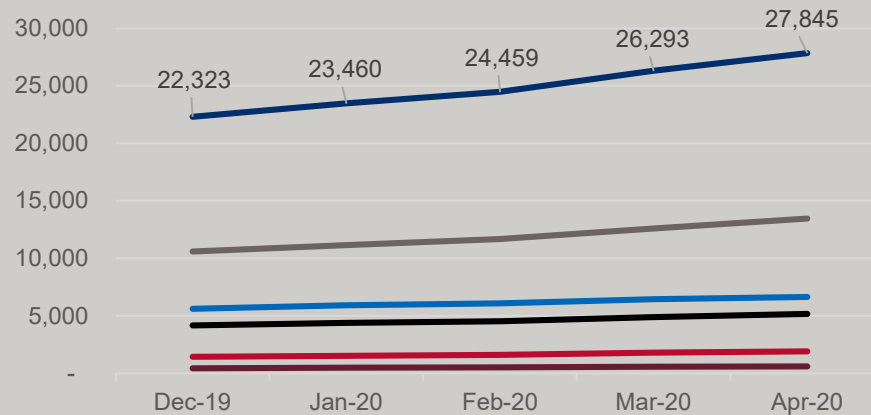


DESCRIPTION

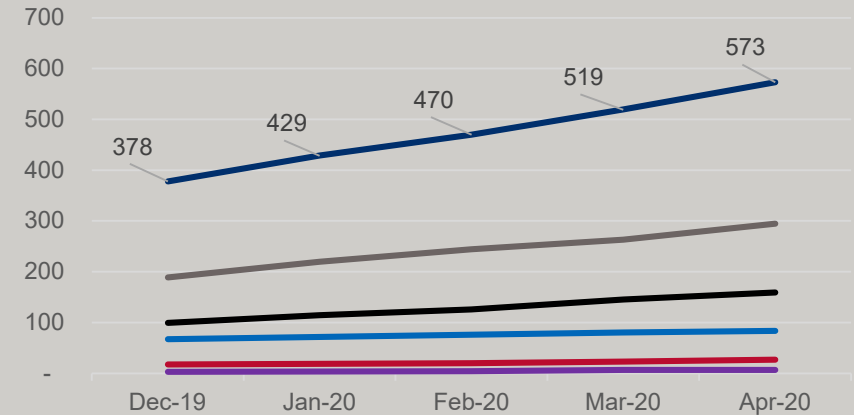
- RTS investor to invest, install, do O&M for the PV system, **sell all or part of generated electricity to the roof Owner** and remaining electricity to EVN (if any).
- The payment scheme between RTS investors and roof Owner is negotiated through private PPA.
- For excess power sold to EVN (if any), standardized PPA will applied.

RTS Market Outlook - YTD

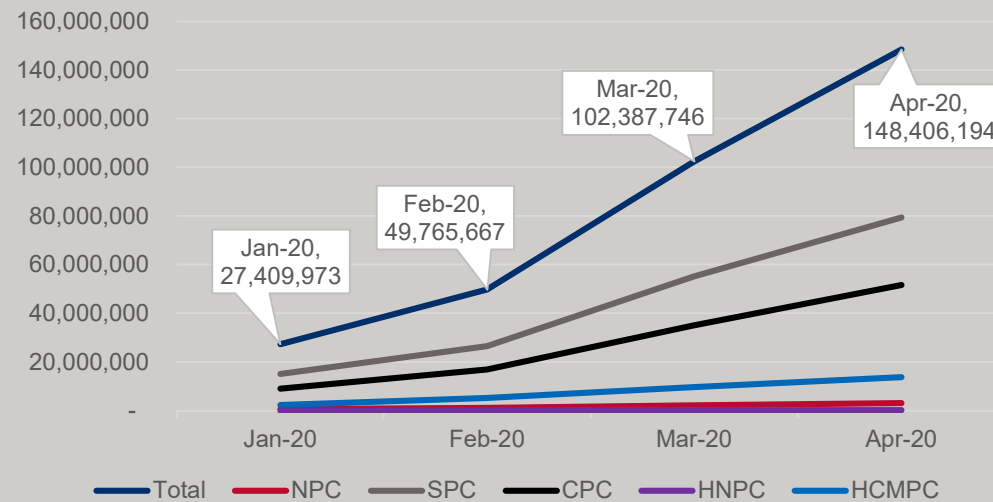
Total RTS Systems



Total Installed Capacity (MWp)

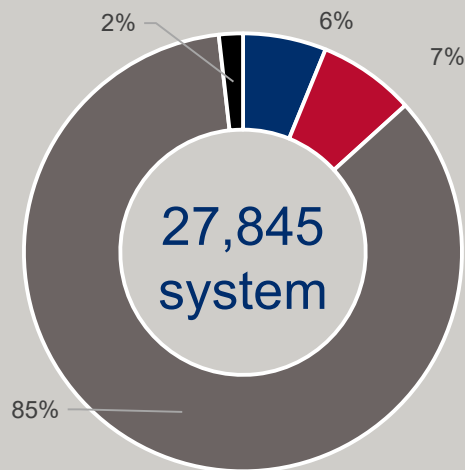


Cumulative generated capacity (kWh) - YTD

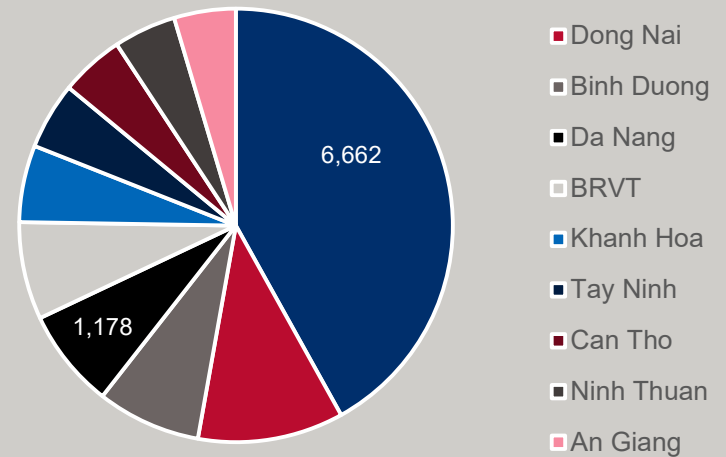


RTS Market Outlook – YTD

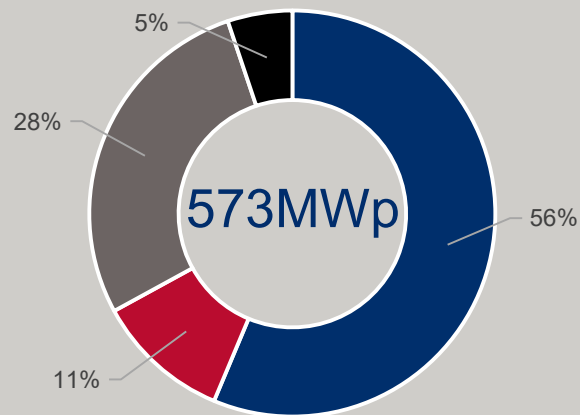
RTS System by Segments



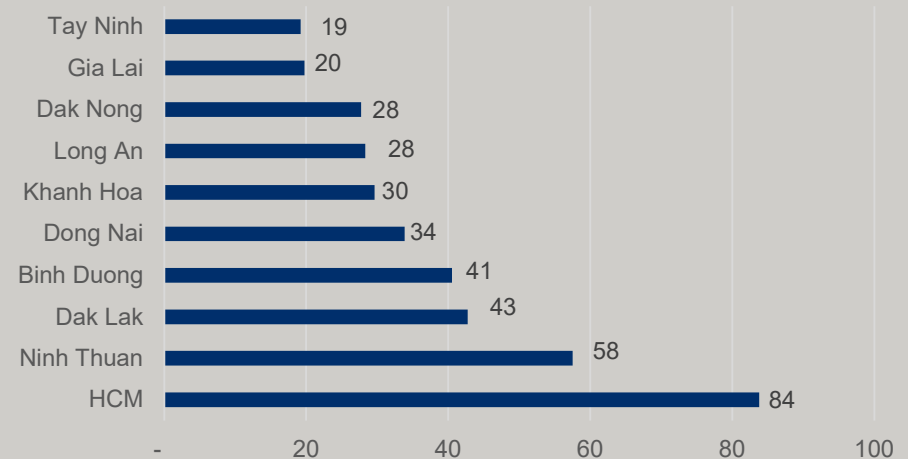
Top Installations by cities



Installed Capacity by Segments



Top installed capacity by cities (MWp)



