Electric mobility

Cost-effective and suitable electric vehicle charging management

Amaia González-Garrido, PhD Research Engineer,
Energy, Climate and Urban Transition - TECNALIA Research & Innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement No. 101037141. This material reflect only the views of the Consortium, and the EC cannot be held responsible for any use that may be made of the information in it.

In this video you will learn:

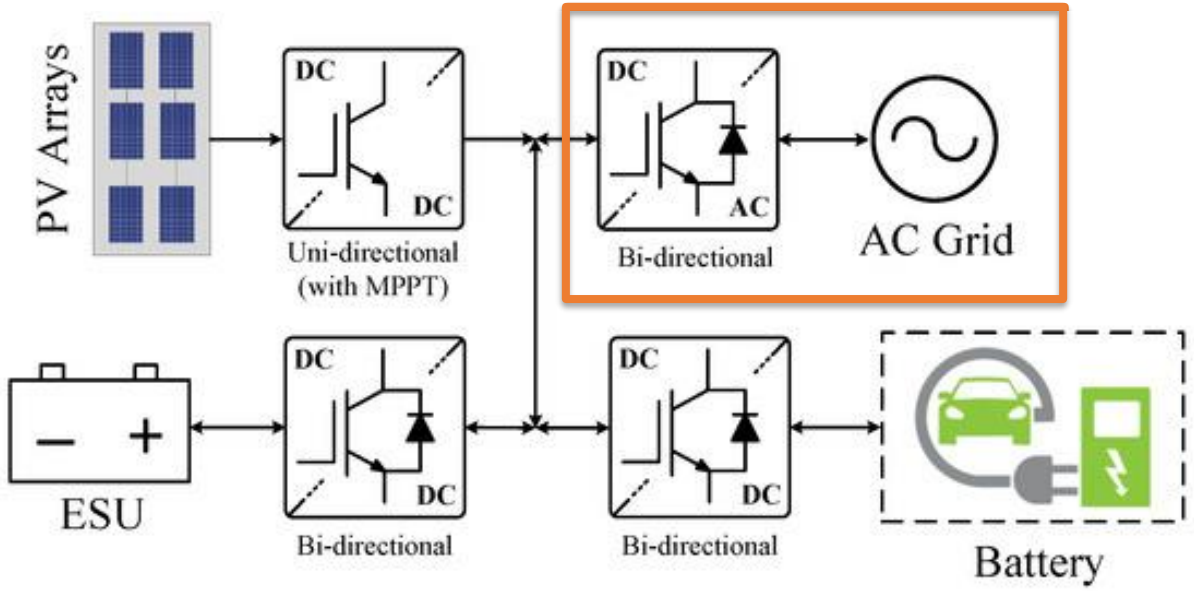
- System topologies (grid, solar) for e-mobility apps.
  - Main criteria for smart EV charging management
    - EV charging management and grid integration
      1. Full grid-tied charging system
      2. Grid-tied solar PV for e-mobility
      3. Off-grid solar PV for e-mobility
         - EV charging technologies (i.e.,V2G)

