Photovoltaic Systems for Rural Health Facilities

Georg Bopp, Adnan Al-Akori

Fraunhofer Institute for Solar Energy Systems ISE

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Introduction and methodology

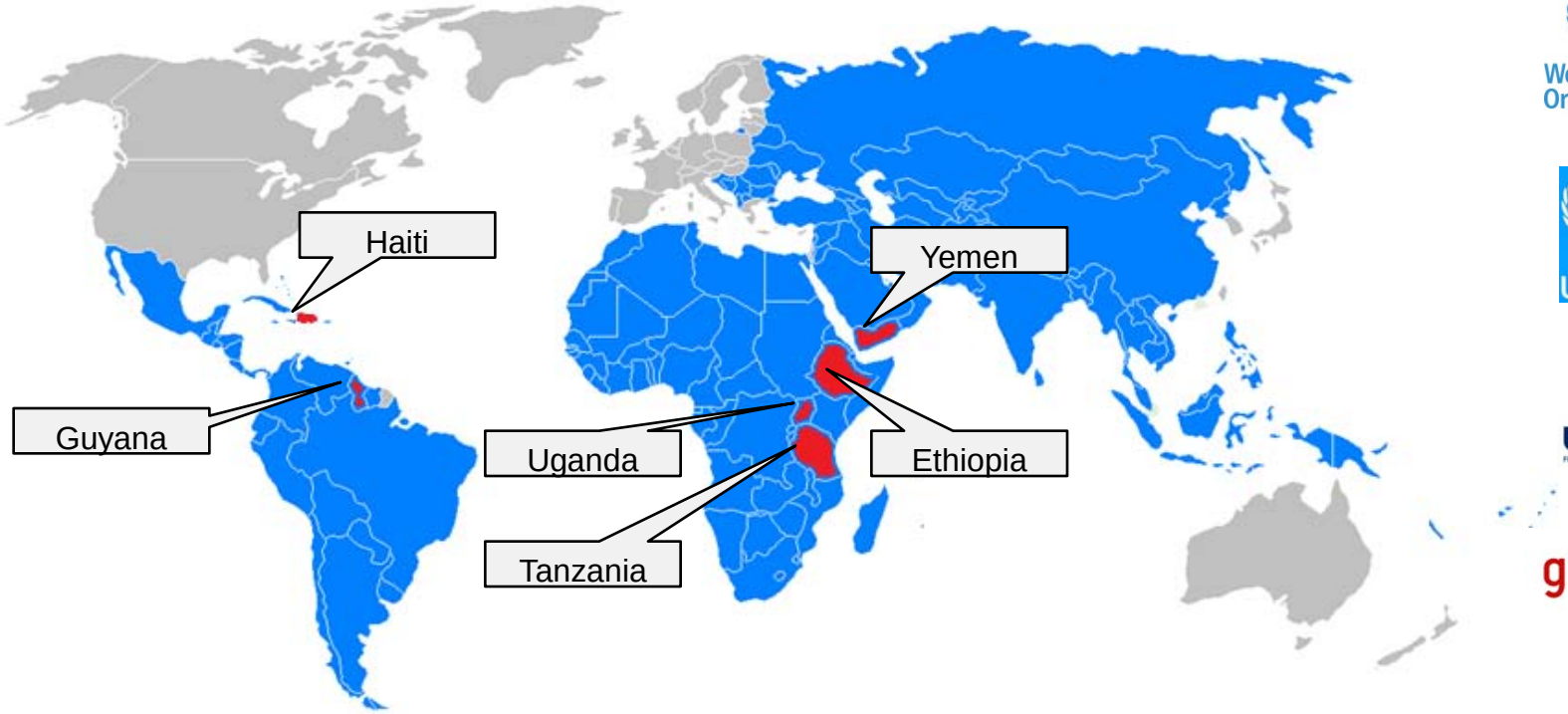
- Work was done inside International Energy Agency Photovoltaic Power Systems Programme IEA-PVPS task 9 “deploying PV services for regional development”
- Report: “PV Systems for Rural Health Facilities in Developing Areas – A completion of lessons” learnt is available at www.iea-pvps.org
- Methodology Applied
  - Using survey templates/ questionnaire*
  - Contact international organizations

World Health Organization USAID FROM THE AMERICAN PEOPLE unicef giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