■ Industrial ■ Commercial ■ Residential ■ Administrative



THANK YOU

USAID Vietnam Low Emission Energy Program

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Q&A

- 1. Prediction of FiT extension?*
- 2. Is rooftop solar applicable for DPPA?*
- 3. Regarding rooftop solar which has capacity of more than 1MW, is the project allowable under Vietnam legal law, or any permitting process?*
- 4. How will the COVID-19 impact the solar power especially rooftop solar?*

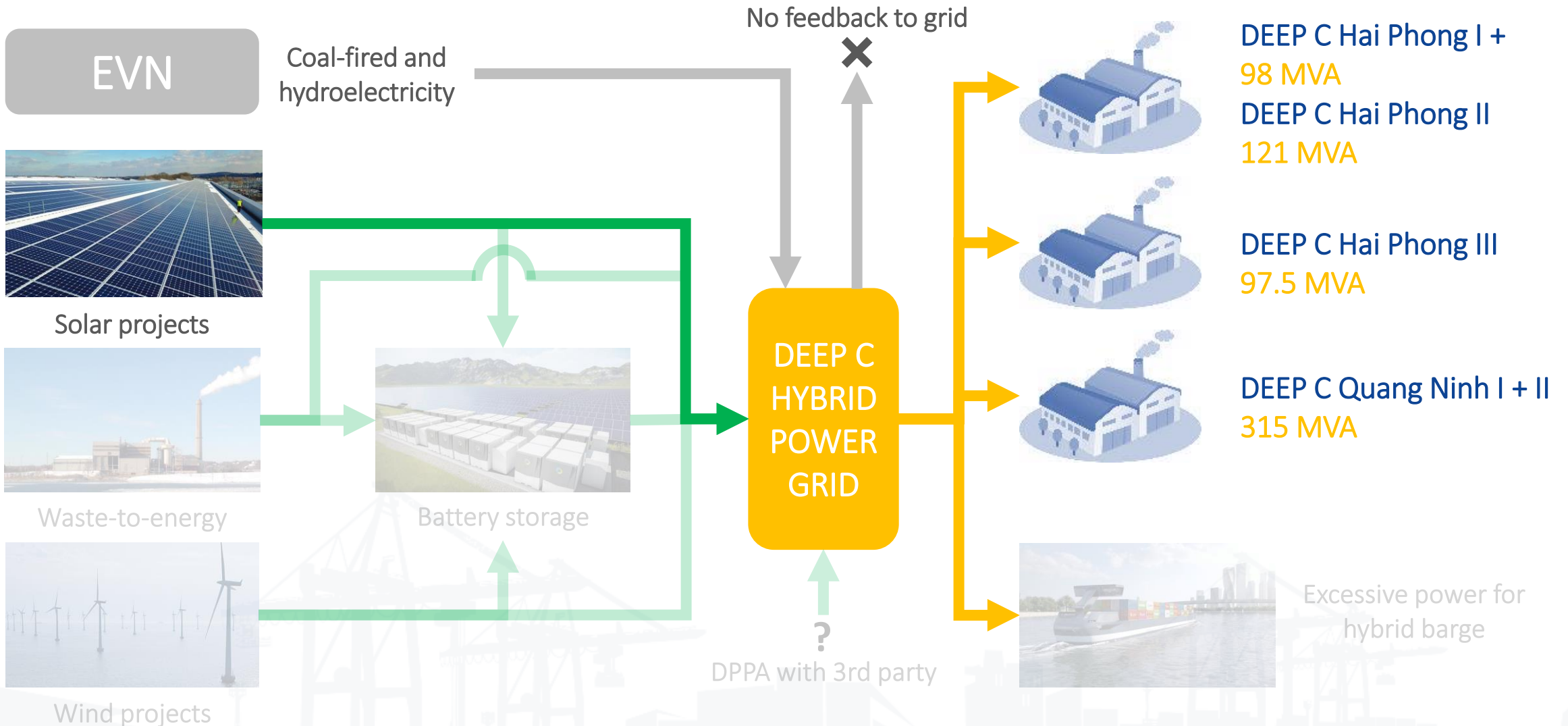
DEEP C Industrial Zones for RE Buyers Vietnam Working Group Webinar #2

EPC selection WWHHP rooftop solar project

May 21st 2020



BACKGROUND



Target: supply 50% of DEEP C's electricity demand with renewable energy by 2030

BACKGROUND

Preceding development

- › 2016: pre-feasibility study by international consultant
- › 2017: measurement campaign with small test installation
- › 2018: yield study based on 12 months' data
 - » Consistent with satellite readings for area
 - » Observed performance ratio in line with expectations
- › 2019 – 2021: business case rooftop solar
 - » CAPEX model: higher return (+ develop own expertise)
 - » 2019-2020: 1st pilot of 2,1756 MWp on warehouses WWWHP
 - › Demonstrate economic viability
 - › Already in PDP under Decision 4274/QD-TTg
 - › Set up legal framework for 'copy-paste'
 - » 2020-2021: further roll-out additional capacity to XX MWp
 - › New and existing tenants
 - › Strong interest for green utilities (option to add REC handover)



OFFER GATHERING

Request for Quotations – RfQ

- › 12 suppliers (some known from before 2019, some from conferences/exhibitions)
- › Limited process, consisting of building plan, proposed lay-out and basic technical specifications
- › 9 local, 3 international
- › Price range: 490 USD/kWp to 700 USD/kWp
- › Selection criteria:
 - » Price (within budget)
 - » Materials used
 - » Production specifications
 - » Vietnamese references
 - » International references if available
- › Phase running until October 2019

OFFER GATHERING

Request for Proposals – RfP

- › 4x supplier from RfQ, 2x supplier from reference other partner
- › Official RfP process: proposal document with all technical/contractual specifications
- › Support from Clean Energy Investment Accelerator (CEIA)
 - » Experts on different topics
 - › Contracting/legal
 - › AC
 - › Safety/O&M
 - » Several online sessions to discuss progress
 - » Helped to eliminate 3 suppliers not sufficiently according to requirements RfP
- › Discussion on all levels with local team
- › Phase running until January 2020

EPC SELECTION

Parameter definition

› Selection criteria:

- » Low price/kWp installed
- » Good relative production
- » International expertise
- » Trusted sub-contractor(s)
- » Good references
- » No compromises in terms of quality
- » Payment terms

› Attention points:

- » Location of HQ
- » Offering of LV/MV
- » Financial stability/guarantee

EPC SELECTION

Price comparison

- › Excluding maintenance costs vs. including maintenance costs
 - » High maintenance burden on profitability
 - » Low maintenance not realistic
- › Excluding medium voltage equipment vs. including medium voltage equipment
 - » Needed for connection to the grid
 - » Prices can differ according to expertise supplier

Bidding Company	Excl. maintenance				Incl. Maintenance	
	Excl. MV		Incl. MV		Excl. MV	Incl. MV
	USD/kWp	USD/kWh	USD/kWp	USD/kWh	USD/kWh	USD/kWh

EPC SELECTION

BoQ comparison

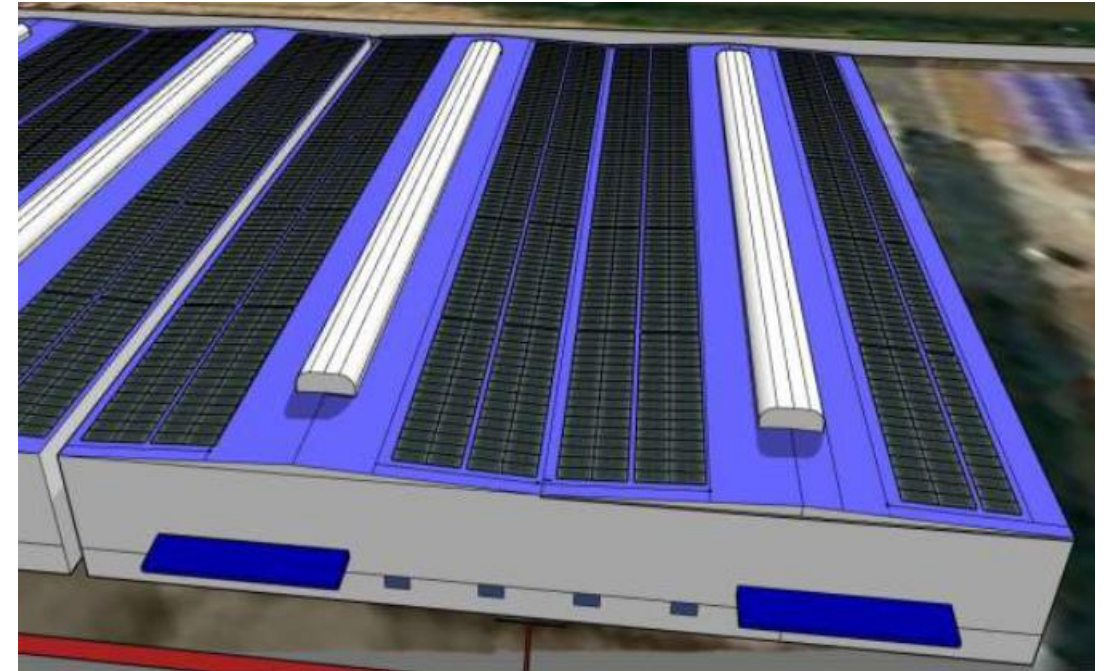
- › Know the prices of your components
- › Compare on specific items (too low vs. too high)

