Renewable Energy for Health System Resilience:
Strategies for Planning & Implementation

13th May 2020

Talal Kanaan

Guidance Outline

1. **Planning Overview: Scope & Strategy**
2. **System Assessment**
   - Assessment Planning
   - Data Collection Tool
   - Data Collection Framework
3. **Implementation**
   - Design & Engineering
   - Procurement of Goods & Services
   - Installation Planning
   - Quality Control & Monitoring
   - Sustainability + O&M

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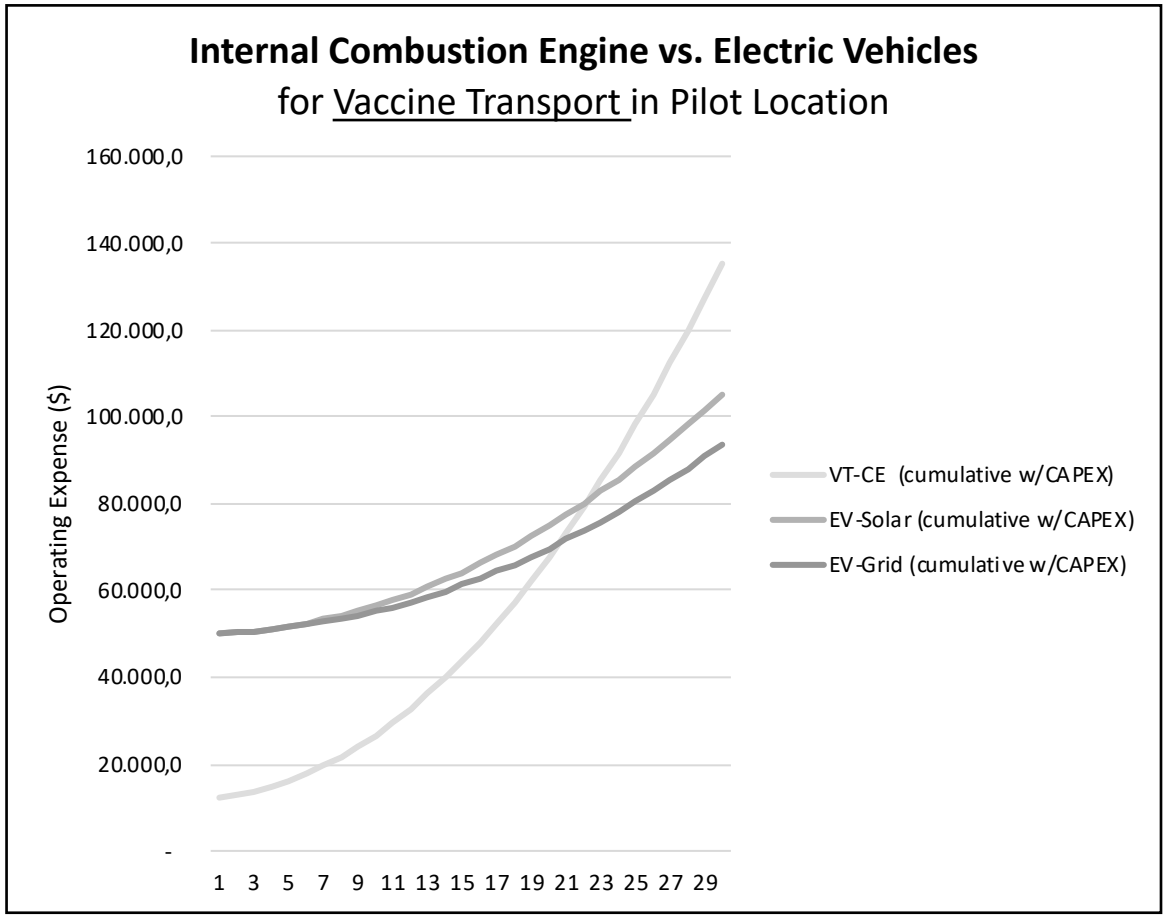
Planning Overview: **Health System & Energy?**

- **Health Clinics:** *Primary Health Care*
- **Cold Rooms & Warehouses for Vaccines***: Cold Chain*
- **Hospitals***: Secondary & Tertiary Health Care*
- **Critical Operational Facilities**
  - Laboratories for Infectious Disease & Surveillance
  - Blood Banks
- **Mobility**
  - Vaccine Transport
  - Referral and Ambulance