  - Contact PV companies
  - Analysis existed projects

International Experience in Developing Countries

- **Selected Countries**



- **Involved Organizations**

World Health Organization

unicef

USAID
FROM THE AMERICAN PEOPLE

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Source: Wikipedia (adapted)

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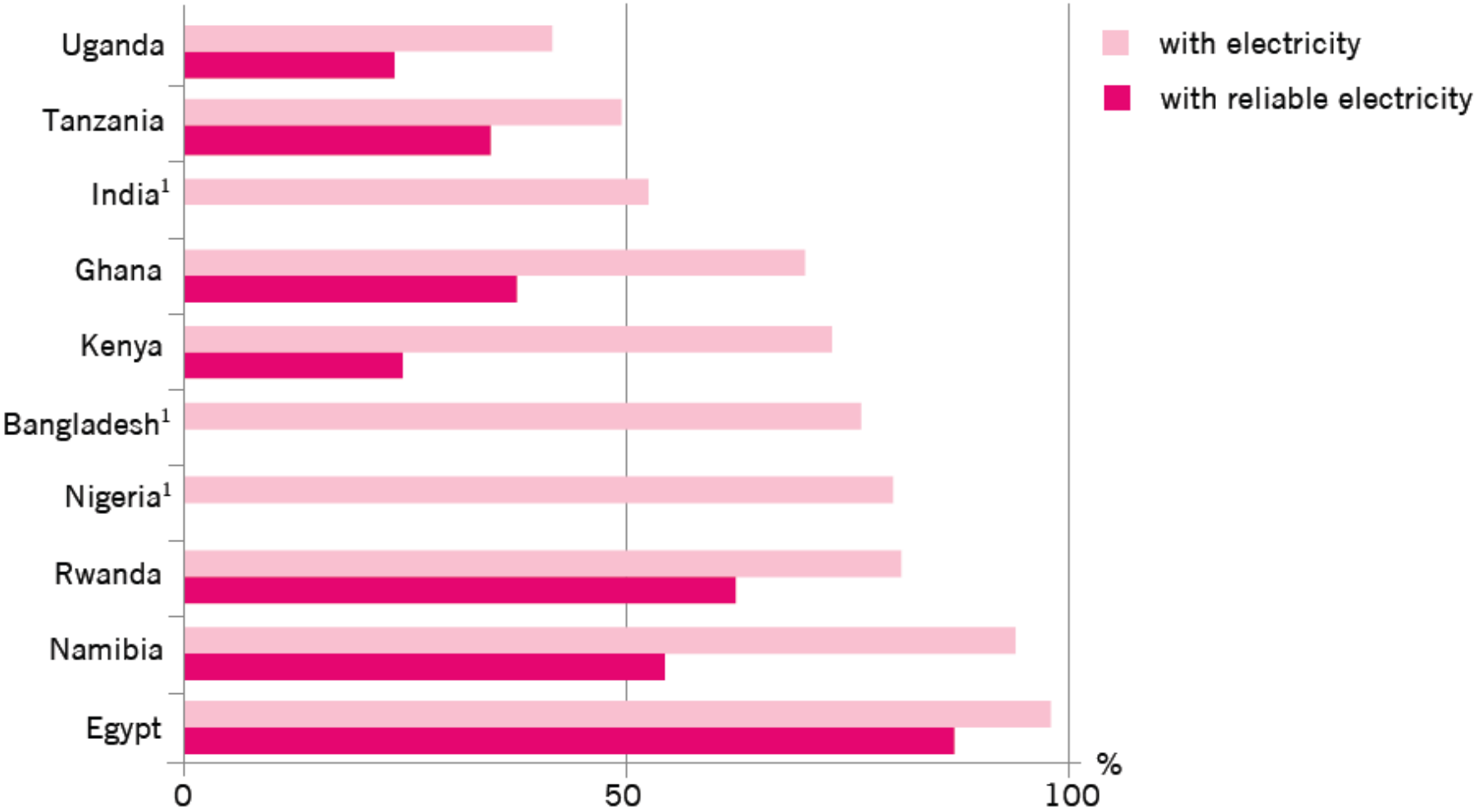
International Experience of PV in Health Facilities