Cost Component	USD	USD/Wp	USD	USD/Wp	USD	USD/Wp	USD	USD/Wp	USD	USD/Wp	USD	USD/Wp
Panels	509,541	0.235	476,171	0.239	507,036	0.235	582,074	0.286	483,002	0.245	828,248	0.300
Mounting	123,189	0.057	75,842	0.038	141,971	0.070	78,531	0.036	57,216	0.029	169,690	0.061
DC Cables	78,528	0.036	119,902	0.060	64,974	0.030	33,679	0.017	29,242	0.015	68,703	0.025
Inverters	117,438	0.054	117,666	0.059	99,932	0.046	101,869	0.050	80,783	0.041	136,810	0.049

CONCLUSION

End result

- › Two suppliers with very strong proposals
 - » 'Luxury of choice'
 - » Good negotiation position
- › Successful start of the project with 
 - » Strong investment case
 - » No surprises before or after contract signing
 - » Good preparation and project planning means less impact from COVID-19



THANK YOU FOR YOUR ATTENTION!



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TEPCO Power Grid





CORPORATE BUYER PERSPECTIVE

**Lessons and Learnings from adidas Rooftop
Solar Experience in Vietnam with suppliers**

CONTENTS

1. ADIDAS CARBON TARGETS AND ROADMAP

- ADIDAS FOOTPRINT IN VIETNAM
- SUCCESSFUL ROOFTOP ADOPTION IN VN

2. ADIDAS SOLAR ROOFTOP PROGRAM

- END TO END APPROACH

3. ADIDAS SOLAR ROOFTOP GUIDELINE

4. KEY TAKEAWAYS

5. Q&A

ADIDAS CARBON TARGETS AND ROADMAP

2050 Target



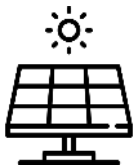
Climate neutrality

2030 Target

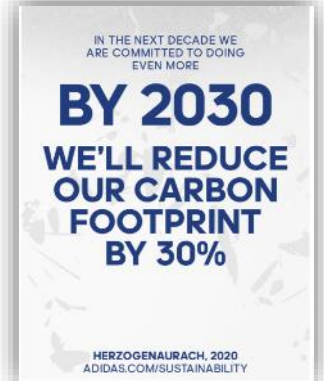


30% absolute CO2 reduction target (UNFCCC)*
- 60% of adidas carbon emission directly linked to its T1 & T2 suppliers

2020 Action



- 100% of strategic suppliers must conduct a rooftop solar **feasibility study**
- Produce at least **5%** of on-site renewable energy
- Pilot **dPPA** for strategic suppliers in Vietnam
- Adopt the adidas rooftop solar guideline

