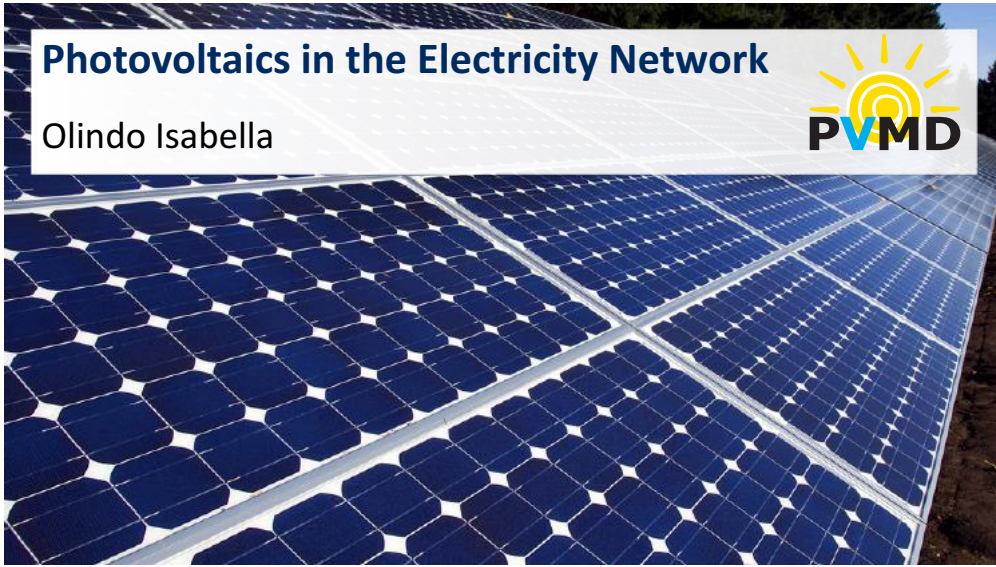


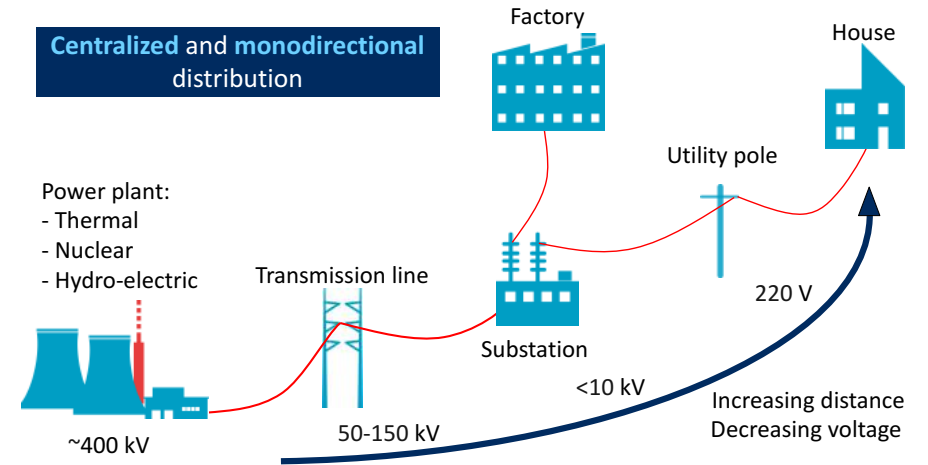
Photovoltaics in the Electricity Network