Electricity Access in health facilities



Source: Poor People's Energy Outlook 2013

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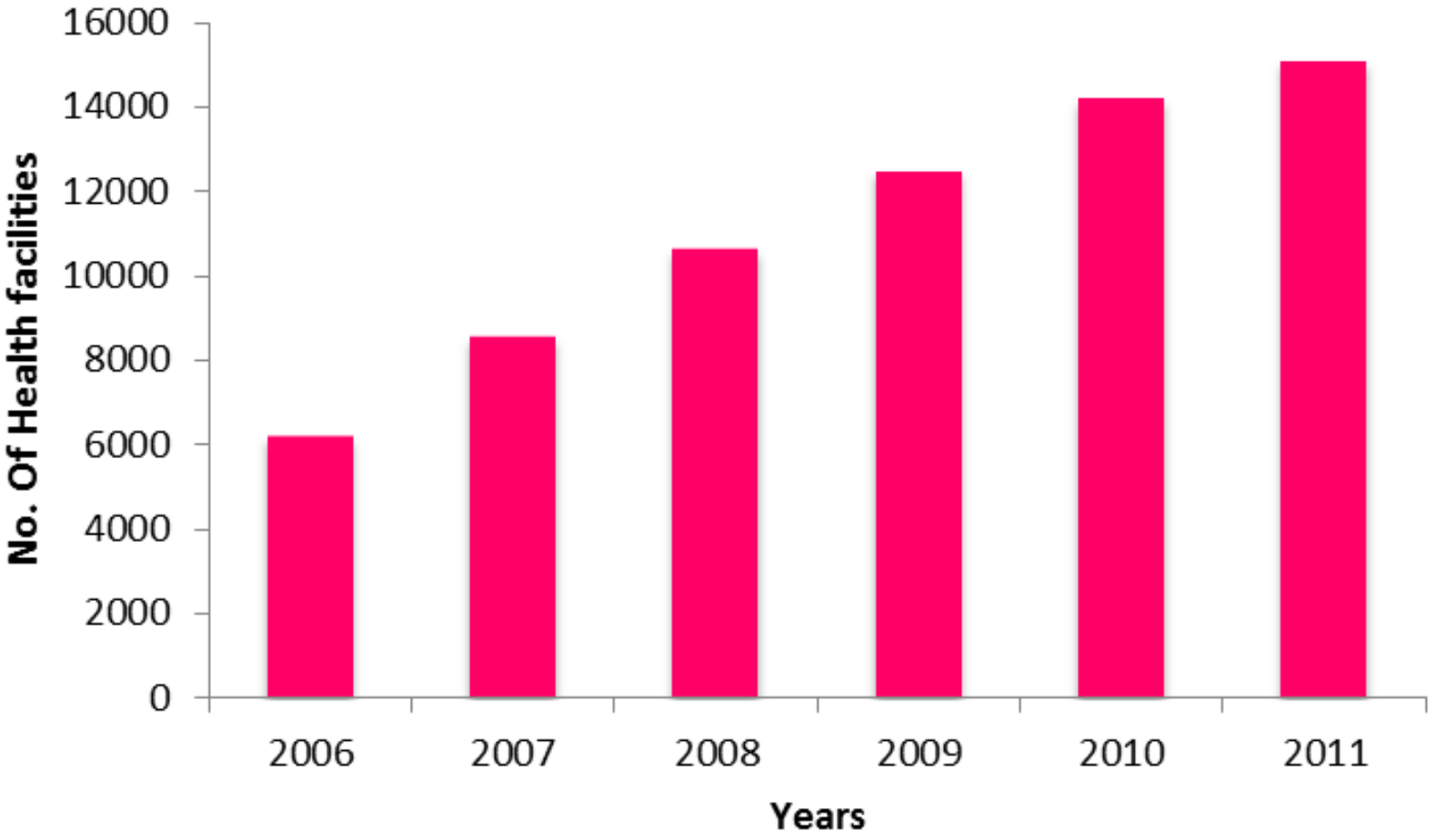
International Experience of PV in Health Facilities