SESA

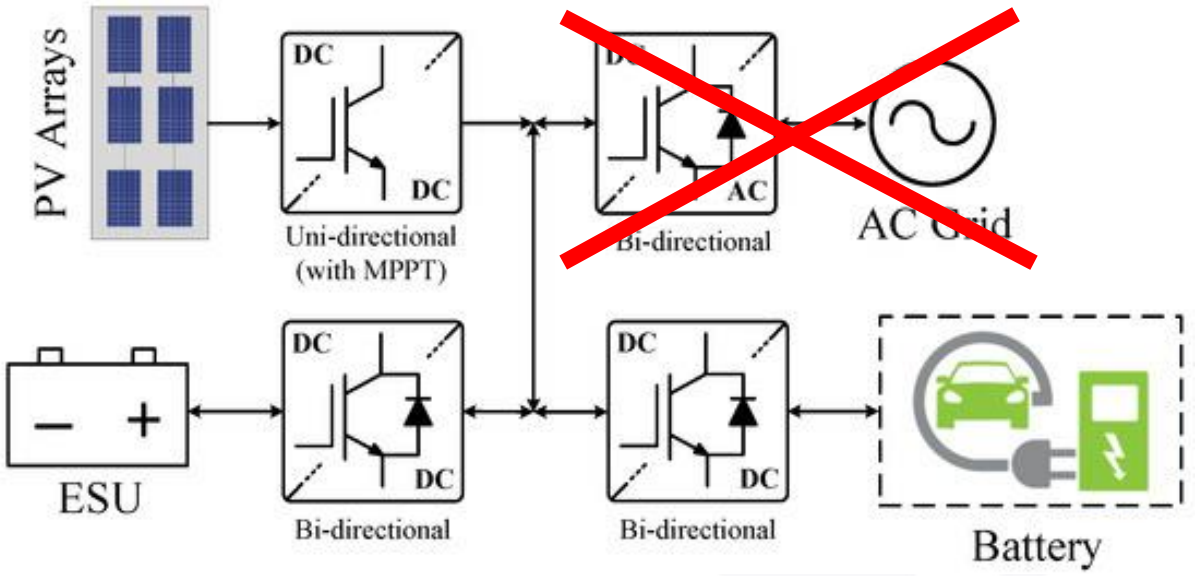
Topology: Grid-tied/off-grid

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Grid-tied hybrid system (DC coupling)



Off-grid solar PV-powered system



Source: Nasr Esfahani F, Darwish A, Williams BW. Power Converter Topologies for Grid-Tied Solar Photovoltaic (PV) Powered Electric Vehicles (EVs)—A Comprehensive Review. Energies. 2022; 15(13):4648. https://doi.org/10.3390/en15134648

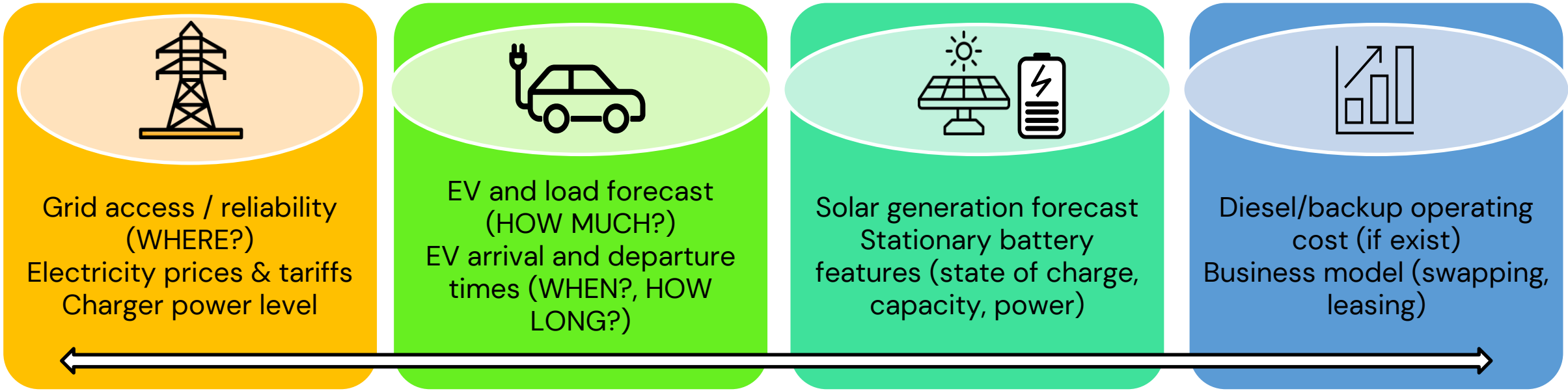
SESA

Main criteria for smart EV charging

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Smart EV charging enables to charge the EV battery when is more suitable, cheap and efficient

- ✓ **Security of supply (satisfy EV users)**
- ✓ **Cheaper and low-CO_2 EV charge**