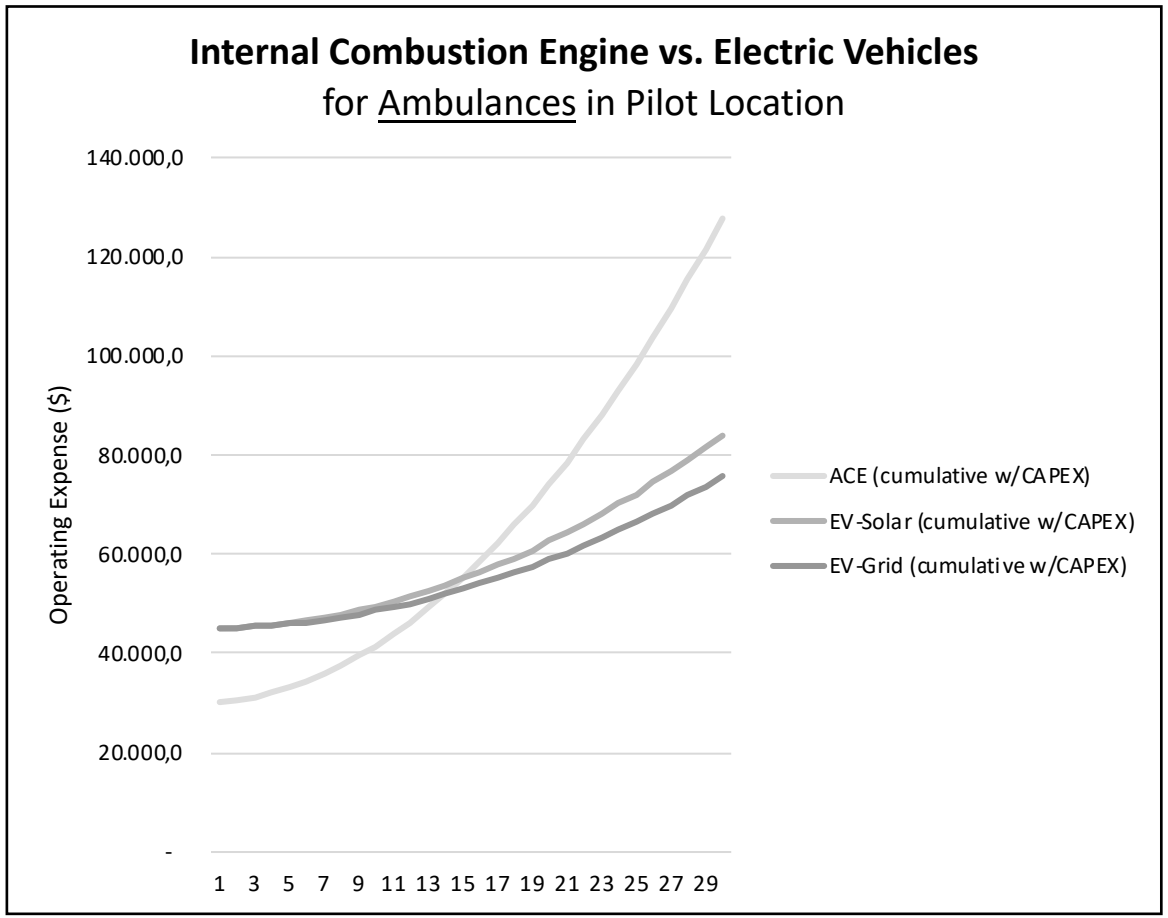
Courtesy of WHO occupied Palestinian Territory
(Nasser Medical Complex, Gaza Strip)

Energy for Mobility in a Health System?



Vaccine Transport: Breaks-even in ~ **20 months**

(VT-CE: Vaccine Transport Combustion Engine)



Ambulance Transport: Breaks-even in ~ **15 months**

(ACE: Ambulance Combustion Engine)