Growth in number of small health facilities in Ethiopia



Source: Poor People's Energy Outlook 2013

Energy demand in health facilities

- **Classification of health facilities /** ***daily energy consumption***
  - Small size also called

    health posts: basic services

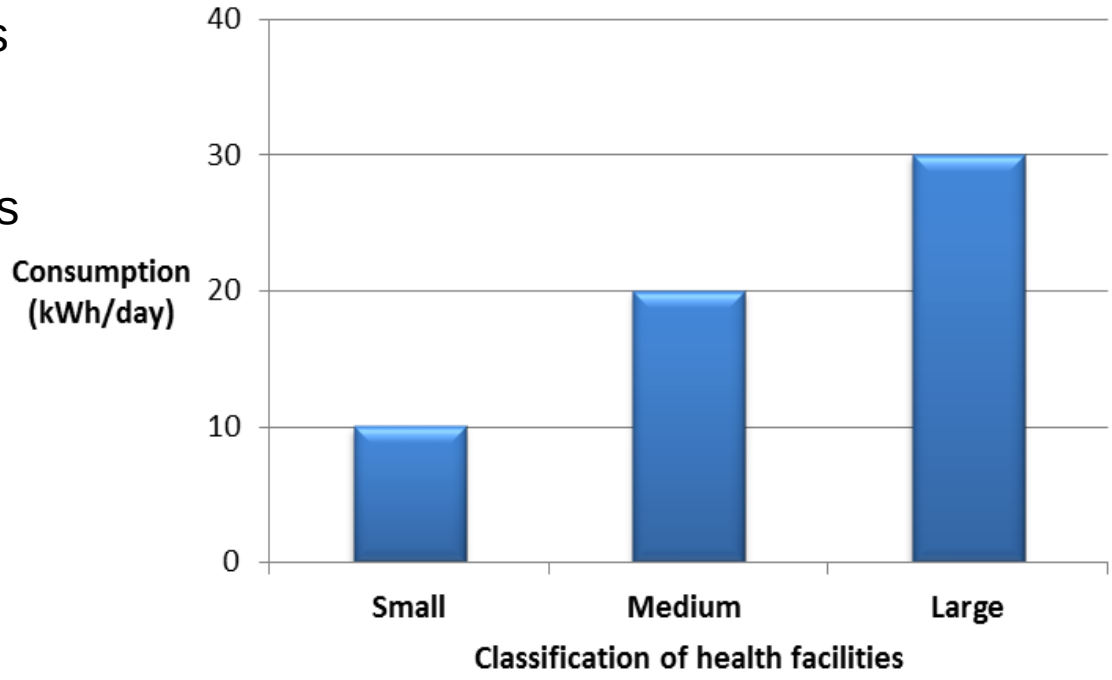
    up to 10kWh/day
  - Medium size: basic services

    + blood testing, dental,..

    up to 20kWh/day
  - Large size: small hospitals

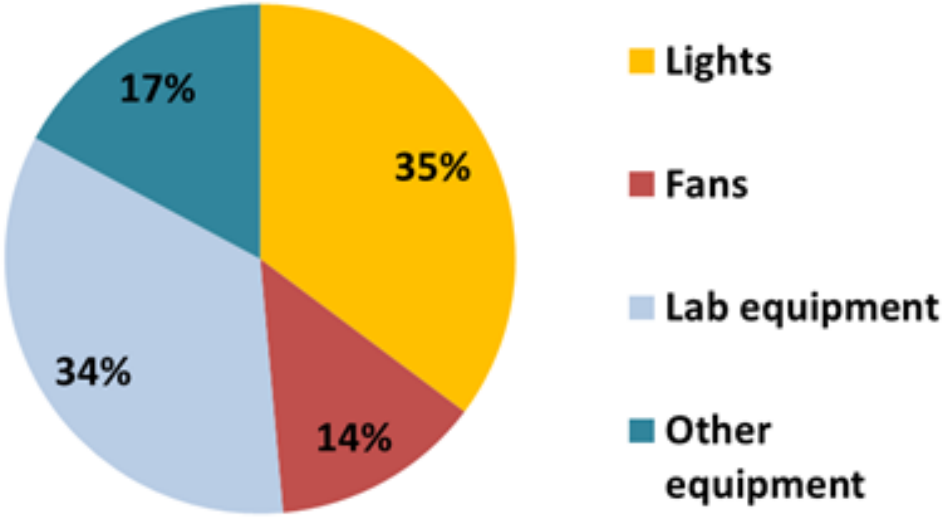
    > 120 beds

    over 20kWh/day



Distribution of Energy demand in small health facilities

- **Main load**
  - Vaccine refrigeration shares 30% of the total load when its included
  - Lights and fans
  - Lab equipment



  - Other equipment (computer, etc)

System design

- Load estimation
- Power generation options
- Solar radiation
- System configuration
  - Voltage
  - DC& AC coupling
  - Backup generator
  - System components
  - Losses