Olindo Isabella



Past Electricity Network

Centralized and monodirectional distribution



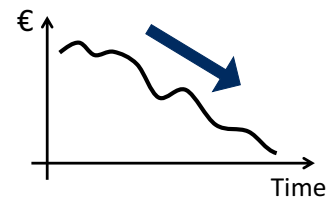
Future sustainable power system

Motivation for the transition

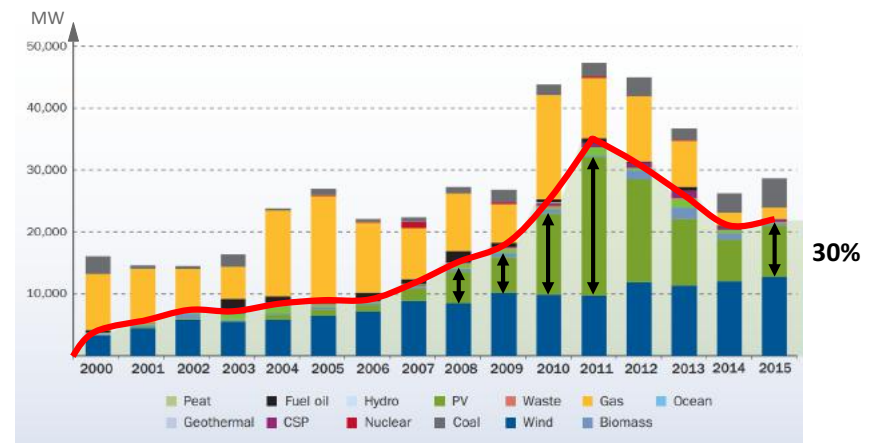
- **Environmental** concerns
- Increasingly **lower cost** of renewables

Main characteristics

- **Decentralized** and produced **on site**
- **Storage systems**



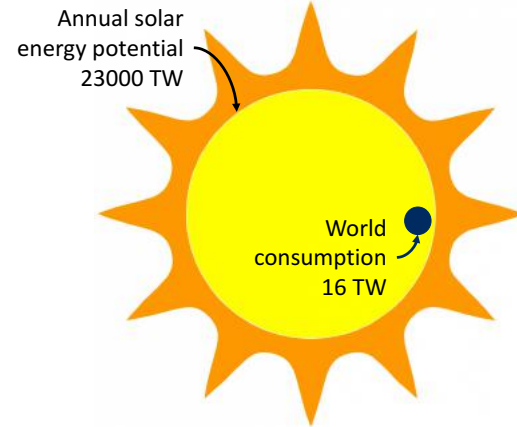
Annual installed capacity (MW) and renewable share



Solar Energy, a renewable source

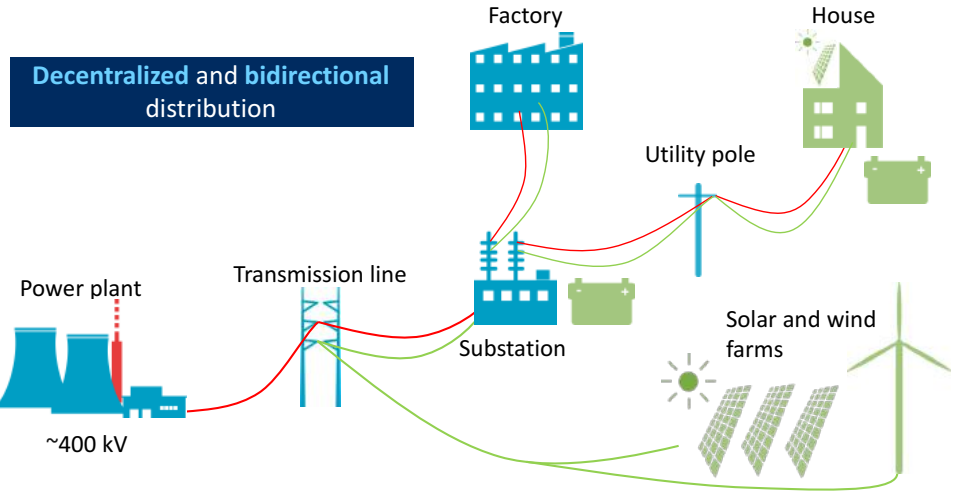
PV plants:

- **silent**
- **emission-free**
- **low-maintenance**
- **decentralized**



Source: S. Cloete, September 2016, <http://energypost.eu/reality-check-renewable-energy-potential/>