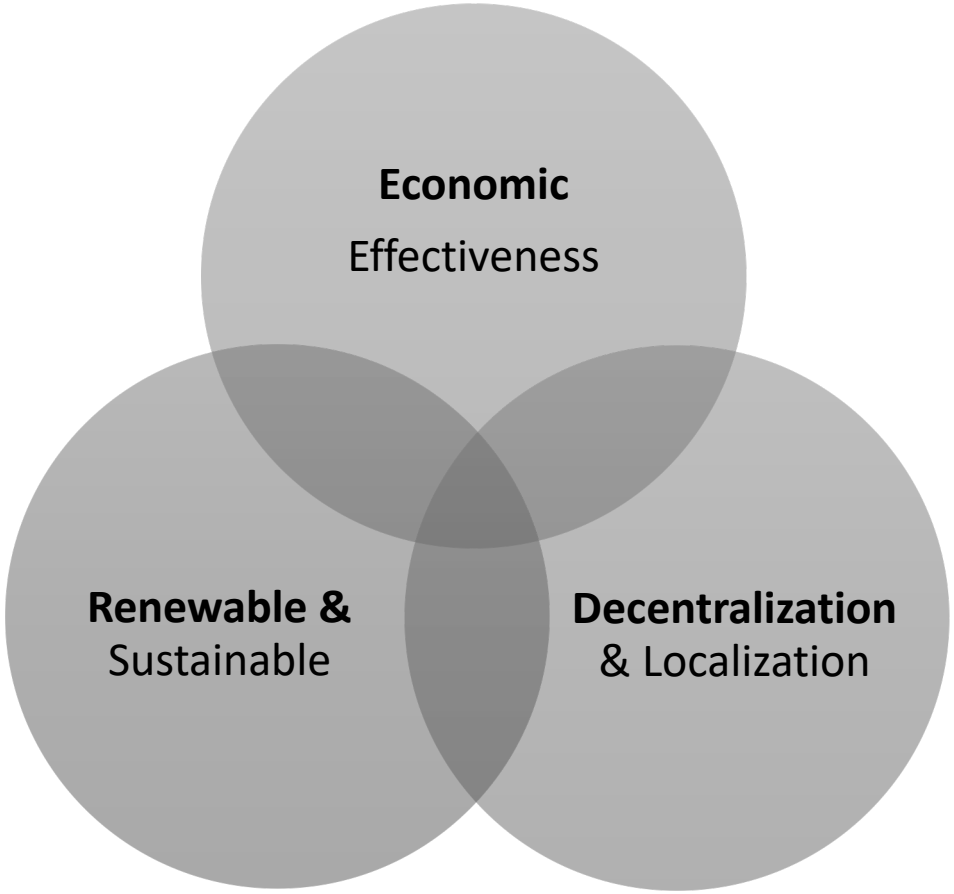
(Courtesy of ''*Health Integrated Resilience System'' Project*– HIRS / UOSSM)

Health & Energy Resilience

Health System Energy Problem:

- No Energy Access
- Diesel Generators (Fuel)
- Weak Unreliable Grid
- Risk of Grid Failure

Solution: Solar PV Electrification



Planning Overview: Types of Applications

Off-grid PV systems (PV + Energy Storage) – 2 sources

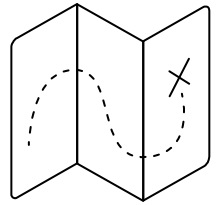
- AC System
- DC System

Hybrid PV-Diesel system with Energy Storage back-up – 3 sources

- Normal Energy Storage
- Lean Energy Storage

Hybrid PV-Diesel-Grid System with & w/o ESS – 4 sources

Planning Overview: Scope & Strategy



What is <u>the scope of the plan</u>?

- Single critical facility?
- Specific group of facilities (critical hospitals, cold chain system, clinics, etc)?
- Integrated Health System Approach for a Country/Region?