- Designing tools (Homer, RETSreen, Pvsol, Pvsyst,..)
- Design optimizations
- International standards

System design

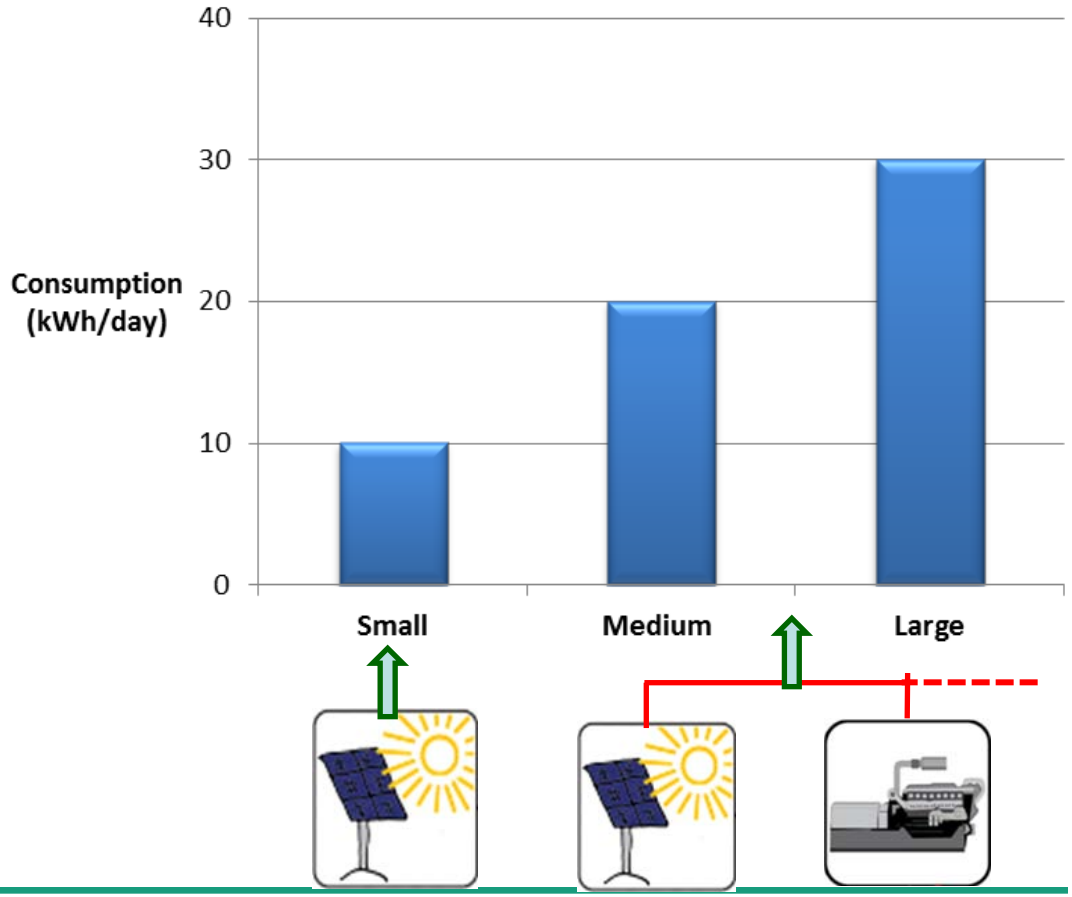
- **Power generation options**
  - Small:

    PV stand-alone system

    mainly DC coupled
  - Medium and Large:

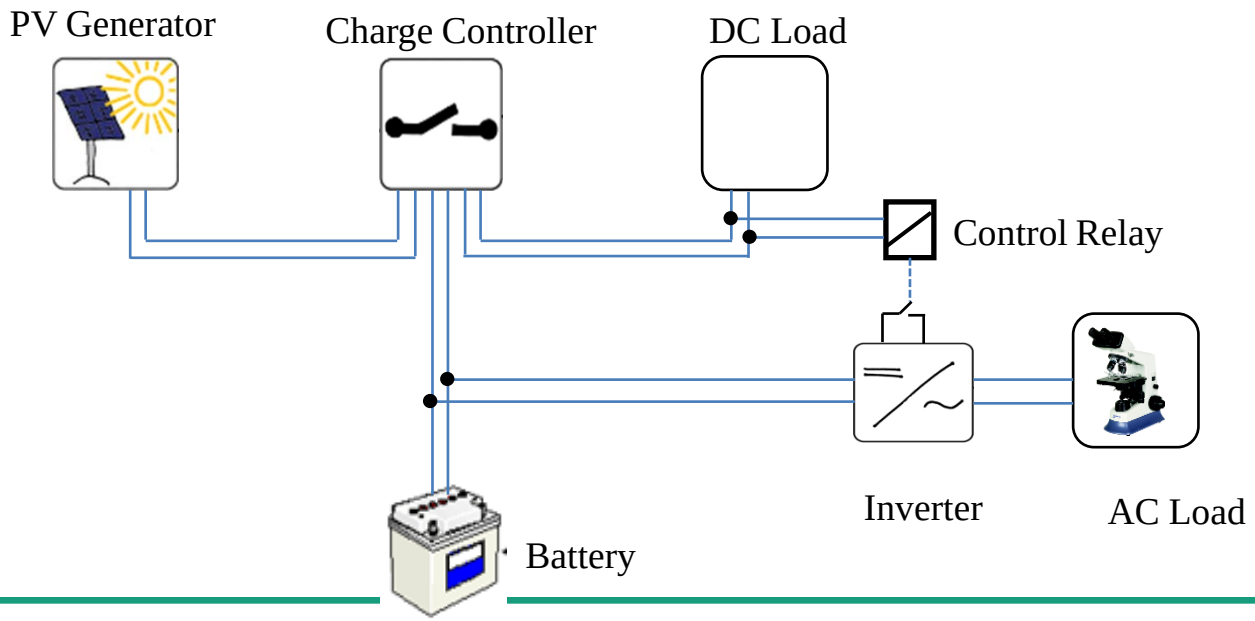
    PV Hybrid system

    DC or AC coupled

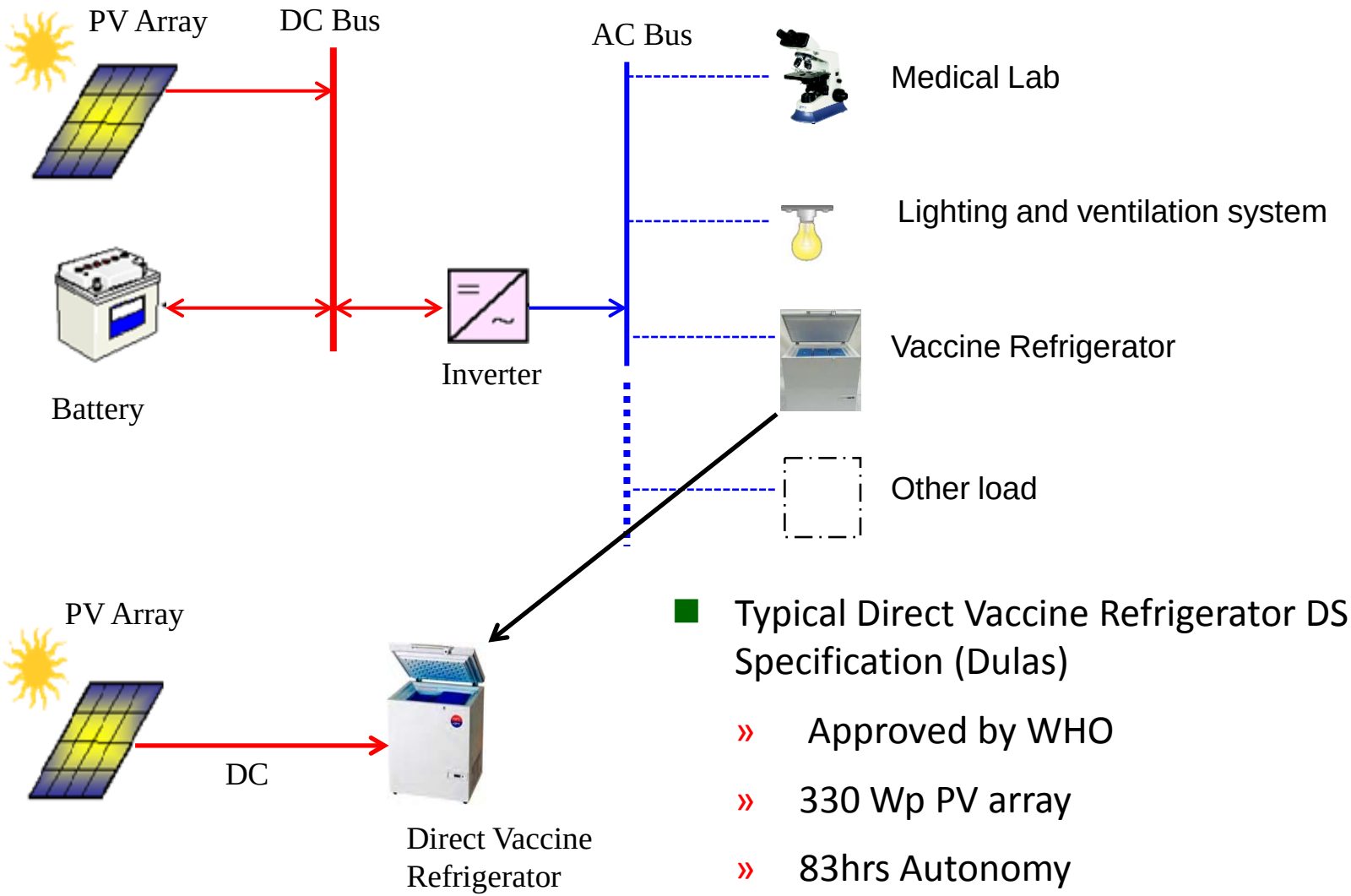


Technical lessons learnt

- Compressor refrigerators are more efficient than absorption refrigerators (about 5 times less energy), but not independent
