

SOLAR PV ENERGY IN HOTELS - BALI

An aerial photograph of a hotel complex in Bali. The image shows several large, circular, white, umbrella-like structures arranged in a row. To the right, there is a large building with a flat roof covered in solar panels. A yellow circle is drawn around a specific area on the solar panel roof, with a yellow dot in the center. The background is a lush green landscape with trees and a winding path.

Overview
Dec 2021

www.elisabetebellaunde.com

Contents

1. Benefits of Solar Photovoltaic (PV) Systems in Hotels
2. Eco – Tourism – Sustainability
3. Types of Solar PV Systems for Hotels
4. Types of Solar PV Installation for Hotels
5. Basics of Rooftop Solar PV System
6. Grid-Tie Rooftop Solar PV System – How it Works?
7. Policies Relevant to Rooftop Solar PV – Bali
8. Design of Solar PV System in Hotel
9. Photovoltaic Power Potential in Bali
10. Hotel Case Study – Nusa Dua, Bali
11. Annex - References

1 Benefits of Solar PV in Hotels

- ✓ **Reduce operating costs** over the long term by reducing energy bills (*Hotels can use 50% more energy than residential block of similar size, due to energy-intense applications such as cooling systems, pool and water heating, indoor and outdoor lighting and other electrical appliances*)
- ✓ **Green marketing**: Attract eco-friendly guests, generate favorable publicity, raise level of customers satisfaction (*as guests are becoming more aware of hotel environmental policies*)
- ✓ **Contribute to National and International Environmental Targets**: Reduce carbon footprint, reduce CO2 emissions
- ✓ **Under feed-in tariff schemes and/or net-metering policies, compensating the transfer of solar energy** into the national electricity grid
- ✓ **Provide power supply to hotels in remote areas** without a reliable utility grid connection and dependent on decentralized diesel-based technologies.
- ✓ **Reduce dependence on fossil fuels** (ex. Diesel for generators)



2 Eco – Tourism - Sustainability

"83% of global travelers think sustainable travel is vital, with 61% saying the pandemic has made them want to travel more sustainably in the future" - Booking.com 2021 Sustainable Travel Report

"almost three quarters of global travelers intending to stay at least once in an eco-friendly or green accommodation" - Booking.com 2019 Sustainable Travel Report

Agoda Sustainable Travel Trends Survey 2021 reveals people's top concerns about tourism's impact, and measures to make travel more sustainable, with deforestation and energy inefficiencies ranking joint third



Source www.agoda.com

3 Types of Solar PV Systems for Hotels

1- SMALL INDEPENDENT UNITS (not connected to public grid).

- ✓ Ex. Solar streetlights, outdoor lighting, fountains or small pumps, CCTV cameras...



2- ON-GRID / SUPPORT SYSTEMS

- ✓ Solar energy helps to reduce the electricity bill from the grid (self consumption)
- ✓ Batteries can be added to increase reliability and the solar fraction.
- ✓ In case of a feed-in tariff or net-metering scheme in place, excess solar power can be exported to the grid for a profit or credit
- ✓ In areas with unreliable power supply, solar system with a battery and/or back up generator ensure energy in times of power shortages.



3- OFF-GRID / STAND-ALONE SYSTEMS

- ✓ Solar energy is a great alternative for hotels in remote off-grid areas (ex. Islands)
- ✓ Solar energy is the main source of electricity and an additional back-up system, such as diesel generators and batteries, is integrated to cover the energy demand during non-sunshine hours



4 Types of Solar PV Installation for Hotels



- **Carport-mounted solar PV system** (also convenient for electric-vehicle charging stations)
- **Integrated solar PV into canopies** (ex. around pool areas)



- **Façade integrated solar PV system**





- **Ground-mounted solar PV array** (unused grounds)



✓ **Roof mounted solar PV system**
(centralized or decentralized)