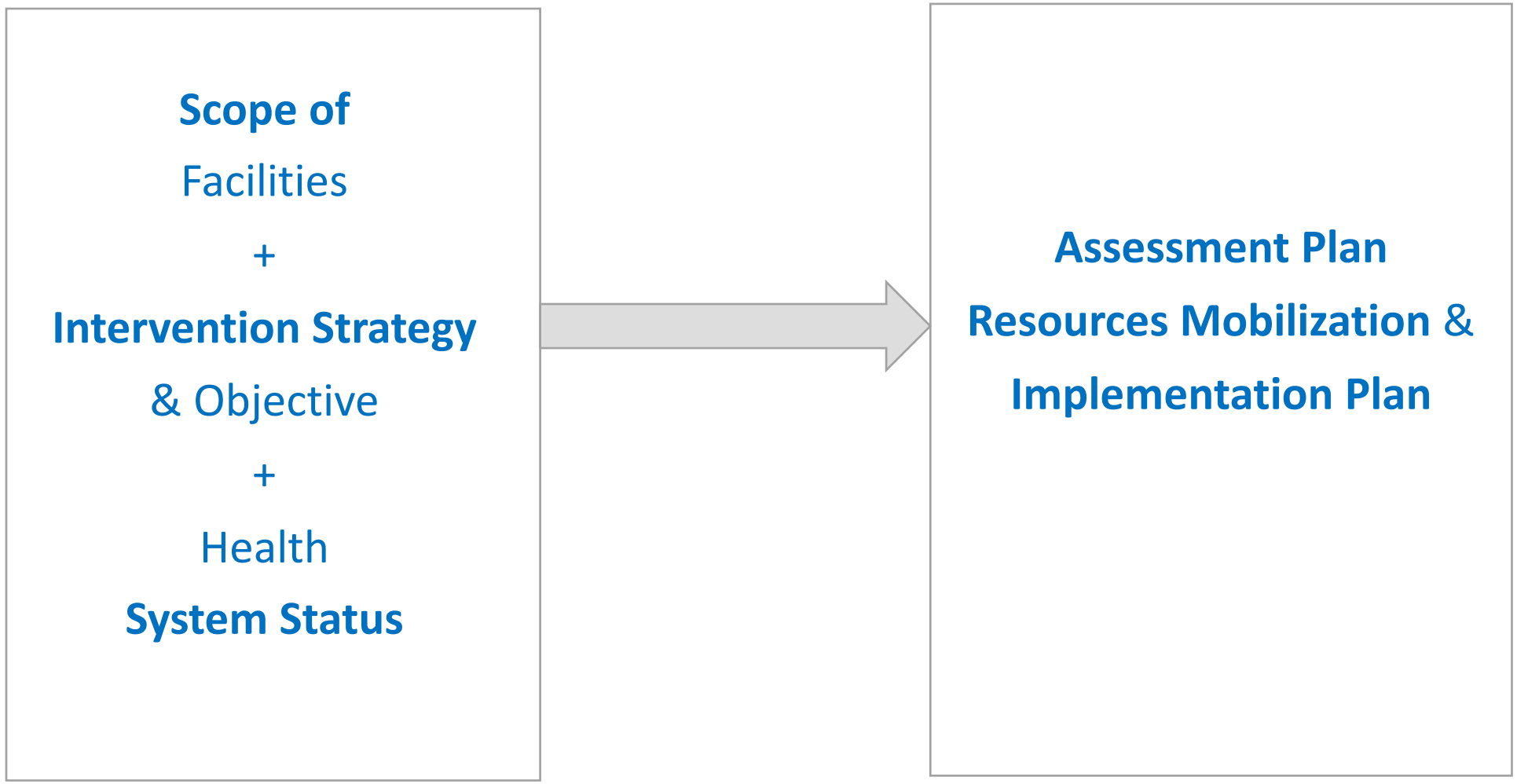
What is the <u>conditions</u> of country/region of intervention?

- Status of Electricity and Primary Sources locally?
- Fuel dependency?
- No Energy Access?

What <u>ensures the system's energy resilience</u>, and what is the priority?

- Full Electrification
- Critical Department for Emergencies
- Cold Chain Only?

Planning Overview: Scope & Strategy



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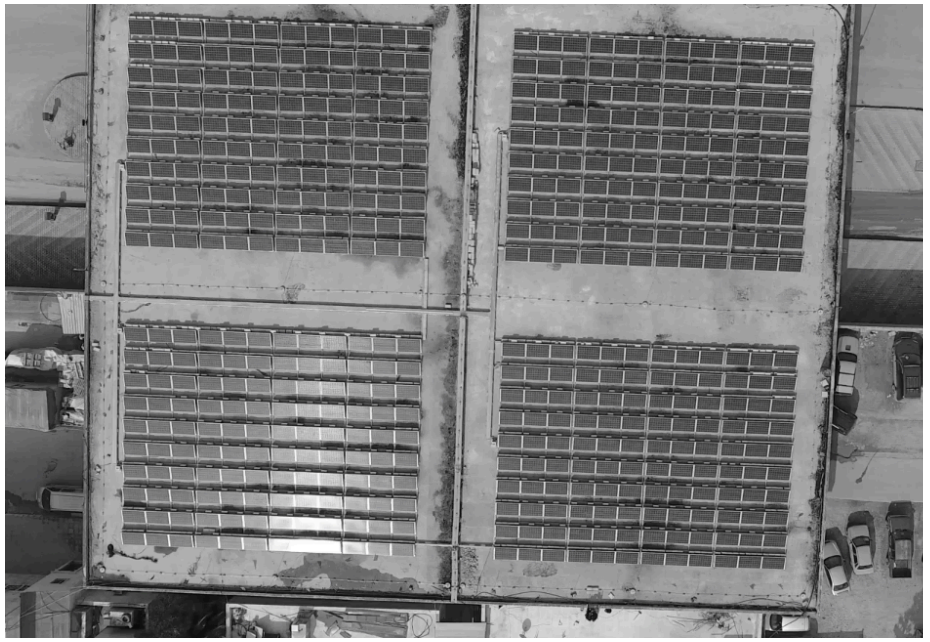