Future Electricity Network

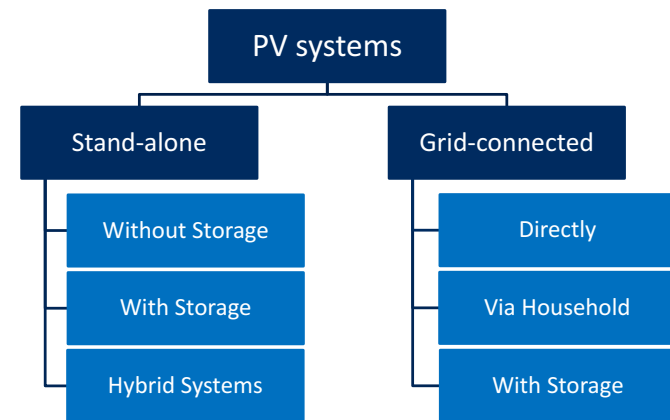


Types of PV systems

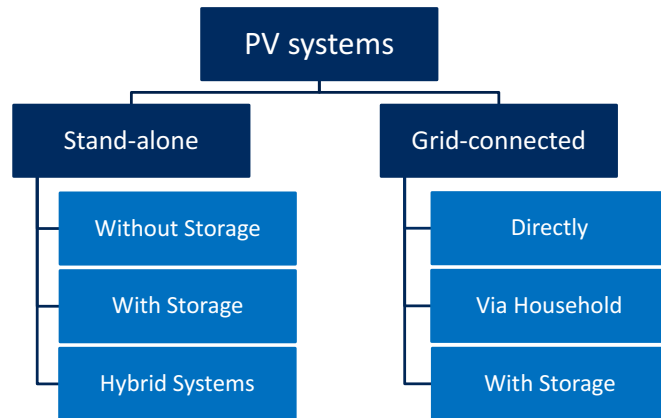
Olindo Isabella



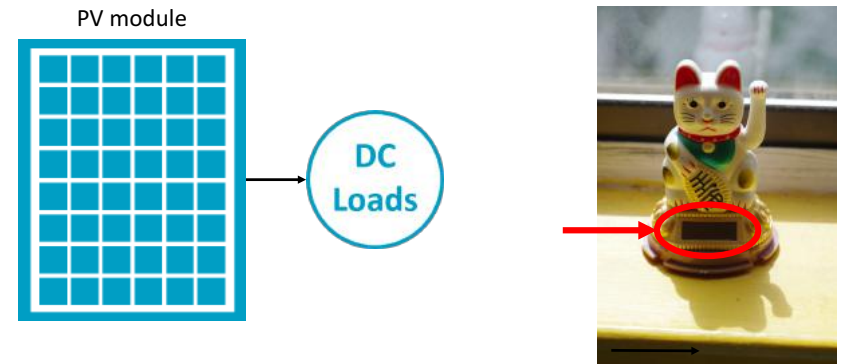
Types of PV systems



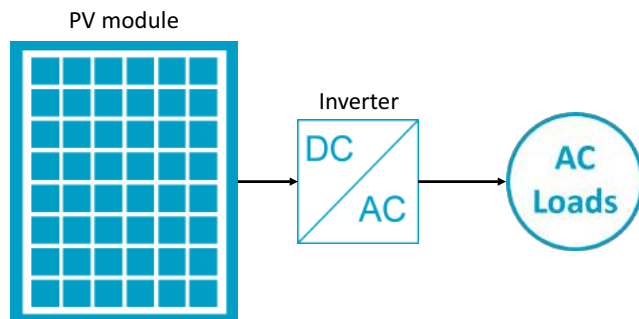
Types of PV systems



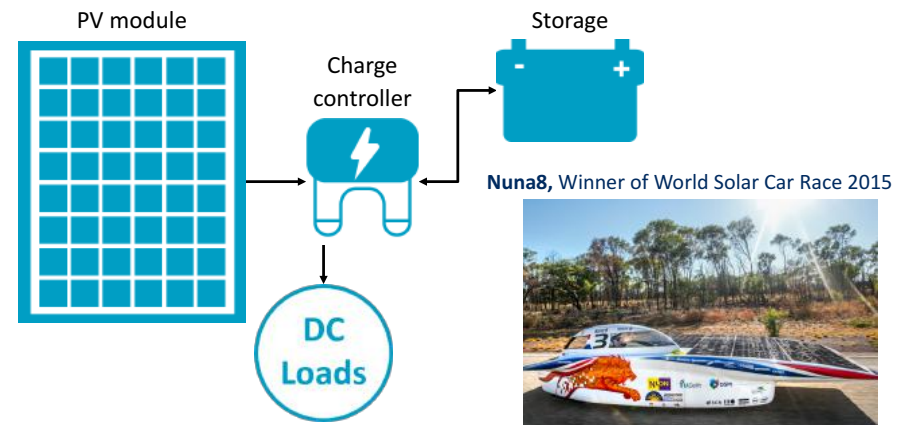
Stand-alone DC system



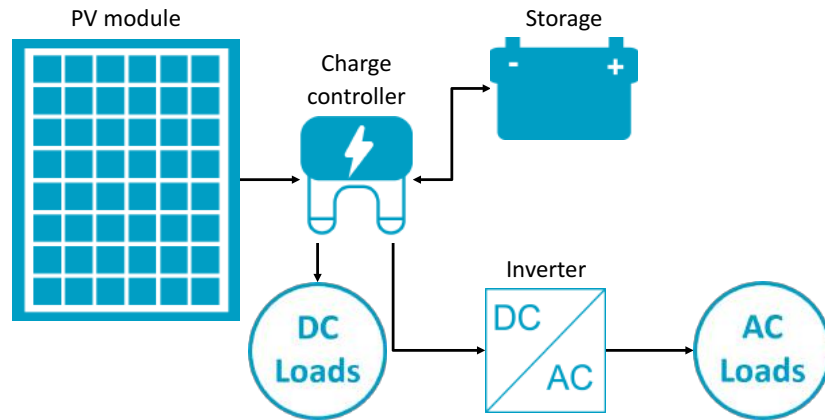