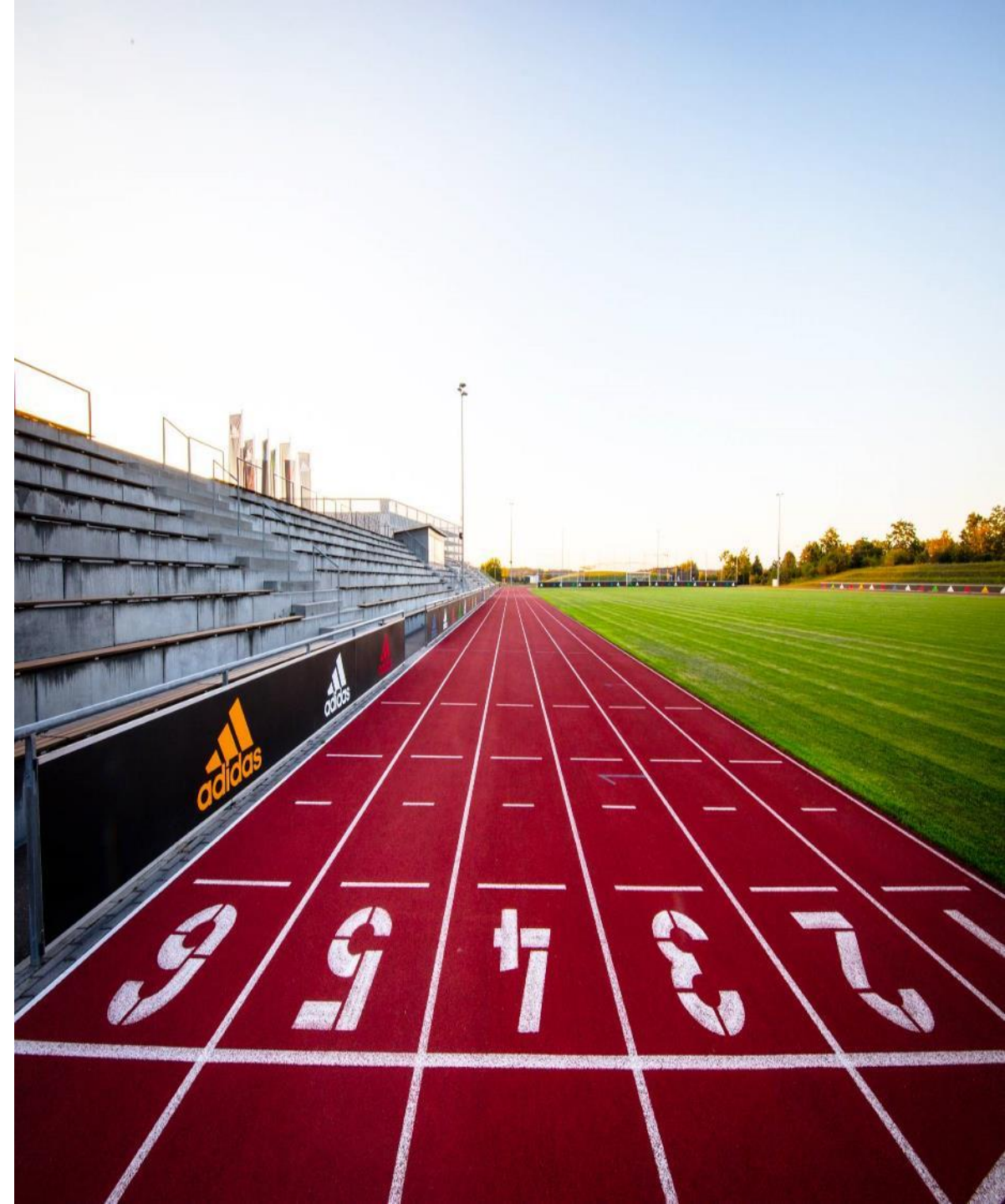


ROOFTOP SOLAR PROGRAM IN VIETNAM

adidas' support to suppliers

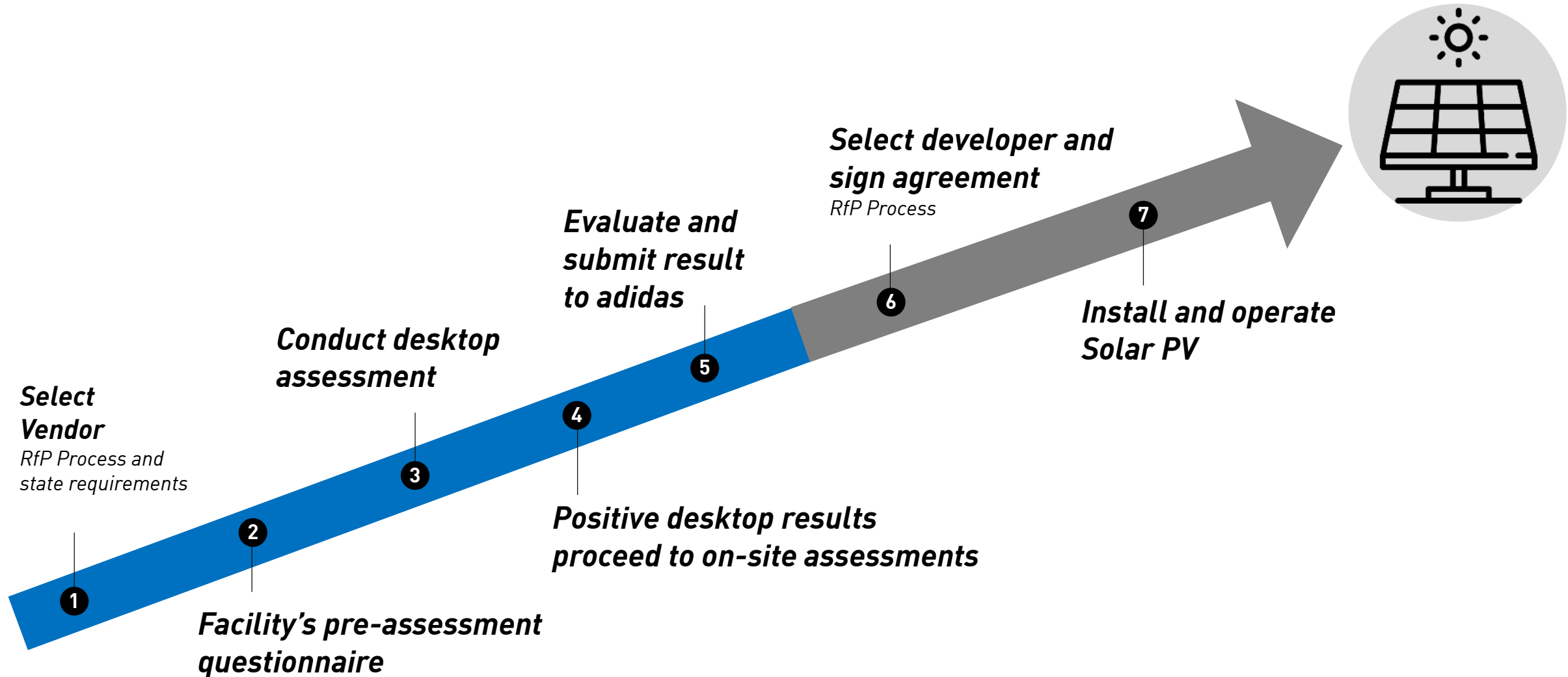
1. **Collect monthly energy data from each facility**
2. **Track their progress towards RE and Carbon target**
3. **Identify gaps and opportunities for any RTS system**
4. **Financing both desktop and on-site RTS feasibility studies for 33 suppliers***
5. **Partner with technical experts to support suppliers adoption of RE solutions**

Note(): excluded facilities either have RTS already completed, under constructions, have already conducted FS, or leased building*



ADIDAS' END-TO-END ROOFTOP PROCESS

The end-to-end process guides adidas' suppliers through every step of the way to the solar roof-top installation.



PRE-ASSESSMENT QUESTIONNAIRE

Identify key information of facilities to effectively evaluate the solar compatibility and admission into the project

KEY ELEMENTS TO CAPTURE & EVALUATE:

1. GPS location
2. Building ownership
3. Grid connection
4. Current electricity consumption
5. Rooftop information (dimension, type of roof, etc)



Questionnaire for Sites (Please answer in ENGLISH)
Photovoltaic Rooftop Systems

1. Customer Data

Company:	
Contact person:	
E-Mail address, phone:	
Site address:	
Site coordinates:	
Site picture:	
Country:	

2. Status

a. Does the customer own or rent the premises? If own, specify: _____

b. Do you have any plans to move the current facilities to other facilities and stop operating the current facilities in near future (30 years)? _____

c. Has your facility conducted rooftop systems feasibility study in 2020? If so, please include the report in submission? _____



d. Does your facility currently have photovoltaic (PV) in place? If so, please indicate installed system capacity (e.g., kWp) and year of installation: _____

3. Grid-Connection/Interconnection

In order to help us design a system that would best suit your purpose, please answer the following questions:

a. What is your grid operator / local electrical authority? _____

b. How many connection points to the grid are available? (Y/N) _____

c. Where in the facility is the grid connection point? Please mark on drawing/map: _____

d. Where is the proposed point of interconnection of the PV system? _____

e. What is the voltage level at the proposed point of interconnection of the PV system? _____

f. Is there an existing energy grid available for generating interconnection? _____

g. What is the voltage level from the energy provider at the point of interconnection (KV)? This information should be given as your electricity metering:
☐ A low-voltage level, provide exact value: _____
☐ At medium voltage level, provide exact voltage: _____
☐ At high-voltage level, provide exact voltage: _____

h. Output: Could you provide your operational power factor, if available, for use of working power in comparison to apparent power, as an indication of how efficiently your power is used? _____

i. Is there any special requirement for lightning protection on your roof? (y/n) _____

j. Is there a preferred location for the inverter/racking/mounting station? If yes, please provide coordinates or mark on a map: _____

k. Is net metering allowed to utilize excess energy production by feeding back to the utility grid? (y/n) _____



4. Consumption

a. What is the current electricity price from the power company (please provide invoice)? _____ (currency)/kWh

b. Do you have your own electricity price prediction? _____

c. What average increase in electricity prices do you anticipate per year in the next 3-5 years? _____ %

d. Daily Consumption: Can you provide an estimate for consumption (kWh) on a monthly and an annual basis under proposed operating conditions? _____ kWh/month, _____ kWh/year

e. Daily Consumption: How much electricity do you use on a normal production day? _____ kWh/day

f. Daily Consumption: How much electricity do you use on a non-production day? _____ kWh/day

g. Daily Consumption: How much is the average daily peak load of the facility between 8am and 6pm? At what time do you expect peaks to occur? _____ kWh, time: _____

h. Does the site have ability to expand more electrical capacity or more load? _____

i. Please provide 24 hours load curve/diagram for an average year: _____

5. Roof

a. What kind of roof is installed? If possible: Roof design, slope/angle, Material/Manufacturer and type (e.g., flat, metal sheet, concrete, etc.) _____

b. Do you have technical drawings available for the building and the roof? (DWG format is preferred, but also JPG and PDF can be used for assessment) _____

c. What are the roof dimensions? (m²) _____

d. What does the construction/structure of the roof look like? _____



Please insert a picture or rough drawing with some indicative measurements of the expected area to install your PV array: _____

e. What is the specific residential load history of the roof (kg/m²)? This shows how much load the roof currently can hold and is important to select modules and define the space between the modules: _____

f. Please specify wind load details (if available): _____

g. Please specify the inclination angle of the roof (in degrees): _____

h. What is the height of the building (proposed buildings and surroundings)? _____

i. Are there any restricted areas on the roof? _____

j. Are there any requirements for specific clearances on the roof? _____

k. Is there an existing access way to the roof? Are there any specific requirements for roof access? _____

l. Are there any specific health and safety regulations? _____

m. Additional requirement, such as security, modules (e.g., fireproof, monitoring, windows in the roof, control rooms, others)?
Photos and drawings are always helpful.



KEY INSIGHTS FROM DESKTOP FEASIBILITY STUDY

Assess technical feasibility for a potential PV generation based on supplier specific electricity data and position coordinates

KEY ELEMENTS TO CONSIDER & EVALUATE:

1. Usable rooftop maximum potential
2. Proposed RTS capacity based on energy demand
3. Avoided CO2 emissions
4. financial business case