(General Hospital, North Syria – Courtesy of UOSSM – Syria Solar)

Assessment: Assessment Phases

1. **Planning of Assessment**
   - Identifying Approach & Scope
   - Developing the Data Collection Tool (Questionnaire)
   - Planning the Data Analysis Framework
2. **Performing Field Data Collection**
   - Collecting data from sites
   - Organizing and cleaning data set
3. **Data Analysis and Synthesis**
   - In accordance with Data Analysis Framework

Data Collection Tool Example (OPEN SOURCE):
https://www.kobotoolbox.org/

KoBoToolbox

(or other internally developed tools for UN agencies or NGOs)

Assessment: Data Collection Tool

A. **General Information**

PRIMARY HEALTH CARE (PHC)

B. **Health Services** (*services, impact, beneficiaries*)

C. **Assessment of Space Availability & Conditions** (*Roof, Elec. room*)

D. **Quantification of Energy Needs**

E. **Assessment of Energy Infrastructure**

Assessment: Data Collection Tool

A. General Information

- Location and Governorate
- Facility Code
- General information
- Facility Management

B. Health Services

- *Health Services:* Types and quantity of services and departments
- Type and category of health facility (For Example Center Classification: 1,2,3)
- Impact & beneficiary quantification
- Categorization for Impact and Geographical Distribution

Assessment: Data Collection Tool

C. Spaces

- Availability of Roof Space & Ground Space
- Battery and Inverter Room (Electrical)

D. Quantification of Energy Needs

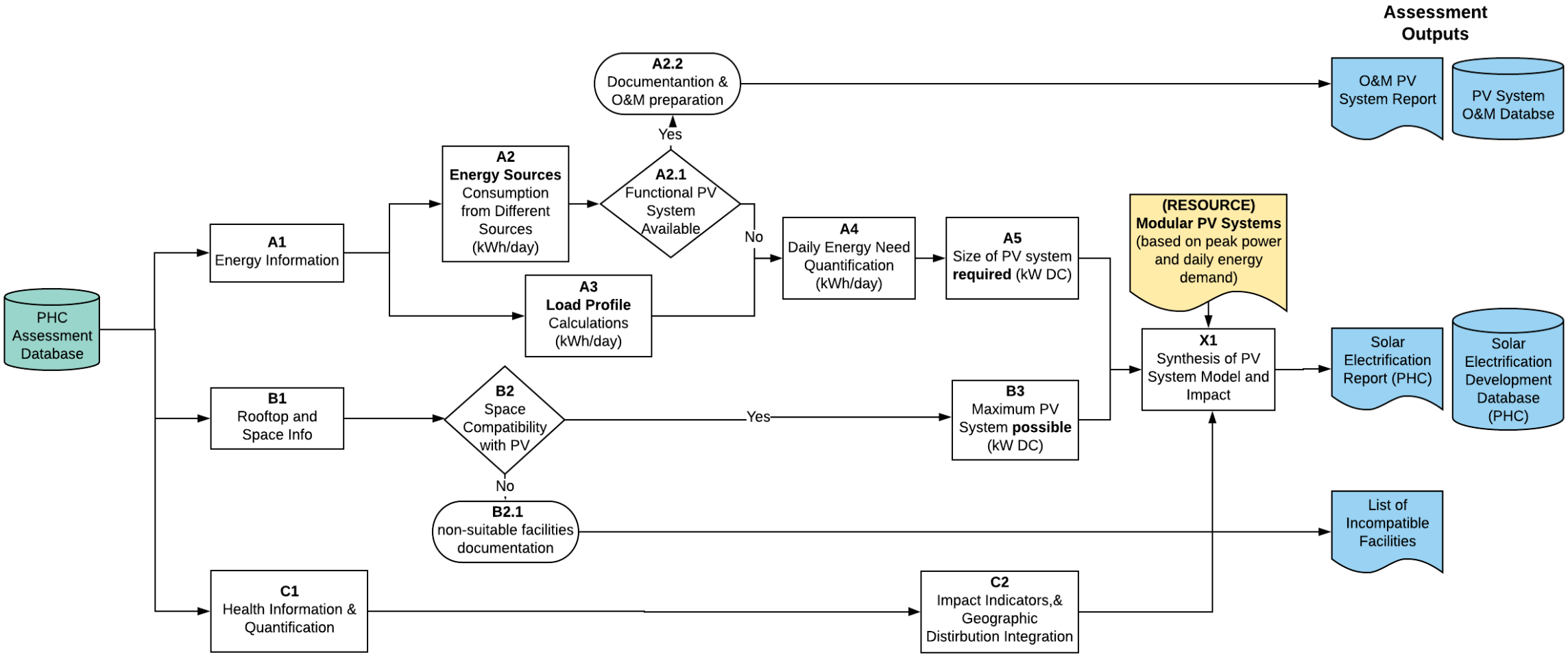
- Energy quantification based on Load Profile (Hospitals Requires Data Loggers)
- Energy quantification based on the source (Diesel, Grid, Others)
- Possible modularization of energy demand based on service/clinic