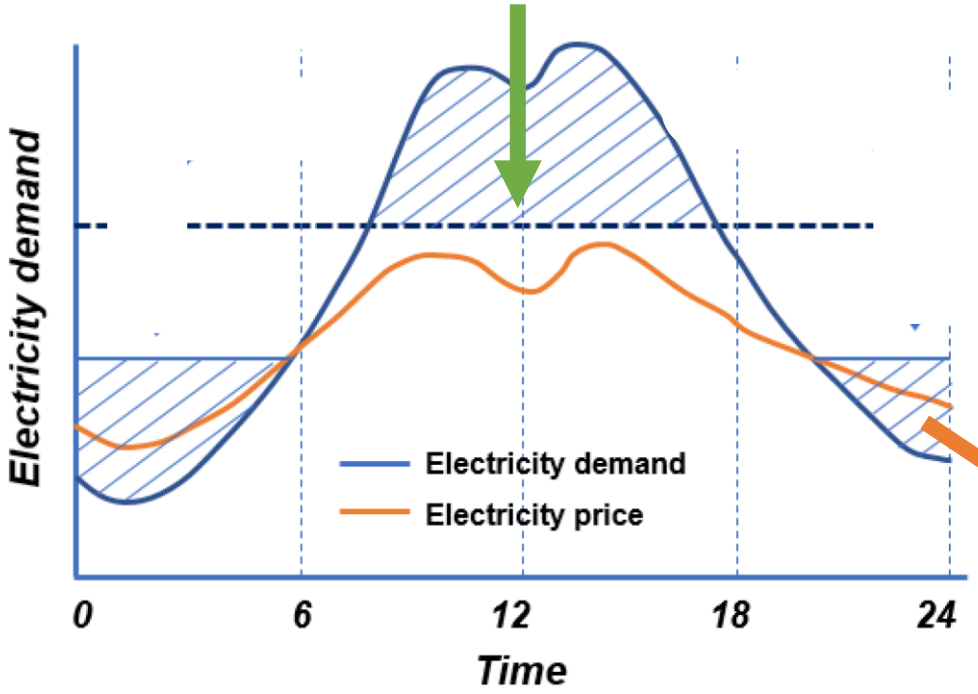


Source: https://energy-base.org/news/how-to-drive-decarbonisation-accelerating-e-mobility-in-africa/

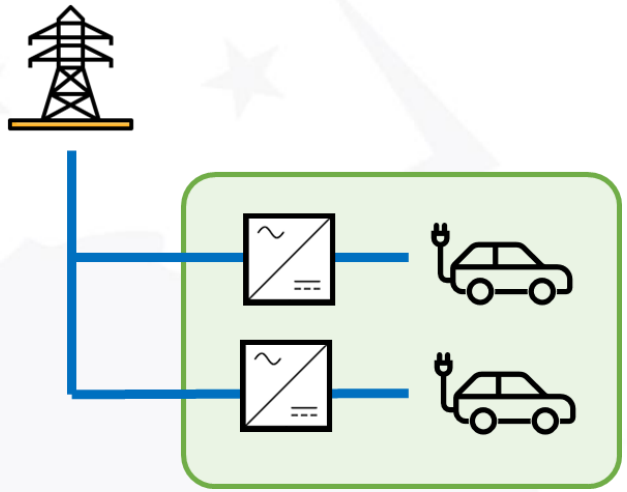
Source: Vermeer, W.; Chandra Mouli, G.R.; Bauer, P. Real-Time Building Smart Charging System Based on PV Forecast and Li-Ion Battery Degradation. Energies 2020, 13, 3415. https://doi.org/10.3390/en13133415