Stand-alone AC system



Stand-alone DC system with storage



Stand-alone AC and DC system with storage



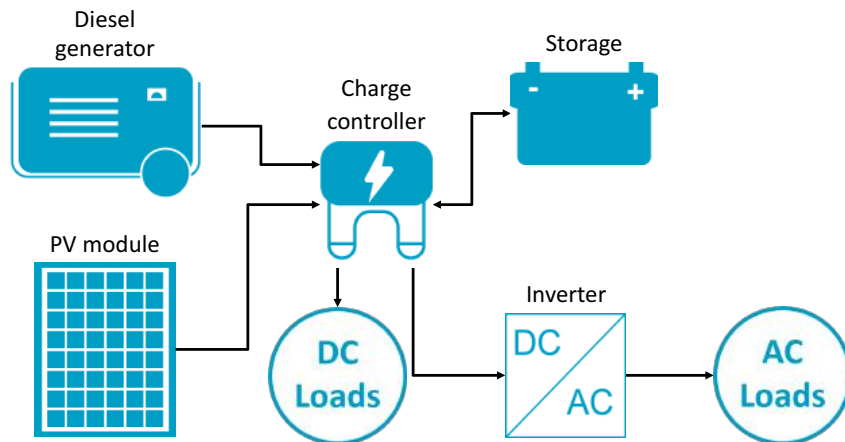
Example

- Both AC and DC loads used
- Might contain **DC micro-grid**

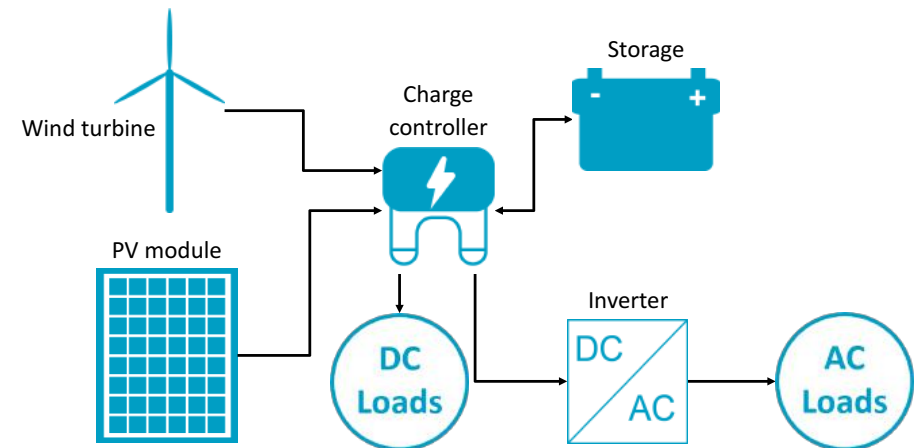


Source: concept made by P. Beladon (developer) and Shau (architect), <http://beladon.com/>