E. Electricity Infrastructure

- Status of grid availability in the area
- Possible extension to target region

PHC EXAMPLE

Assessment: Data Analysis Framework



Modular Size of PV systems (Example)

<u>Modular PV Systems based on existing & potential energy demand:</u>

- System A | **5** kWp
- System B | **7.5** kWp
- System C | **10** kWp
- System D | **12.5** kWp
- System E | **15** kWp
- System F | **20** kWp

Example of **10** kWp PHC

Example of **20** kWp PHC

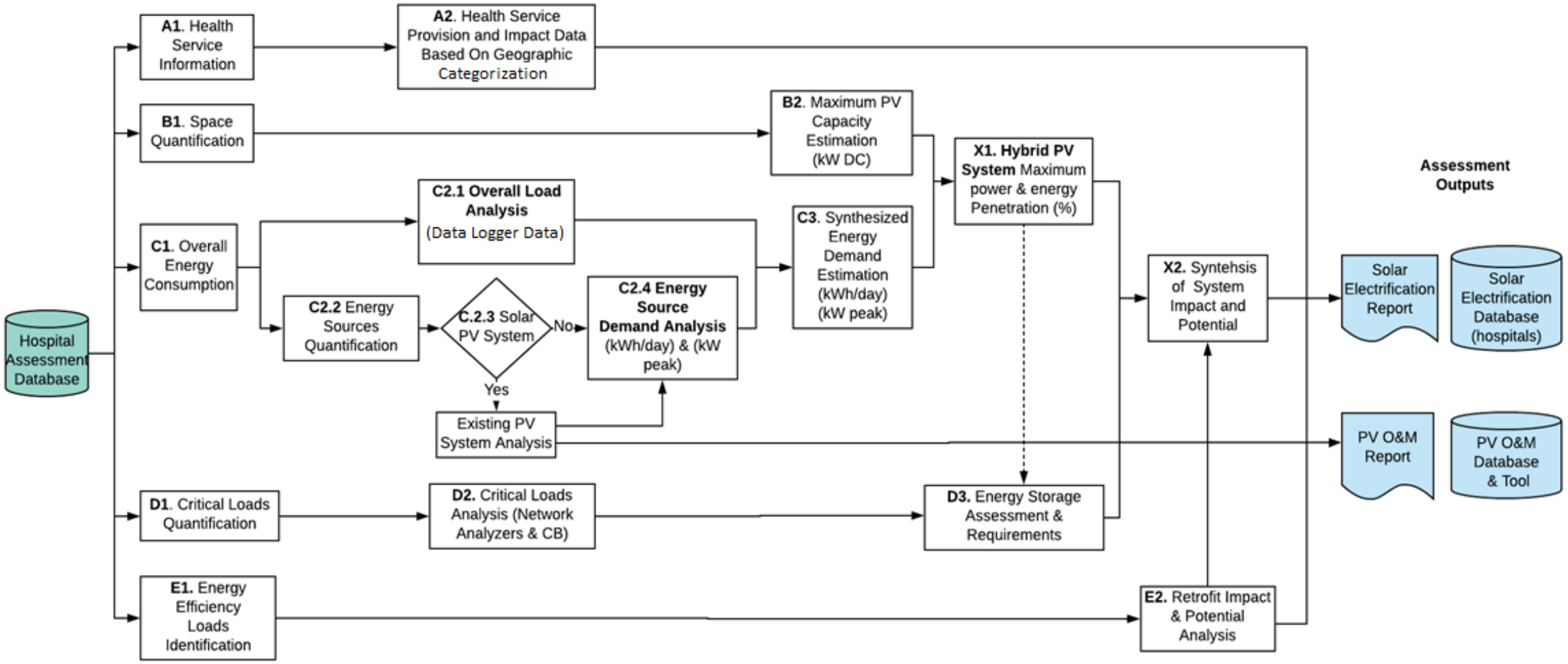
(Courtesy of UNICEF – MENARO)