Photo by Swimsol

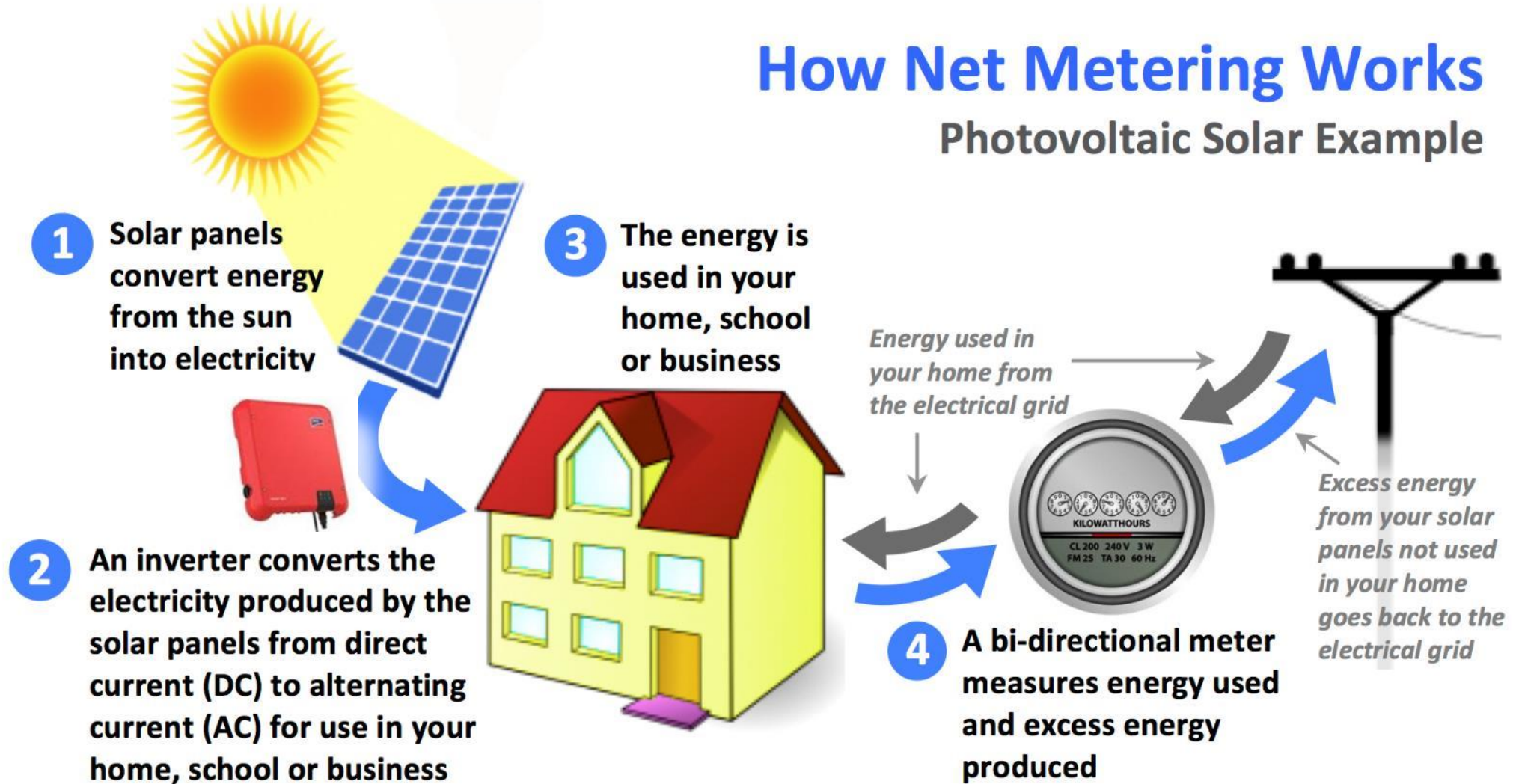
5 Basics of Rooftop Solar PV System

Solar PV System	Description	Remarks
Application	Electricity supply	
Working Principle	Solar cells (aka Photovoltaic PV cells) transform sunlight (solar irradiation) directly into electricity	
PV Generators	Solar PV Modules or Panels: <ul style="list-style-type: none"> • Monocrystalline and Polycrystalline (based on silicon) • Thin Film modules 	
Interface to Hotel/Connection	PV Inverters & Wiring: Convert DC into AC power It either synchronizes with an existing grid or builds its own grid	
Connection Point	The solar power system is connected to either the mains or sub-distribution board of the hotel.	Mono or Bi-directional energy meter at Point of Common Coupling (PCC): Interconnection point with the existing power distribution infrastructure, defines the boundary between the customer and utility.
Alternative Storage	Batteries with charge controller to store excess solar energy at peak times, whilst stabilizing the solar power at times with sunshine interruptions (e.g. clouds)	<ul style="list-style-type: none"> • Lead-acid (LA), one of the most cost-effective batteries. • Lithium-ion (Li-ion) batteries are more expensive, have the same capacity of lead-acid types, but at 20% of the weight. • Nickel Iron (Ni-Fe) batteries have a longer lifetime, but also high losses
Back-up/Supplementary Energy	Public Grid (Grid-tied system) or Generator	

6 Grid-Tie Rooftop Solar PV System – How it Works?

How Net Metering Works

Photovoltaic Solar Example



Note: This is a solar PV system without battery. If there is no net-metering scheme, then no excess energy can be exported to the grid.

7 Policies Relevant to Rooftop Solar PV - Bali

2017	Presidential Decree No. 22/2017 - RUEN (target 6.5GW Solar PV by 2025, mandatory use of solar panels covering a minimum of 30% and 25% of the rooftops of government buildings and houses/apartments respectively)