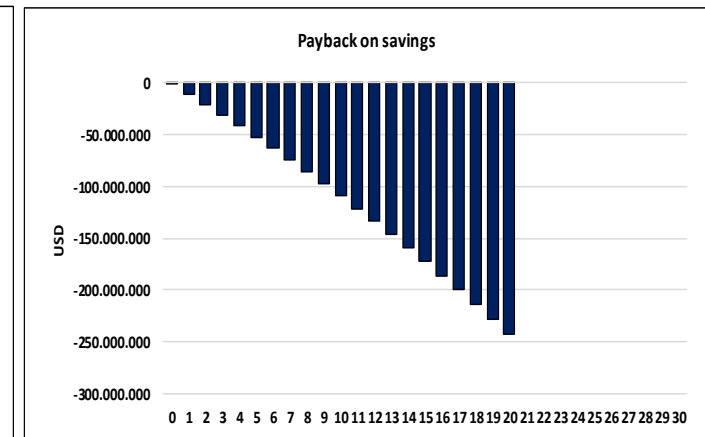
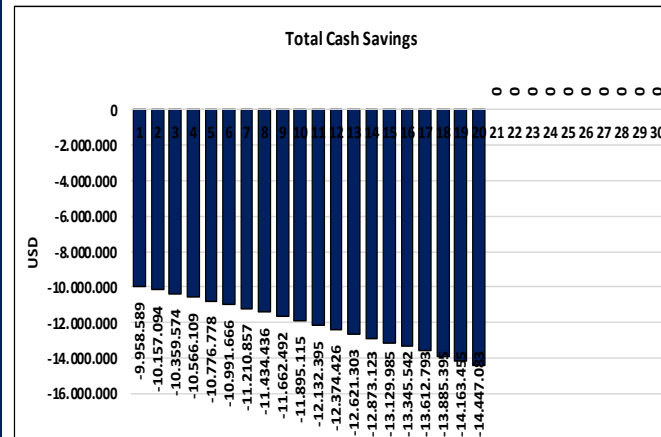
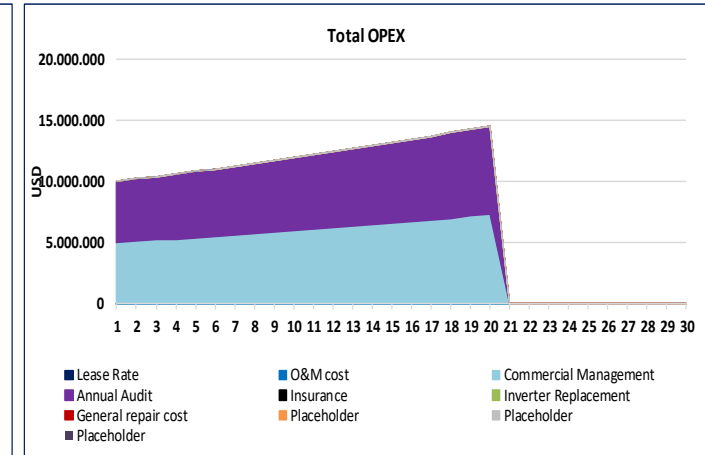
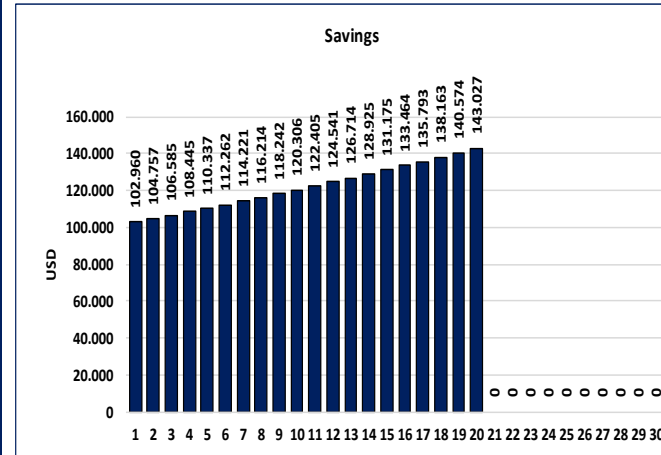
FINANCIAL BUSINESS CASE

Financial analysis to derive amortization and savings are necessary

KEY ELEMENTS TO CONSIDER & EVALUATE:

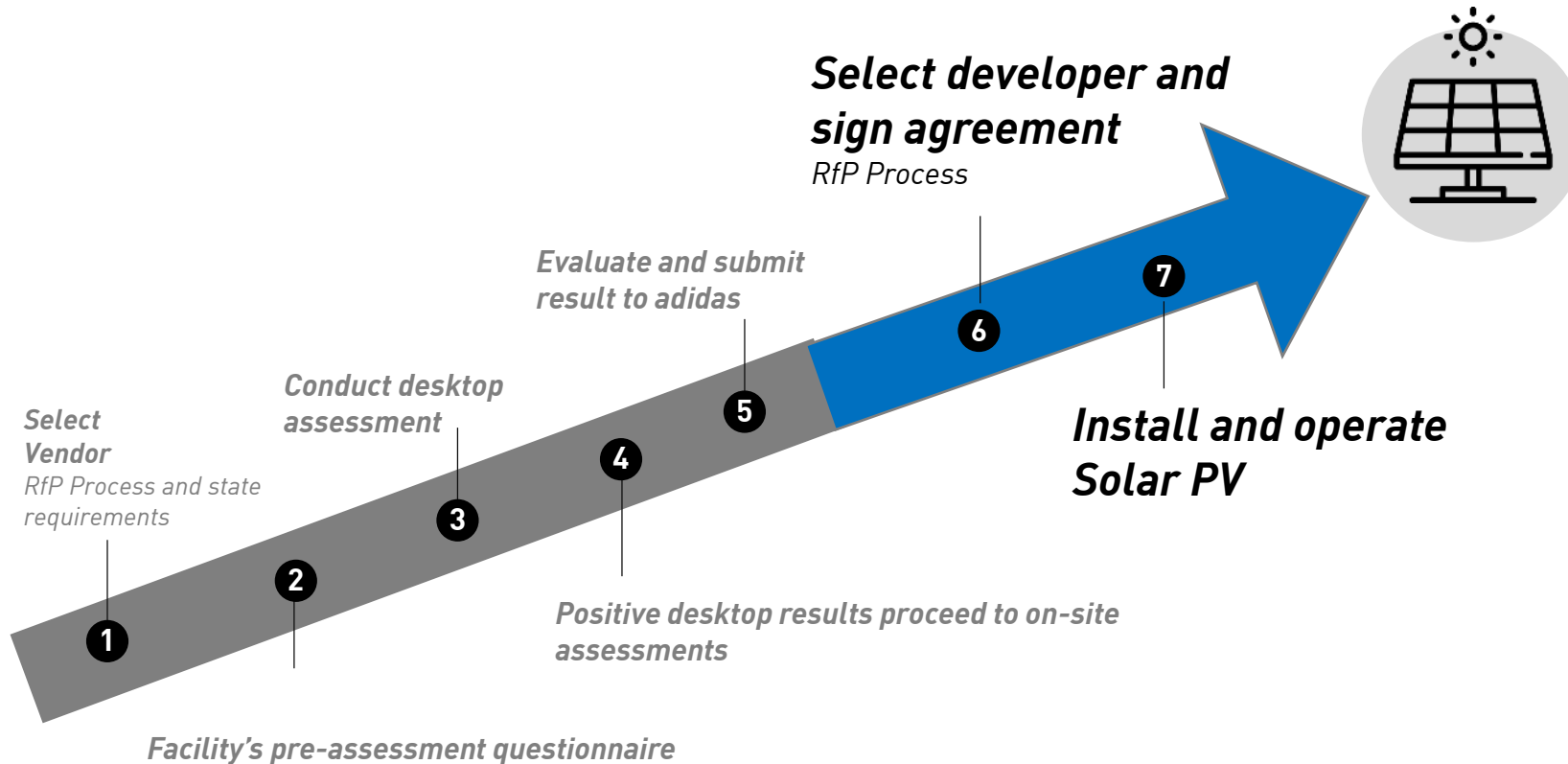
1. Cost and saving overview (USD/year) compared to existing case
2. ROI (if self-invest)
3. Availability of leasing model
4. Availability of on-site PPA options

Snapshot - Financial Analysis Graphs



RFP FOR SOLAR DEVELOPERS

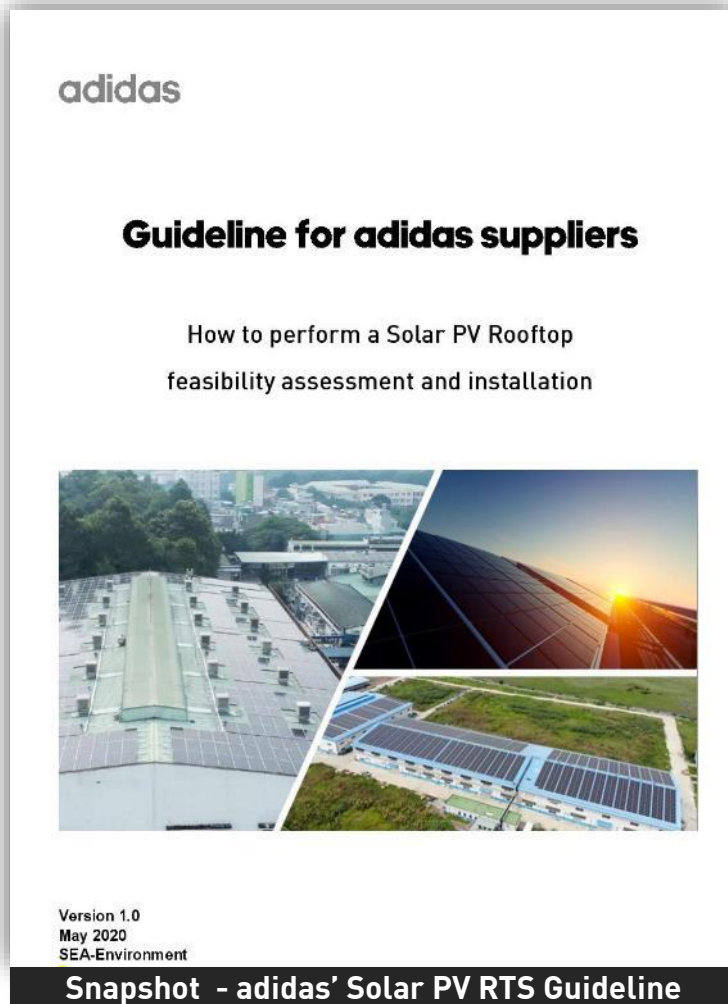
Key factors to consider for RfP of solar developers