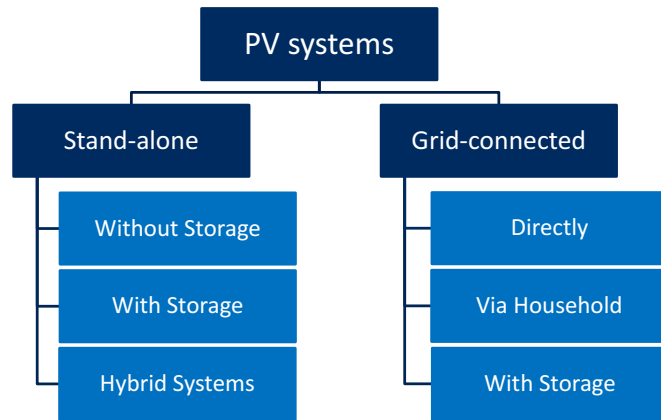
Stand-alone hybrid system



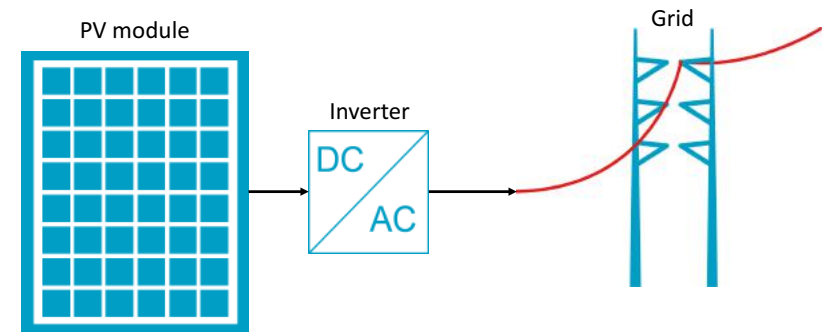
Stand-alone hybrid system



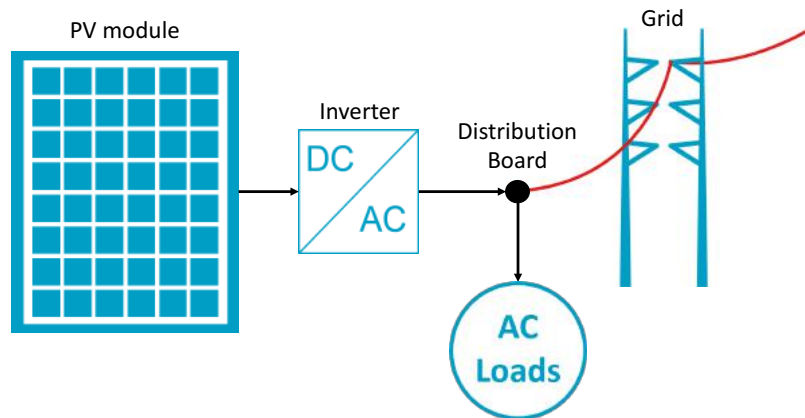
Types of PV systems



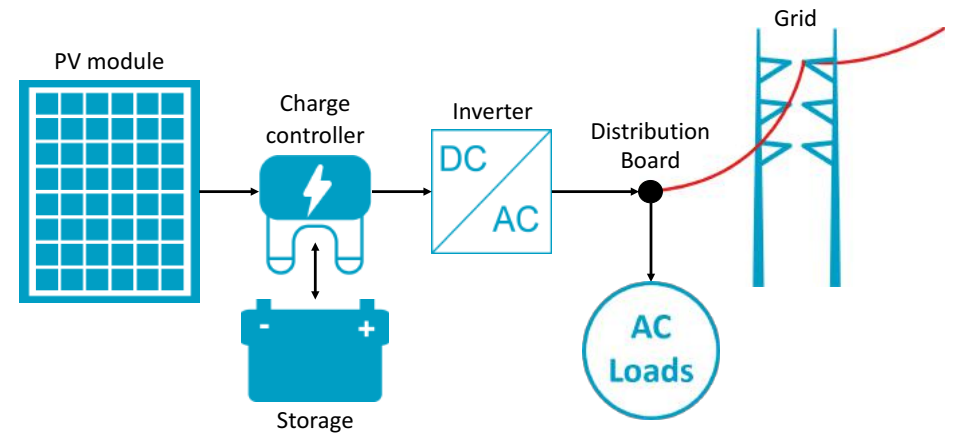