2018/19	MEMR Regulation No. 49/2018 on Use of Rooftop Solar Power Generation Systems by Consumers of PT Perusahaan Listrik Negara, amended by MEMR Regulation No. 16/2019 (export-import kWh multiplier limited to 65%)
2019	Government of Bali Regulation No. 45/2019 concerning Bali Clean Energy , which regulates the adoption of rooftop solar power plants on buildings with a certain area, both public and private buildings (*).
2020	Bali Provincial Regulation No. 9/2020 - Target 1,254 MW Solar PV in Bali The Province of Bali has created some guidelines to develop and utilize energy in the region in 2020-2050
2020	Regional general energy policy and planning (RUED) at Denpasar on Monday, 28 September 2020: intended to control the current energy management while gradually switching to cleaner and nature-friendly energy sources
2021	PLN's Electricity Business Plan (RUPTL) 2021-2030 , renewable power plants receive 51.6% of share
2021	MEMR Regulation No. 26/2021 on Rooftop Solar Power Plant (revoked MEMR No.49/2018): export-import kWh multiplier is increased to 100%. Extended the accumulation period for any excess exported electric power from three to six months. Maximum solar rooftop capacity remains as 100% of the connected capacity from PLN

* Article 23: (1) Industrial, commercial and mall buildings with a floor area of more than 1,000 (one thousand) square meters; resort buildings with a land area of more than 3,000 (three thousand) square meters and hotel buildings of 4 (four) stars and above that use electricity sourced from Clean Energy proportionally receive special electricity tariffs/green tariffs from Electricity Business Actors.

8

Design of Solar PV System in Hotel

Define Objectives: Design based on maximum budget, available roof area, targeted energy savings, daily and seasonal power demand profile...

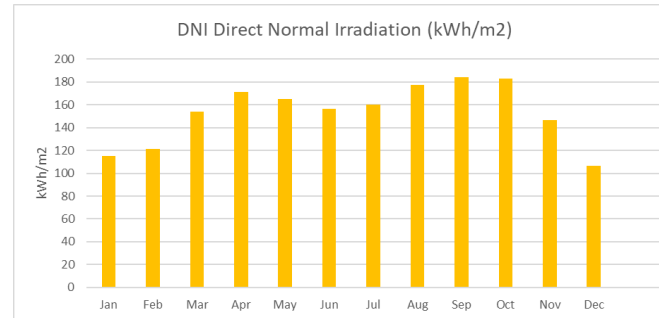
Process: The solar yield profile will be compared to the total energy demand profile to evaluate the solar system design and cost efficiency.