- 1. Extend RfP to multiple developers**
- 2. Both desktop and on-site assessments should be conducted**
– on-site assessment is a minimum requirement and necessary to ensure that technical details are considered.
- 3. Consider factors other than price** – Ensure all key criteria / quality / hidden cost are checked and evaluated before making the final decision
- 4. Ensure the solar developers have experience in your local market**

ADIDAS SOLAR ROOFTOP GUIDELINE

A comprehensive solar roof-top installation guideline to support adidas global suppliers' transition to renewable energy



The guideline provides detailed guidance on how to approach and address the feasibility study, select a developer and answers the following key questions:

1. *What does the process of conducting a feasibility study look like?*
2. *What are the adidas minimum requirements to fulfill the solar roof-top feasibility study?*
3. *What minimum parameters are needed for the supplier to determine if they proceed to the next steps in developer selection?*
4. *What does the general process of developer selection look like and what are the important criteria in each step in the process?*
5. *How to choose a reliable developer and what to look for?*
6. *How to ensure a successful outcome (Do's and Don'ts)?*

KEY TAKEAWAYS



1. **Brand/supplier collaboration is critical to reduce carbon footprint**



2. **Understand the supplier's energy consumption and potential RTS capacity**



3. **Credible external technical expertise needed to conduct both desktop and on-site**



4. **Keep informed on the country's renewable energy policy and incentives**

Q&A

THANK YOU

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Senior Director, Global Environment
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ROOFTOP SOLAR POWER

CONTENTS

- 1 INTRODUCTION TO TTC GROUP AND TTC ENERGY
- 2 O&M MODEL
- 3 ORIENTATIONS AND DEVELOPMENT

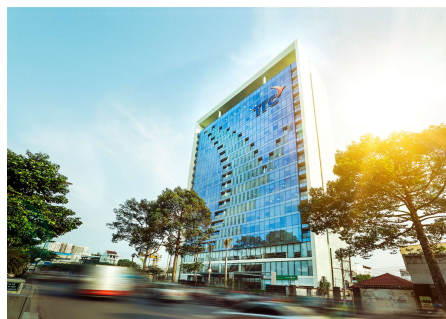


TTC GROUP

ENERGY



REAL ESTATE



AGRICULTURE



TOURISM



❖ Charter capital

18,152 billion VND

❖ Owner's equity

20,968 billion VND

❖ Total assets

61,873 billion VND

❖ Net revenue

10,314 billion VND

❖ Profit before tax

1,167 billion VND

❖ Member companies
& affiliates

3 Corporations
1 Sectoral Committee
> 120 Belonged units

❖ Employees

over 8,000

www.ttcenergy.vn

TTC ENERGY JOINT STOCK COMPANY

An illustration on the left side of the slide shows a blue and green globe with several blue solar panels tilted upwards, partially covering the top of the globe. Green trees are visible behind the solar panels.

A member of
TTC Group

Solar power systems have
been installed in over **20 large**
cities, provinces in Vietnam,
Laos, Cambodia.

Over 132 works with a
total installed capacity
as of January 2020:
50 MWp

A SOLID FOUNDATION



- A solid foundation formed by Gialai Electricity JSC (GEC) with **more than 30 years of experience** in energy sector, including solar power (7 plants: 380 MW), wind power, hydropower and thermal power.
- **Sponsored by well-known international organizations:**
 - **IFC:** International Finance Corporation of World Bank
 - **ARMSTRONG:** Singaporean Clean Energy Fund

**SUPPORTED BY TTC GROUP -
A MORE THAN 40-YEAR BRAND**

- Commit to accompany the Customer in 25 years of the product life cycle.
- Commit to the warranty for products and services until the last year of the product life cycle.

CUSTOMER'S CHOICE

ASSURED SYSTEM'S QUALITY

- Solar power system's equipment is strictly selected and tested by TTC through the installation of projects invested by TTC Group.
- A skilled technical team with over 30 years of system installation and operation experience.



SHARP

NHẬT

CanadianSolar

CANADA



ĐỨC

ABB

THỤY SĨ

SMA

ĐỨC



Growatt

**TRUNG
QUỐC**

www.ttcenergy.vn

O&M MODEL

1. TRENDS AND REQUIREMENTS



II. O&M MODEL

3. WORK

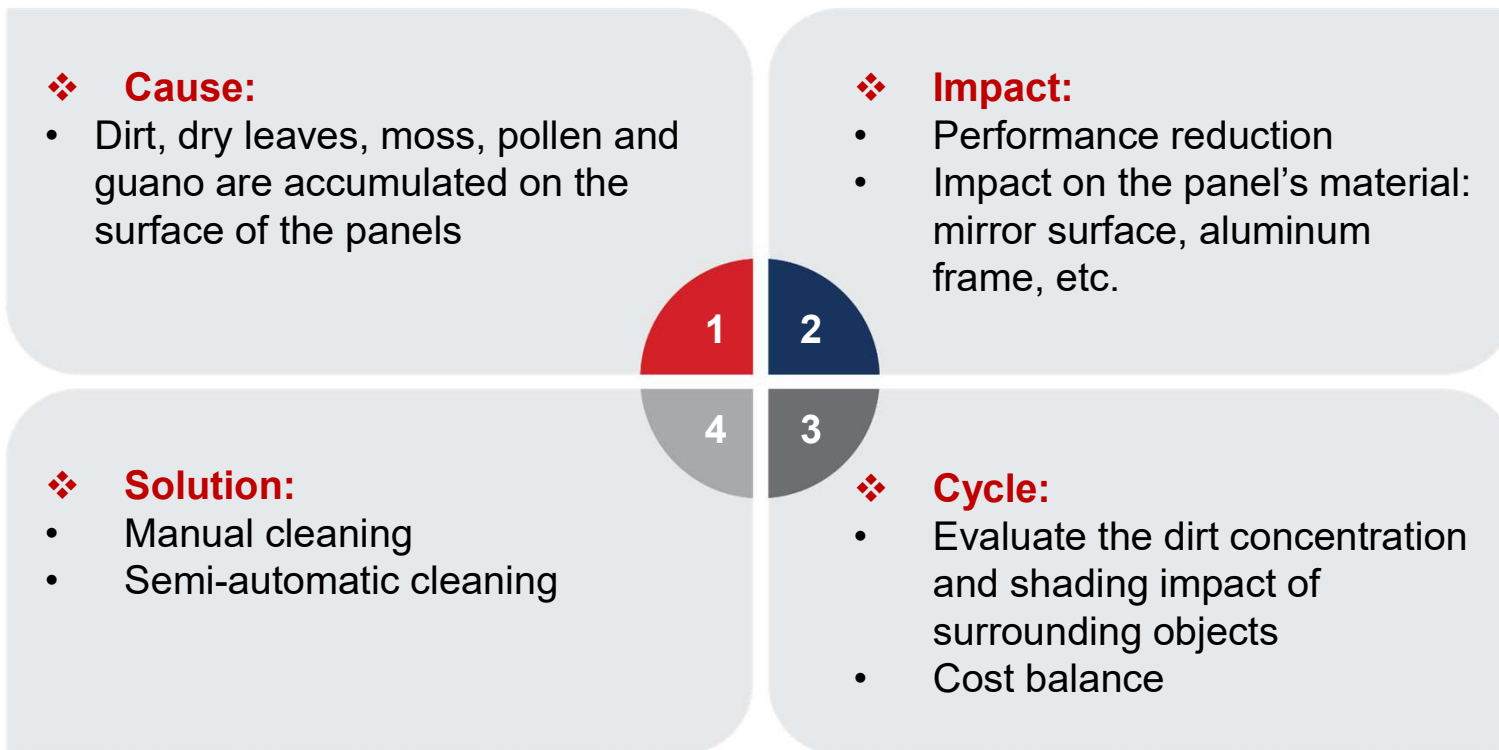
- ❖ Regular maintenance and cleaning:



II. O&M MODEL

3. WORK

❖ Regular maintenance and cleaning:

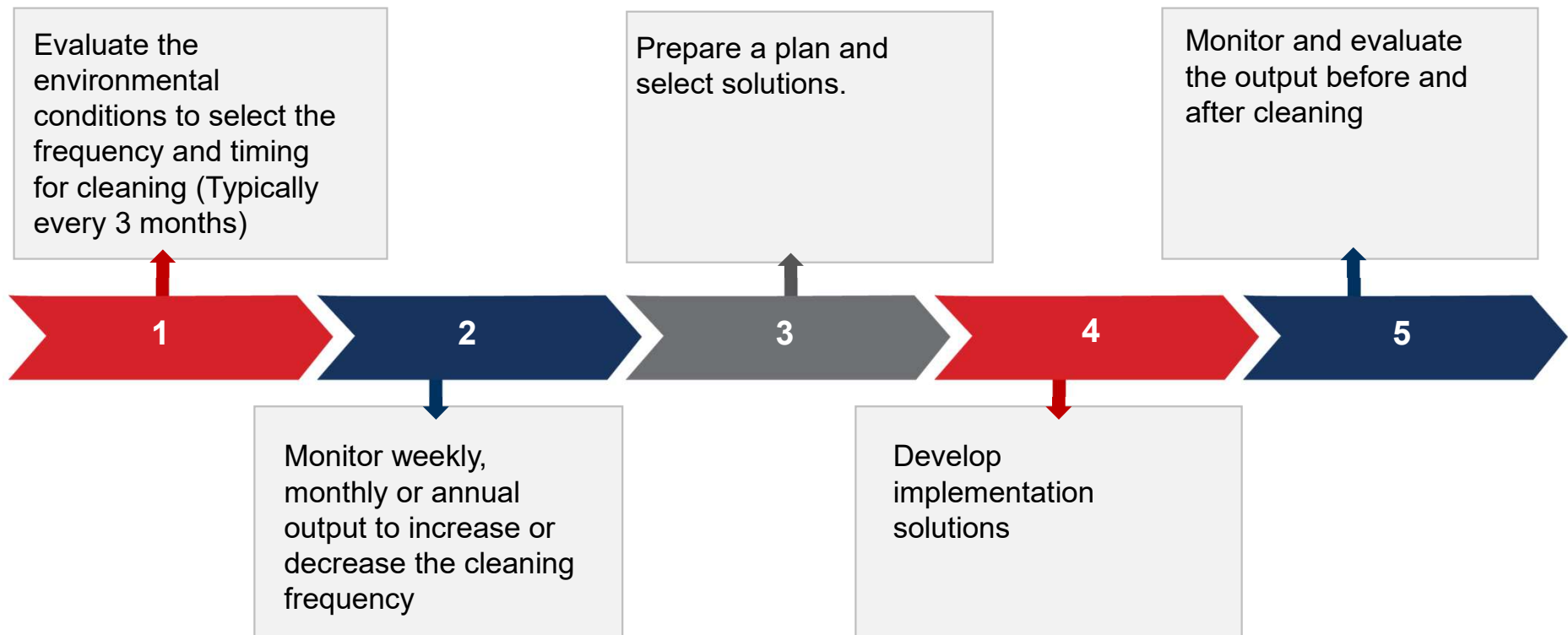


II. O&M MODEL

3. WORK

❖ Regular maintenance and cleaning:

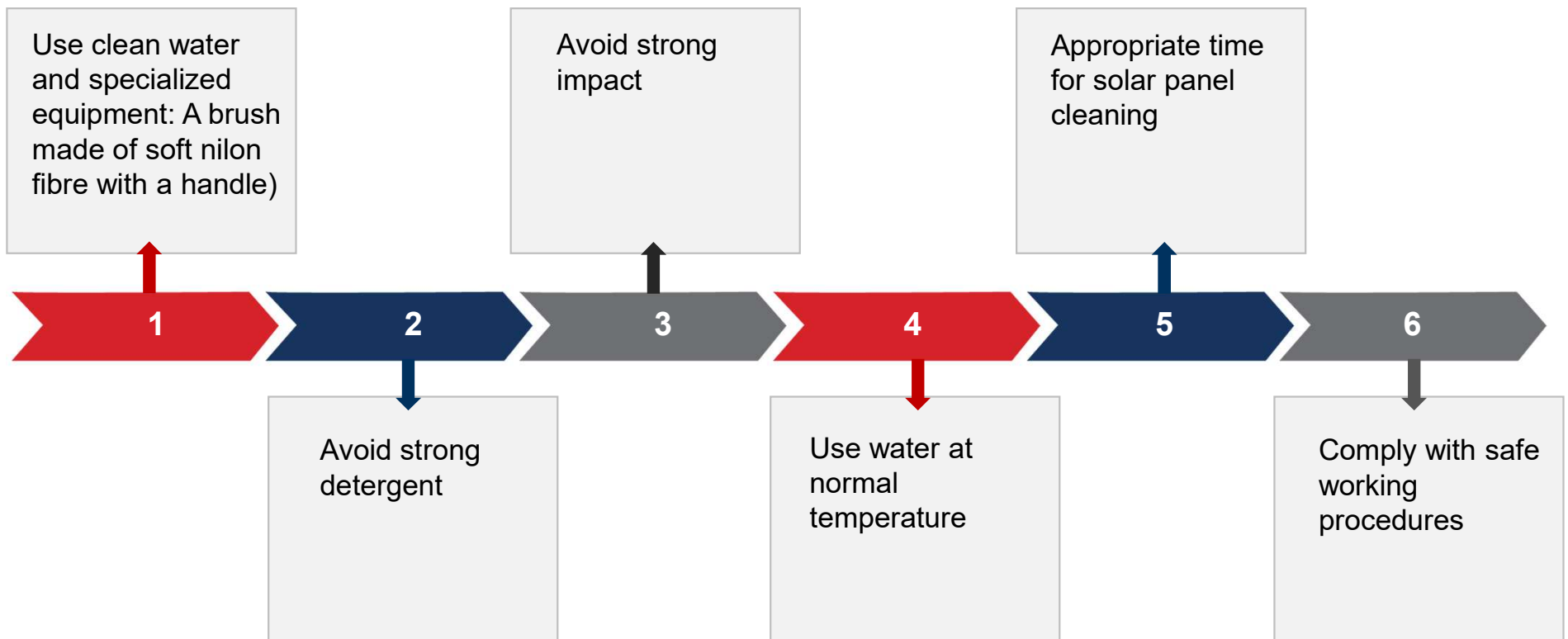
IMPLEMENTATION PROCEDURE



II. O&M MODEL

3. WORK

❖ Regular maintenance and cleaning: **MANUAL CLEANING**

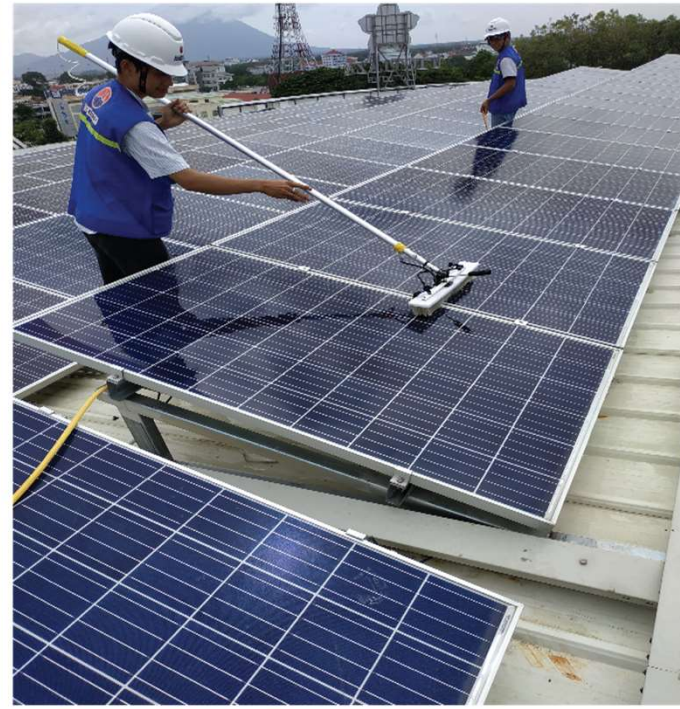


II. O&M MODEL

3. WORK

❖ Regular maintenance and cleaning:

Manual cleaning

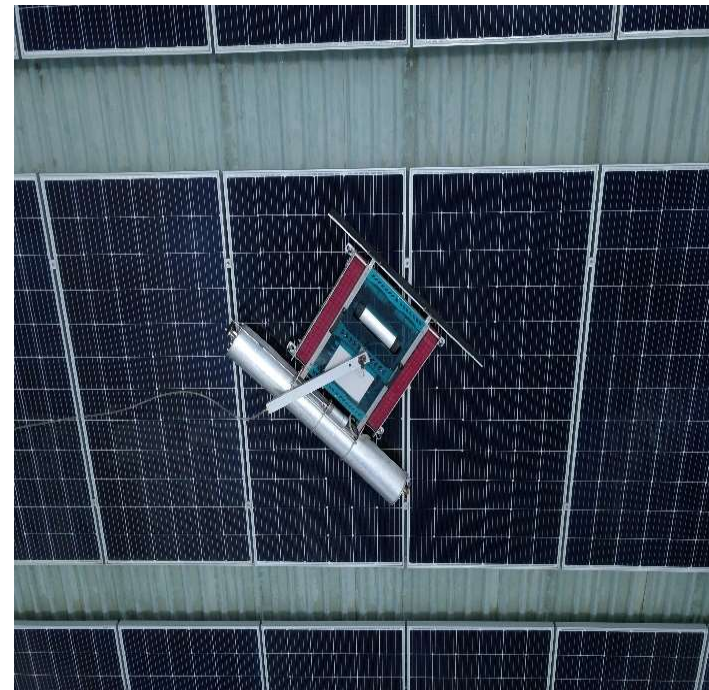


II. O&M MODEL

3. WORK

❖ Regular maintenance and cleaning:

Semi-automatic cleaning (cleaning robot)



II. O&M MODEL

3. WORK

❖ Preventive maintenance

System operation principles

1

- Ensure that the mechanical installation complies with installation guidelines.