Grid-connected system



Grid-connected system via household



Grid-connected system with storage



Classification of PV systems by Watt peak

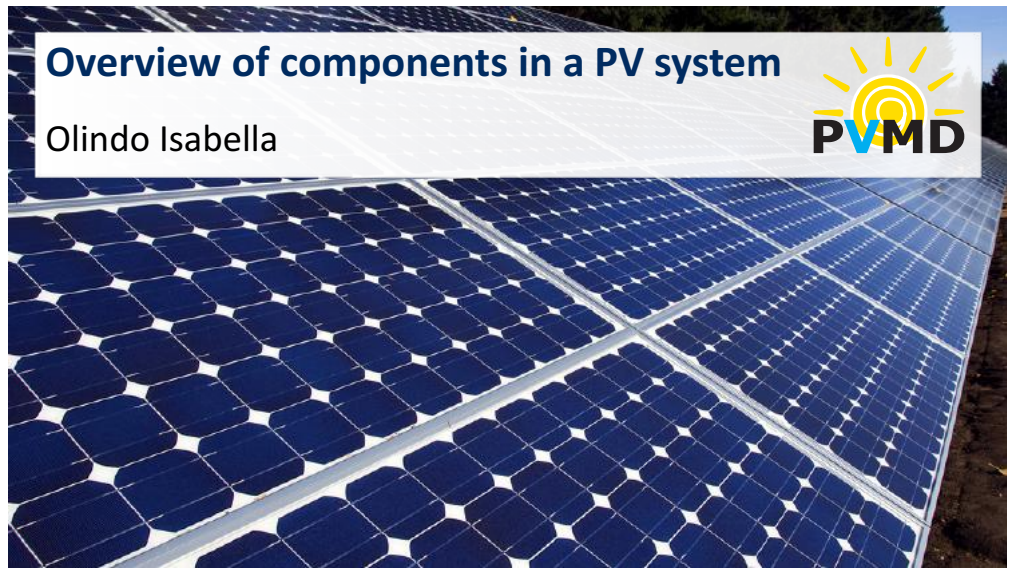


Environment Integrated PhotoVoltaics (EIPV)