- An independent PV supply system only for a vaccine refrigerator is recommended
- Direct-drive refrigerator is independent from rest of energy system
- Do not connect inverter directly to battery, instead use a control relay



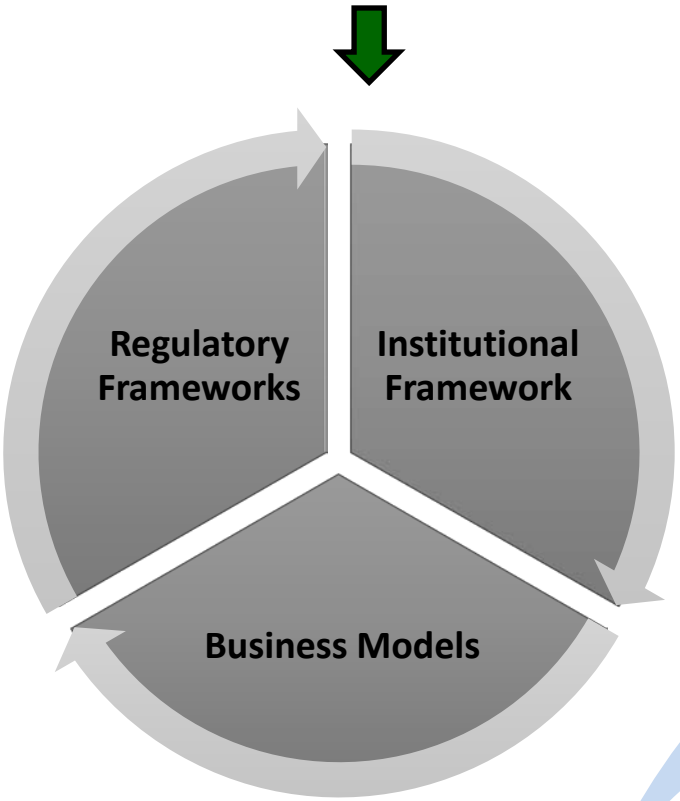
Reliable operation of Vaccine Refrigerator