2

- Ensure that the electrical installation complies with installation guidelines.

3

- Ensure that all switches, MCB, MCCB are off.

4

- Assure technical requirements.

5

- Ensure electricity safety.

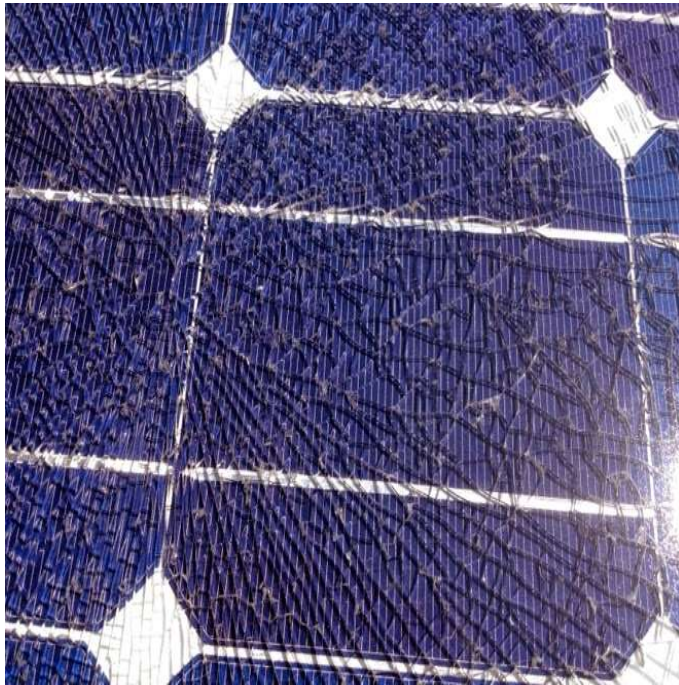


II. O&M MODEL

3. WORK

❖ Common issues

The panel surface is broken



II. O&M MODEL

3. WORK

❖ Common issues

The outer layer of electric cable is scratched

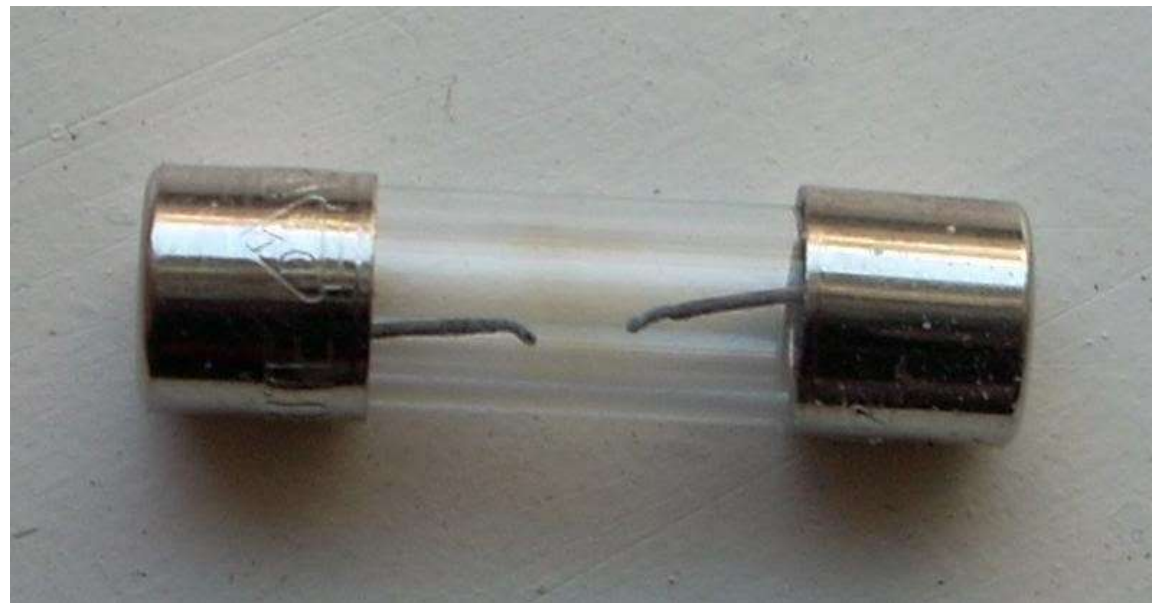


II. O&M MODEL

3. WORK

❖ Common issues

Fuse is broken, flash point or overheating occurs



II. O&M MODEL

3. WORK

❖ Common issues

MC4 joint is loose, not tightened



II. O&M MODEL

3. WORK

❖ Common issues

Frame, screws, and bolts are rusty



III. ORIENTATIONS AND DEVELOPMENT

1. OBJECTIVES



- Maintain the good condition of equipment at the lowest cost (VND/Kwp/year)

- Study to improve the system performance (%)

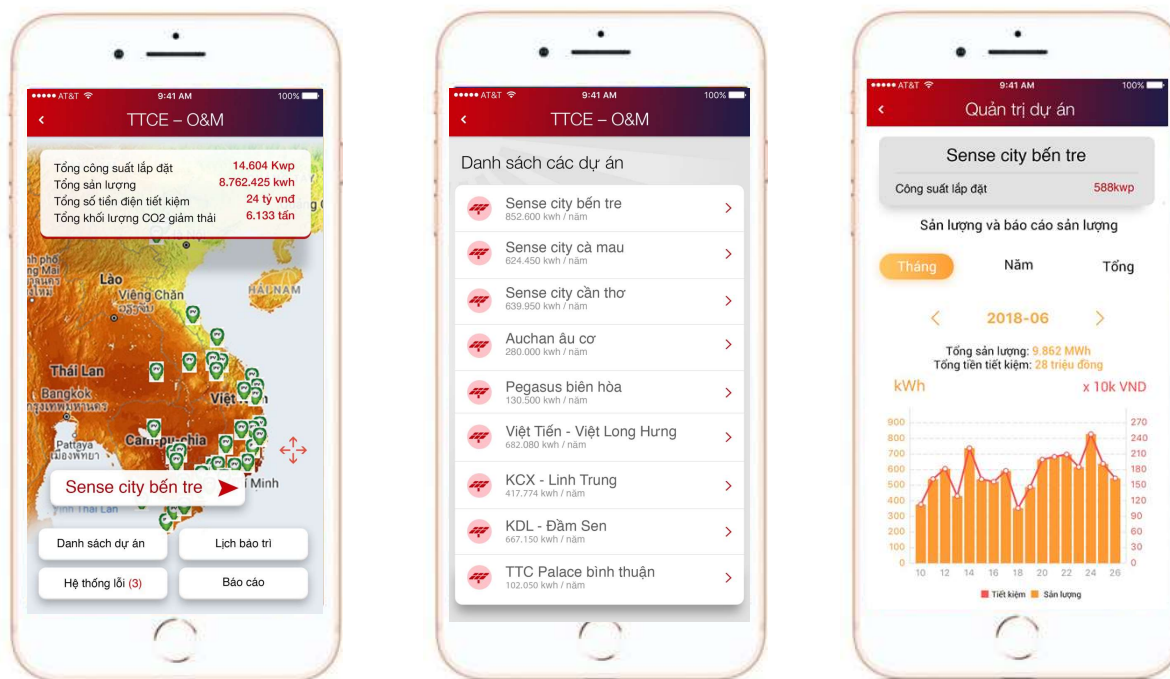
- Provide professional O&M service

III. ORIENTATIONS AND DEVELOPMENT

2. R&D

MOBILE APP: TTCE

PROJECT MANAGEMENT





THANK YOU!

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