Primary Health Care Center| **5 kWp** (Example Load Table)

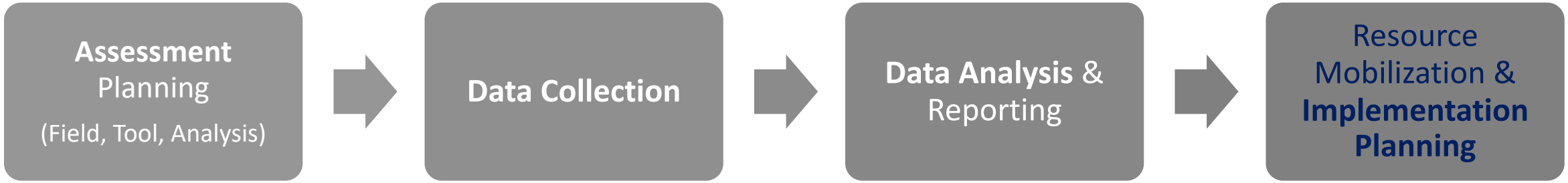
PHC Center | TYPE A 1 | 5 kWp							
Load Name	Category	Department	Quantity	Load (W)	Total Load (W)	Hours	kWh /day
Fan - 56 Inch	General Services	All	4	30	120	7	0.84
LED Light	General Services	All	5	40	200	7	1.4
Microscope	Medical Equipment	Laboratory	1	100	100	7	0.7
Electric Centrifuge	Medical Equipment	Laboratory	1	230	230	7	1.61
Colorimeter	Medical Equipment	Laboratory	1	60	60	7	0.42
AutoClave	Medical Equipment	Clinic	1	1800	1800	2	3.6
Nebulizer	Medical Equipment	Clinic	1	50	50	7	0.35
Vaccine Fridge (Iceline)	Medical Equipment	Vaccine	1	300	300	11	3.3
Vaccine Freezer (Iceline)	Medical Equipment	Vaccine	1	300	300	11	3.3
Charging - Telephone	IT- Admin	Extra	2	60	120	5	0.6
Laptop	IT- Admin	Extra	1	100	100	12	1.2
LED - Lamps	IT- Admin	Extra	3	35	105	8	0.84
Water Pump	IT- Admin	General	1	1000	1000	2	2
						Total	20.16

HOSPTIALS EXAMPLE

Assessment: Data Analysis Framework



Assessment: Summary



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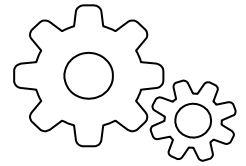
Implementation: Design & Engineering



Modalities?

- *Internal Engineering Unit/Personnel* (In-House)
- *Engineering Firm*: Through competitive tender (Local or International)
- *External Engineering Entity* (Technical NGOs, Public Entity, University)

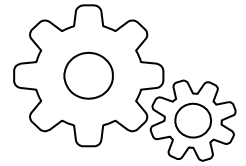
How to decide?

- Your Organizational Capacity
- Local Technical Staff Experience
- Existing Human Resources
- Scale of Project

Functions?

- Validation & Update of Main DB
- Engineering Study (CAD Layouts, etc)
- Bill-of-Quantities and Specification

Implementation: Design & Engineering



1. Trained engineering personnel to be engaged as early as possible
2. Upon resource allocation for the project: validation of site conditions, data, and sizing is necessary before installation planning. Especially if long gap between assessment & mobilization.
3. Must take into consideration international markets, advanced technical solutions (new modules technologies, and storage tech like Lithium), and design/installation standards.
4. Prioritize Energy Efficiency measures **before** solar PV electrification.
5. Critical Loads Segmentation & Integration with existing networks.