Some **essential steps** within the design to be followed:

1 Climate data serve as the basis for simulations of a solar power system using professional software, e.g. PV-Sol.

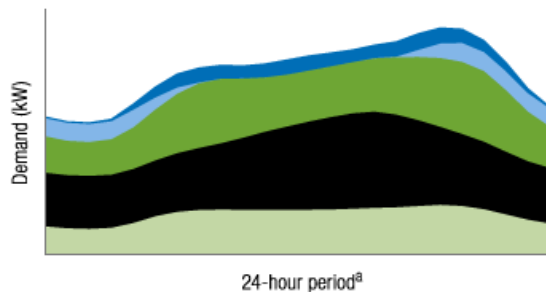
Includes:

- Global Solar Irradiation (Diffuse and DNI)
- Wind speed, Humidity, Air temperature
- Rainfall, No. Sunshine Hours per Year



2 Power demand: based on measured data or billing from the utility, for ideally at least 12 months, or calculated based on the expected occupancy rate incorporating the fixed power demand. Establish yearly, monthly and daily power demand profiles.

■ Cooking ■ Exterior lighting ■ Interior lighting ■ HVAC ■ Other



3 Check available areas for installation: Use building and roof drawings, aerial images, to check possible areas for installations, any limitations and shading effects and needed distances for wiring. Information about the roof structure is needed when choosing the possible PV support structure.



4 Location and voltage level for AC

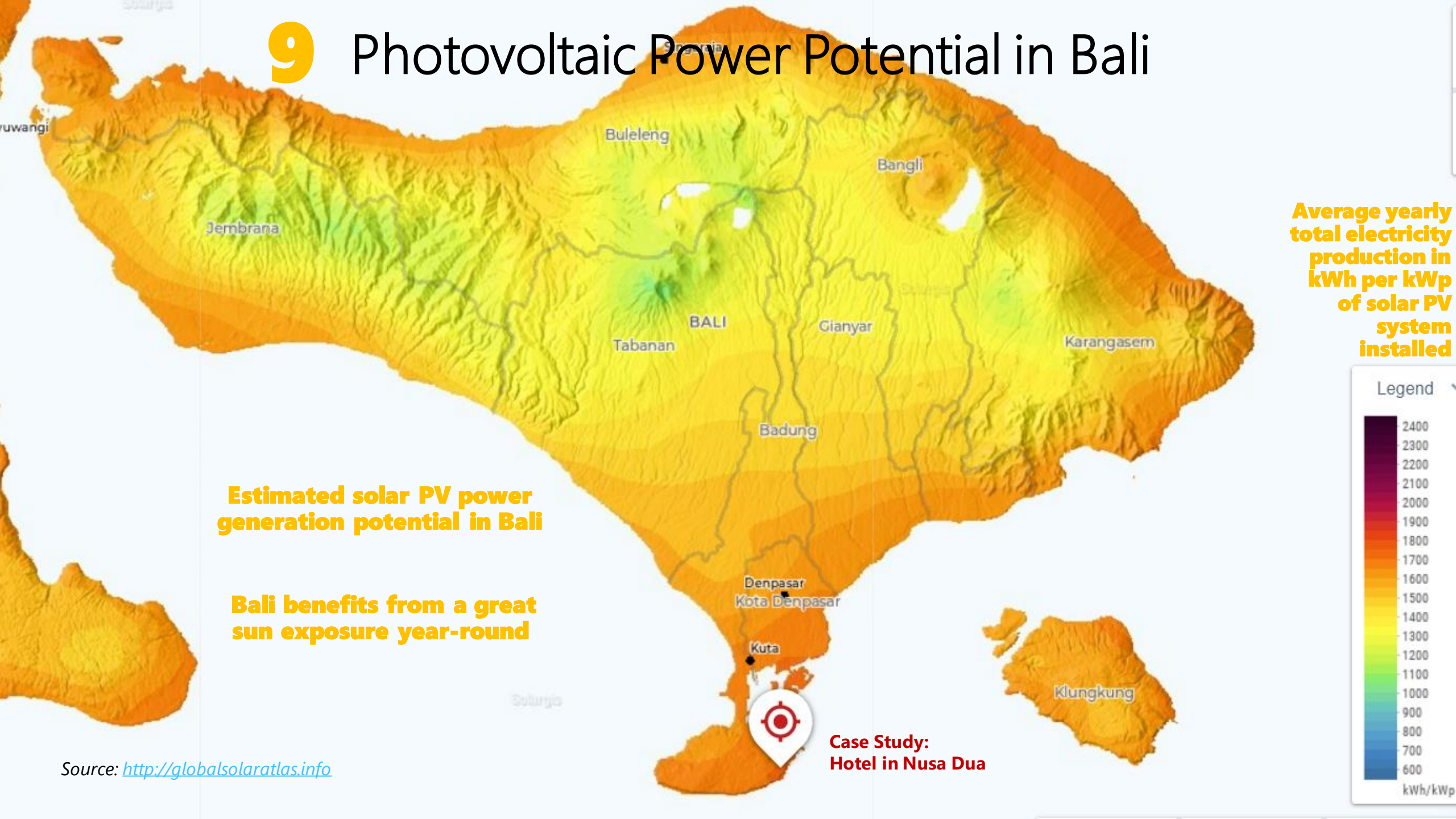
connection: Connection from the hotel to the grid should be identified with their maximum capacity in ampere or kVA, grid configuration, voltage and frequency level including their location within the hotel area.