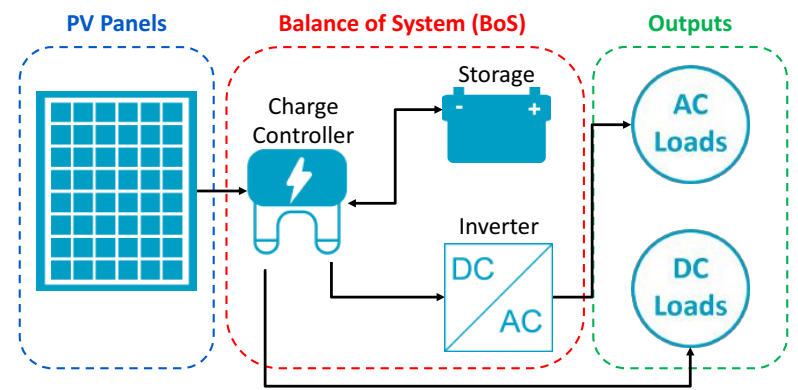


Overview of components in a PV system

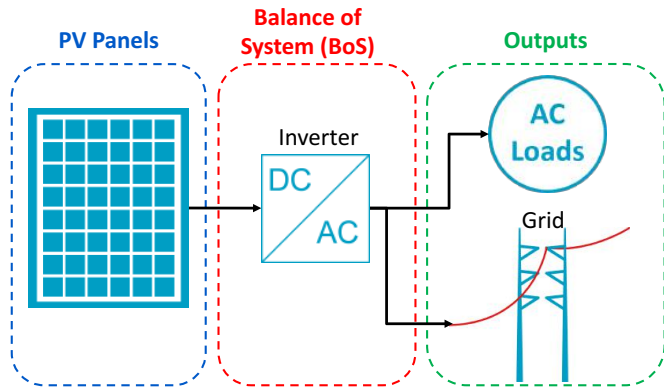
Olindo Isabella



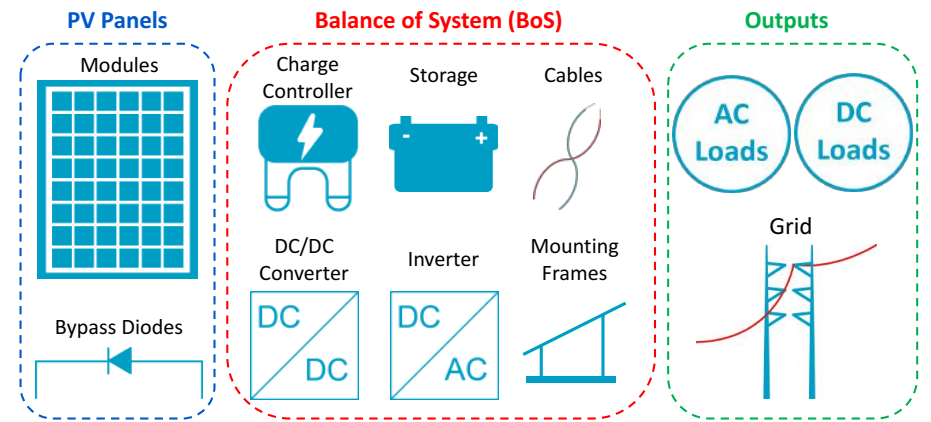
Stand-Alone System



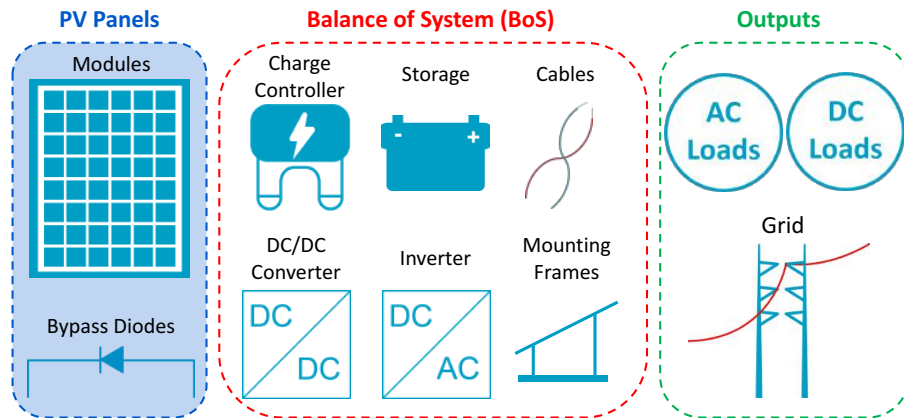
Grid-Connected System



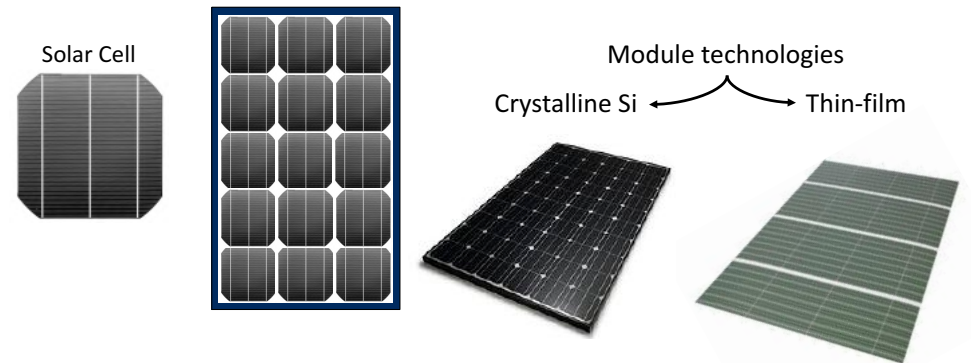
Components



Components



PV Module



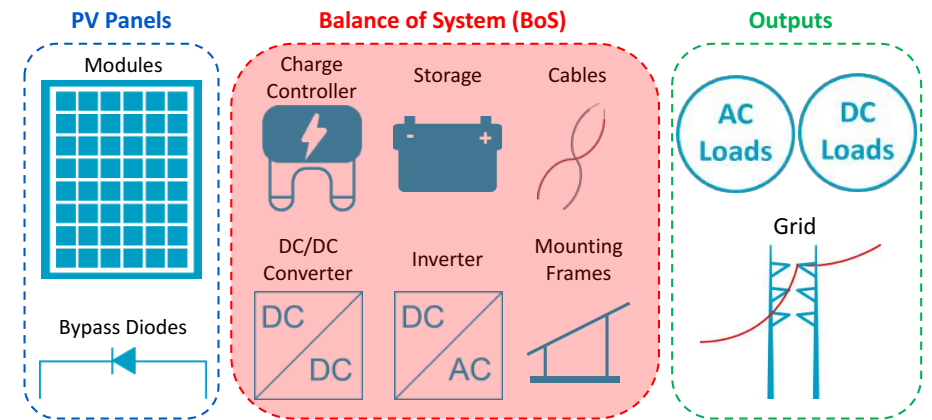
PV Module

- **Bypass diode** to prevent destructive effect of **hot-spot**
- **Blocking diode** to prevent **reverse flow of current**



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Components



Balance of System (BoS)

- **Mounting structures**
- **Cables**
- **Batteries**



Advantages

- Reliable energy source **available at night** or on **cloudy days**

Drawbacks

- Decrease the efficiency of the PV system
- **Replacement** every five to ten years
- Add to the **expense** of the overall system
- Safety concerns



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Balance of System (BoS)