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Implementation: Procurement of Goods & Services

Modalities?

A. **Turn-Key:** Supplier provides materials + installation services. Engineering personnel (internal/external) to develop spec and supervise procurement.
B. **Segmented:** Informed by qualified personnel, organization procures materials according to spec and BOQ from regional or international markets & engages tender for local installation. Options:
    - Open International/Regional Tenders
    - Long Term Agreements (LTAs)

How to decide?

- Local and regional market access and competitiveness
- Internal capacity of the organization

Implementation: Procurement of Goods & Services

1. Qualified engineering personnel to lead procurement (RFPs, spec, etc)
2. Evaluate procurement options and modalities considering economic viability, product range, and accessibility.
3. Consider market accessible viable solutions (lithium ESS), and evaluate competitiveness according to **life-time cost**, and **not only initial cost** (levelized cost of kWh – LCOE).
4. Consider restrictions **due to remoteness** of target region/location, and integrate mitigation within your procurement strategy.
5. Assess existing implemented solutions locally and extrapolate challenges and lessons learned if any.

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Implementation: Installation Planning

1. Engineering personnel must consider **geographic** and **environmental consideration** in the target region *(variations exists in one country)*.
2. Installation planning must streamline field implementation: including creation of layouts (civil, electrical, mechanical/mounting).
3. Consider **grouping** and **clustering facilities** into lots, based on the local market of contractor or project management modality selected.
4. Ensure that *design and installation* best-practices and standards are integrated into the installation planning process considering international **and** local codes.

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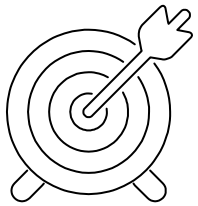
Implementation: Quality Control & Monitoring

1. Qualified Engineering Team that conducted Installation Planning should lead the quality control, supervision and monitoring
2. Advisable to engage technical personnel from the local authorities (Ministries or Directorates of Health, Electricity – if relevant)
3. Formulate Supervisory Committee to ensure follow up.
4. Quality Control standards shall be in accordance with norms for Installation, Testing, and Commissioning.



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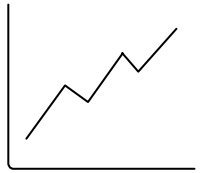
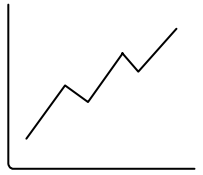
Implementation: **Sustainability + O&M**

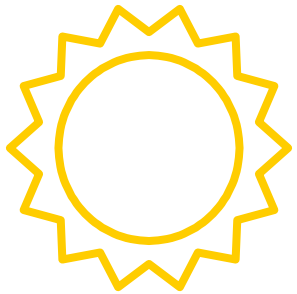


	Option A	**Option B**
Service Lead	Private Service Provider: 1. Installation company 2. Independent O&M company	Local Authorities (Ministry of Health – Province/State Level)
Description	O&M functions would be performed by the company according to an agreed upon TOR and accountable to the Organization or the health authorities.	The local authorities would be responsible for the O&M functions and would manage the direct activities required.
Pros (+)	Quality Management of the service would more robust due to contractual obligation to meet specified standards.	Contributes to building the internal capacity of the public authority enables.
Cons (-)	Sustainability would be problematic if financial resources are not available. Dependency on external funding.	When weak public administration structure, can cause issues, vandalism, lack of adequate follow up.

Implementation: Sustainability + O&M



1. Plan to integrate O&M function **early** in the process
2. Engage all relevant **stakeholders** *(Health Authorities, Staff Management, Installation Service Providers)*
3. Ensure **modality of O&M monitoring** is in place
4. Consider **financial resource availability for** O&M future costs
5. Consider **battery replacement** costs in the initial planning process



Summary of What to Keep in Mind

Summary: 7 tips for Practitioners

1. Plan well for a comprehensive assessment & **prioritize needs.**
2. **Engage qualified** engineering personnel **as early** as possible.
3. Determine the **best long-term value** for **procurement internationally based on market price, advanced solutions (lithium), and longevity.**
4. Include **technical authorities personnel** early in planning (if relevant).
5. Consider **options for implementation for different phases** based on local conditions, experience, and best-practices.
6. **Pursue standards** in all phases, and **build on previous experience** locally.
7. **Plan well in advance for O&M** (funding, personnel, management)

Thank you

talal.a.kanaan@gmail.com