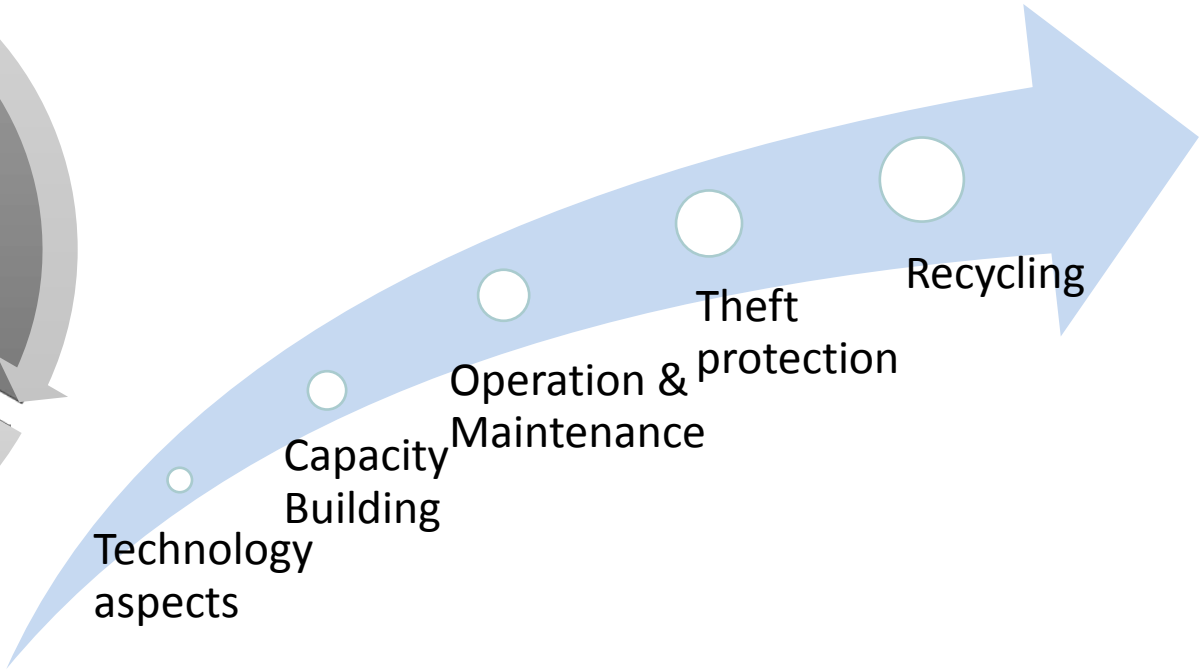
- Typical Direct Vaccine Refrigerator DSR Specification (Dulas)
  - » Approved by WHO
  - » 330 Wp PV array
  - » 83hrs Autonomy

Lessons learned concerning sustainable elements

- **Support factors for PV supply**



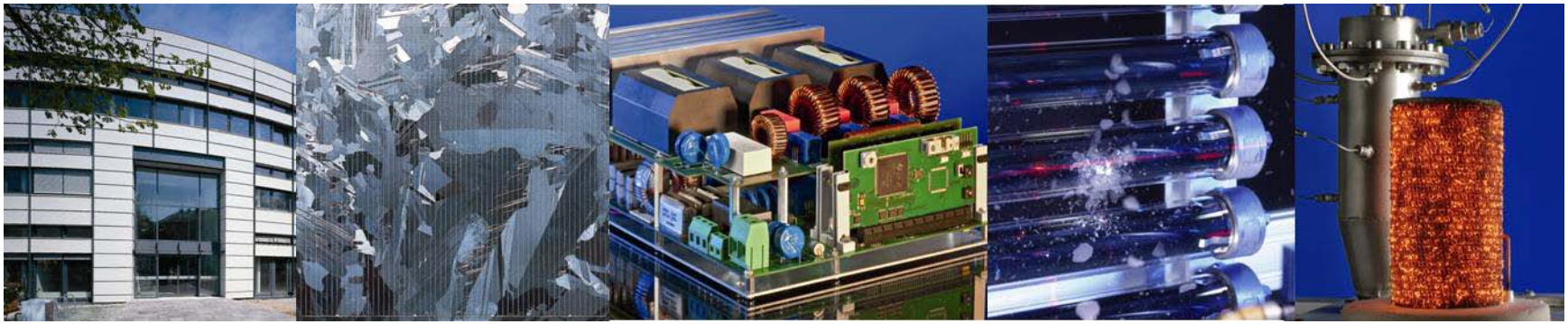
- **Factors enhancing the sustainability**



Conclusion

- PV stand-alone systems became an attractive power generation option, mainly for small rural facilities;
- As there are success stories of utilizing PV systems, however some barriers and mistakes are still existed;
- Matching energy demand and supply is an important task of PV systems planning;
- Direct-drive vaccine refrigerators most probably will be the most suitable type for rural health facilities;
- Allocating a regular finance for maintenance is the backbone of sustainability of PV systems.

Thank you



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The report “PV Systems for Rural Health Facilities in Developing Areas – A completion of lessons learnt” is available at **www.iea-pvps.org** task 9

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