5 System Design:

- Type and size of modules
- Design of support structure (wind load calculation, roof structural assessment...)
- Choice of inverters / String design
- Wiring and accessories
- Lightning protection

6 Simulation and financial analysis: calculate the solar energy production, electricity savings, return period...etc....

9 Photovoltaic Power Potential in Bali



Estimated solar PV power generation potential in Bali

Bali benefits from a great sun exposure year-round

**Case Study:
Hotel in Nusa Dua**

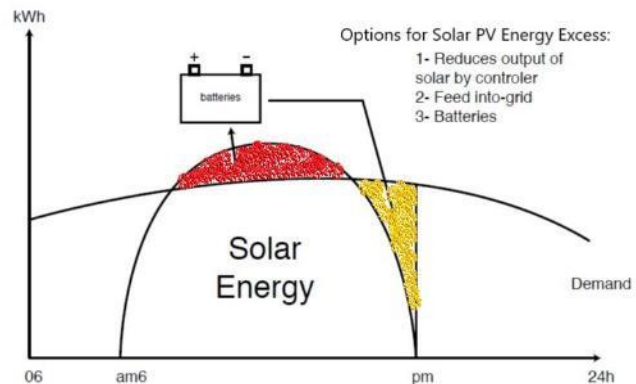
Source: <http://globalsolaratlas.info>

10 Hotel Case Study – Bali

Example: 5 Star Hotel in Nusa Dua, Bali / 200 rooms:

- Rooftop PV System Size: 300 kWp (no batteries)
- Rooftop area required: ~3,000 m² (assumed 10m² per kWp)
- Specific PV power output ~1,700 kWh/kWp per year or 4.7kWh/kWp per day (Source Global Solar Atlas)
- Estimated solar energy production: ~ 450,000 kWh/year
- Potential energy savings per month (year 1): ~ 50,000,000 IDR (3,500 USD). Solar energy excess can be exported to the grid for a feed-in tariff or credit.
- Total Investment (CAPEX): ~ 450,000 USD (based on 1,500 USD/kWp installed)
- Return period: 8 to 10 years
- Solar PV System Lifetime: 20-25 years
- O&M cost: 0.2-0.5% of the total investment per year
- CO₂ emissions reduction per year: 320 metric tons