Full grid-tied charging system

Peak shaving: Reduce daytime peak, minor charging points



Load leveling: Energy time-shifting to cheaper hours



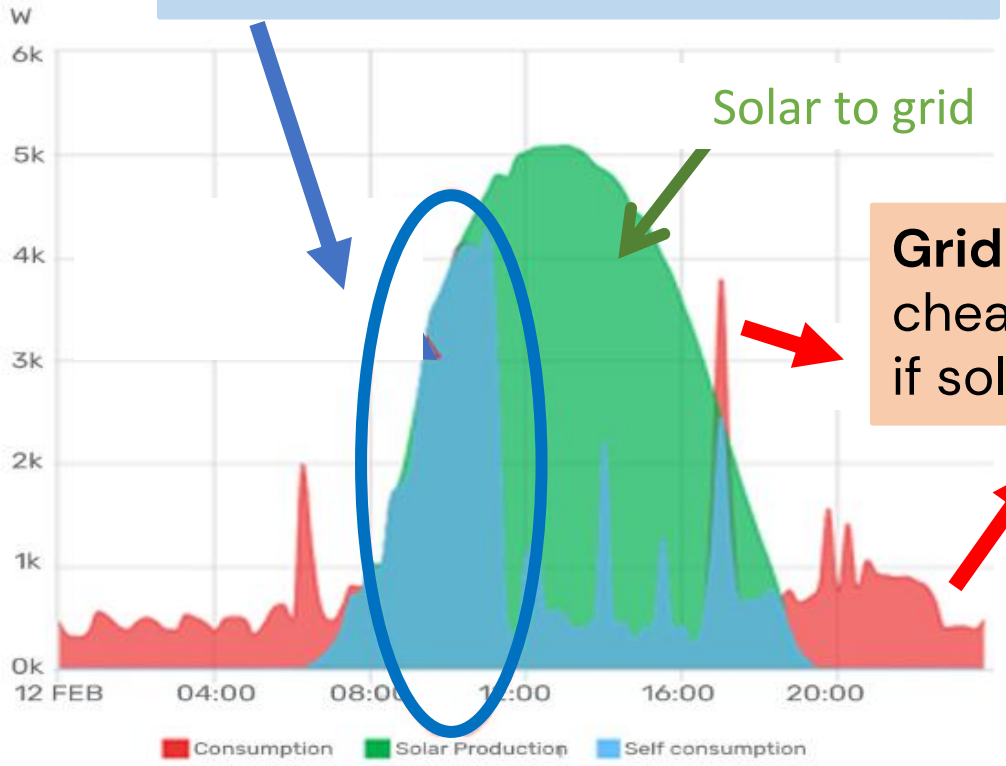
Time-of-use tariffs: Attractive price for lower charging cost

Source: Ravi SS, Aziz M. Utilization of Electric Vehicles for Vehicle-to-Grid Services: Progress and Perspectives. Energies. 2022; 15(2):589. https://doi.org/10.3390/en15020589

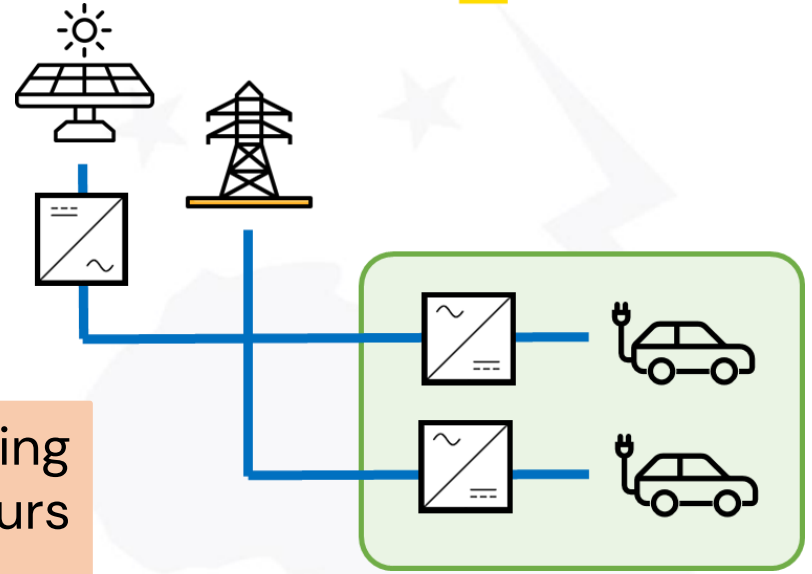
Grid-tied solar PV for e-mobility

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Solar availability: Shift EV charging to sun hours if possible



Grid support: Charge during cheaper prices or certain hours if solar power is not enough



Operating mode: decide when to charge from the grid or solar power

Source: https://solarpro.com.au/our-expertise/residential/ev-charging/

SESA

Grid-tied solar PV for e-mobility

- Lolwe hybrid solar mini-grid power plant: 600 kWp PV + 600kWh lithium-ion battery
- Fully integrated and remotely managed system, in Lolwe Island, Uganda.
- Electric mobility integration: electric outboard engines for boats and e-motorcycles
- Support local fishermen by reducing their fuel expenditure
- Business model: Pay-As-You-Go (PAYGo)