- **DC/DC converter**
- **DC/AC inverter**
 - Grid-connected or Stand-alone
 - **High conversion efficiency**
 - Embedded circuitry for **MPPT**

DC/AC inverter



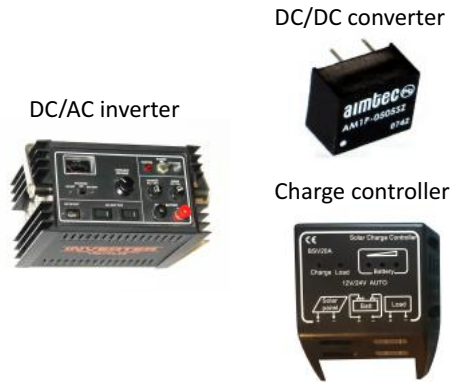
DC/DC converter



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 By Mik81 (Own work) [Public domain], via Wikimedia Commons

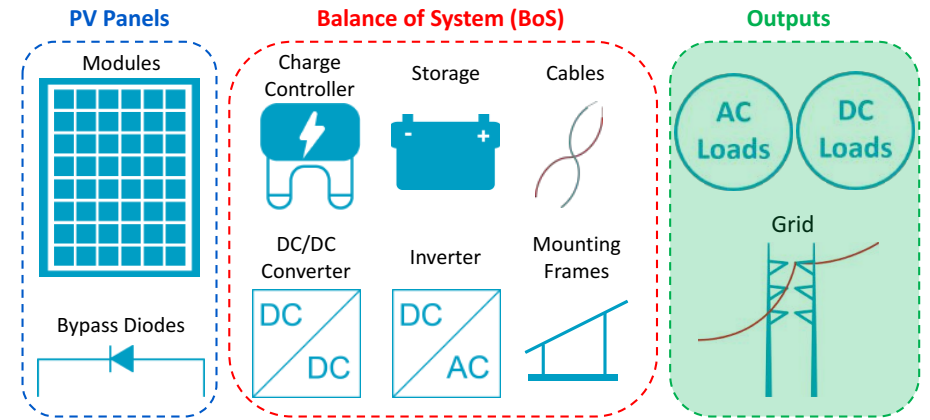
Balance of System (BoS)

- **DC/DC converter**
- **DC/AC inverter**
 - Grid-connected or Stand-alone
 - **High conversion efficiency**
 - Embedded circuitry for **MPPT**
- **Charge controller**
 - **Optimum charge** to the batteries
 - Overcharge protection
 - Preventing unwanted discharging
 - Decoupling voltage and current levels
 - Embedded circuitry for **MPPT**



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 By Mik81 (Own work) [Public domain], via Wikimedia Commons
 Kaspars Dambis, BSV20A Solar Charge Controller, 18/02/2017, Creative Commons License

Components



Recap