Note: The higher the price of electricity, the higher the savings of the solar system and the shorter the payback time of the investment



11 Challenges

- **Reluctancy of Hotel Owners to commit to large capital energy projects**, as solar PV projects payback period might not be short enough to justify the capital expenditure
- **Lack of knowledge** among Hotel Owners and Managers regarding implementation of on-site Solar PV energy generation opportunities
- The **various management and ownership structures in Hotels** can make decision making a challenge
- **Physical constraints in hotels**: ex roofs crowded with equipment, not structurally sound enough, etc..
- **Need of supporting regulations with fiscal and financial incentives** to encourage Hotel Owners to install solar PV systems
- **Need of established competitive purchase tariff or net metering policy**, to have positive impact on solar rooftop PV market
- **Solar applications should be integrated with Energy Conservation and Energy Efficiency Plans** (using energy-saving technologies ex. LED lighting, efficient equipment, sensors, water saving devices...)
- **Visual impact of solar PV modules**, as it may affect the architectural style or aesthetics of the Hotel buildings



Annex References

- **"Solar Resource and Photovoltaic Potential of Indonesia"**, The World Bank, funded by ESMAP – May 2017
- **"Solar Resource Maps of Indonesia"**, The World Bank, funded by ESMAP – 2019 <https://globalsolaratlas.info>
- **"Solar Hub Kalkulator"** by IESR, <https://kalkulator.solarhub.id>
- **"Residential Rooftop Solar Potential: Technical and Market Potential in 34 Provinces in Indonesia"** - Institute for Essential Services Reform (IESR-2019) <https://iesr.or.id>
- **"National Energy General Plan (RUEN): Existing Plan, Current Policies Implication, and Energy Transition Scenario"** – IESR, 2020 <https://iesr.or.id>
- **"Benchmarking Specific Energy Consumption di Bangunan Komersial"** B2TKE – BPPT 2020 www.b2tke.bppt.go.id
- **"Panduan Perencanaan dan Pemanfaatan PLTS ATAP DI INDONESIA"**, ICED Indonesia Clean Energy Development II - June 2020
- **"Technical Manual on Solar PV and Solar Thermal Applications for the Hotel Sector in the MENA Region"** German Development Cooperation (GIZ) - 2017
- **"On-Site Commercial Solar PV Decision Guide For the Hospitality Sector"** U.S. Department of Energy - Sep 2015
- **PwC Indonesia Legal Alert Sept 2021 / No. 10** "MEMR No. 26 of 2021 on Rooftop Solar Power Plant Connected to the Electricity Network of the Holder(s) of the Electric Power Supply Business License for Public Interest"
- **GUBERNUR BALI PERATURAN DAERAH PROVINSI BALI NOMOR 9 TAHUN 2020** TENTANG RENCANA UMUM ENERGI DAERAH PROVINSI BALI TAHUN 2020-2050, Sep 2020
- **GUBERNUR BALI PERATURAN NOMOR 45 TAHUN 2019** TENTANG BALI ENERGI BERSIH, www.jdih.baliprov.go.id
- **Keputusan Menteri Energi dan Sumber Daya Mineral Republik Indonesia No. 188.K/HK.02/MEM.L/2021** tentang "Pengesahan Rencana Usaha Penyediaan Tenaga Listrik PT Perusahaan Listrik Negara (PERSERO) Tahun 2021 sampai dengan tahun 2030
- **Peraturan Menteri Energi dan Sumber Daya Mineral Republik Indonesia No. 26 TAHUN 2021** tentang "Pembangkit Listrik Tenaga Surya Atap yang Terhubung Pada Jaringan Tenaga Listrik Pemegang Izin Usaha Penyediaan Tenaga Listrik untuk Kepentingan Umum"



THANK YOU

Please give your feedback
or contact for further support.

www.elisabetebelaunde.com

Engineer & Consultant