Example: Lolwe hybrid solar mini-grid power plant, Uganda, January 2022

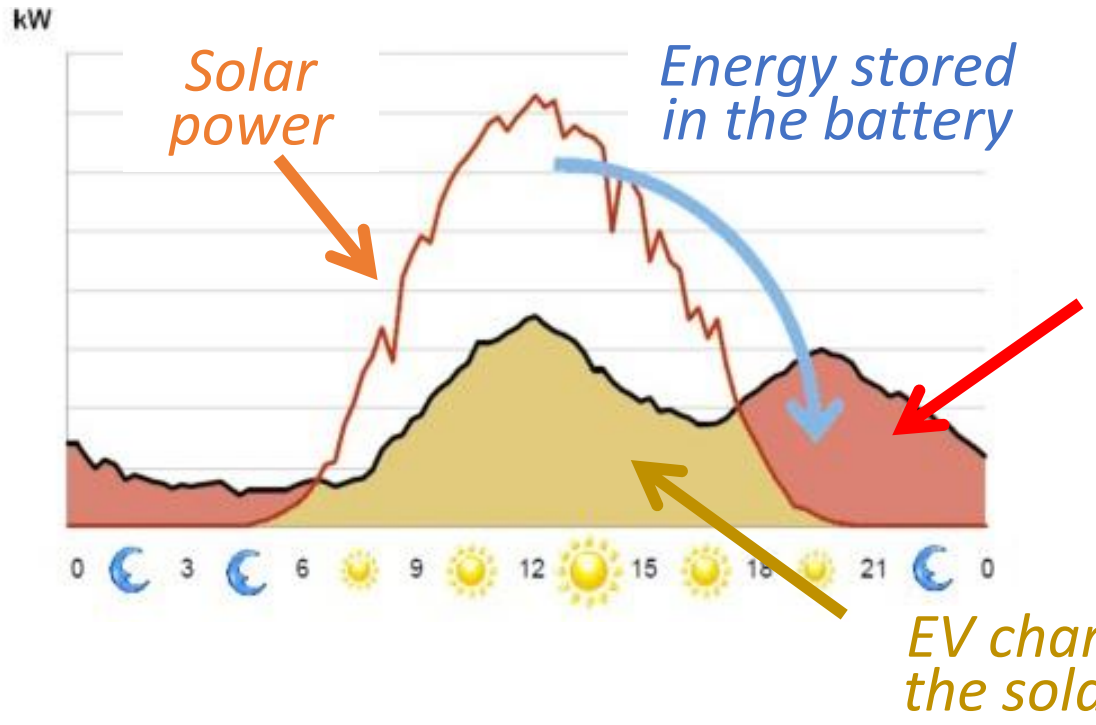

Picture credit: Engie Energy Access

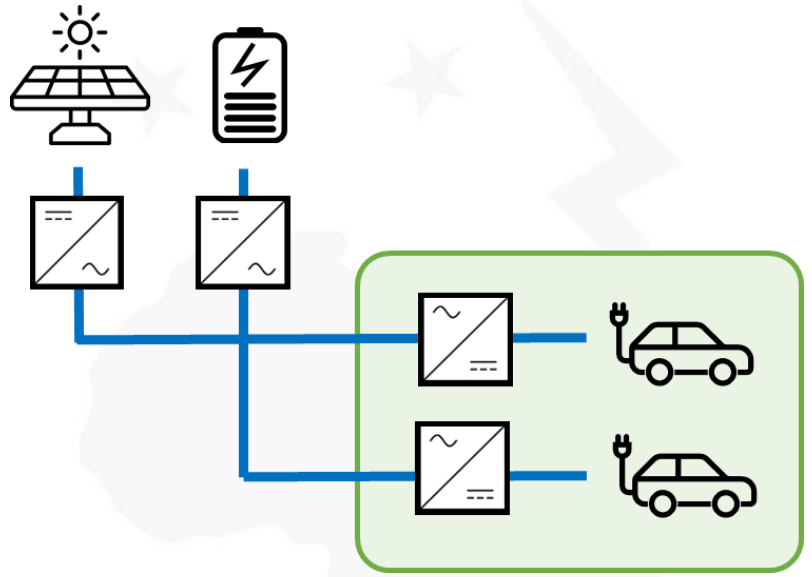
Source: Lolwe Hybrid Solar Mini-Grid Power Plant Inaugurated in Uganda (constructionreviewonline.com)
Source: Innovative Lolwe hybrid solar 600kWp minigrid inaugurated in Uganda - (esi-africa.com)

Off-grid solar PV for e-mobility

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Suitable system sizing: PV and battery capacity to meet all EV demand





Operating mode: decide when the battery is charged or discharged

Source: https://sunfishsolar.ca/solar-options/net-metering/

SESA

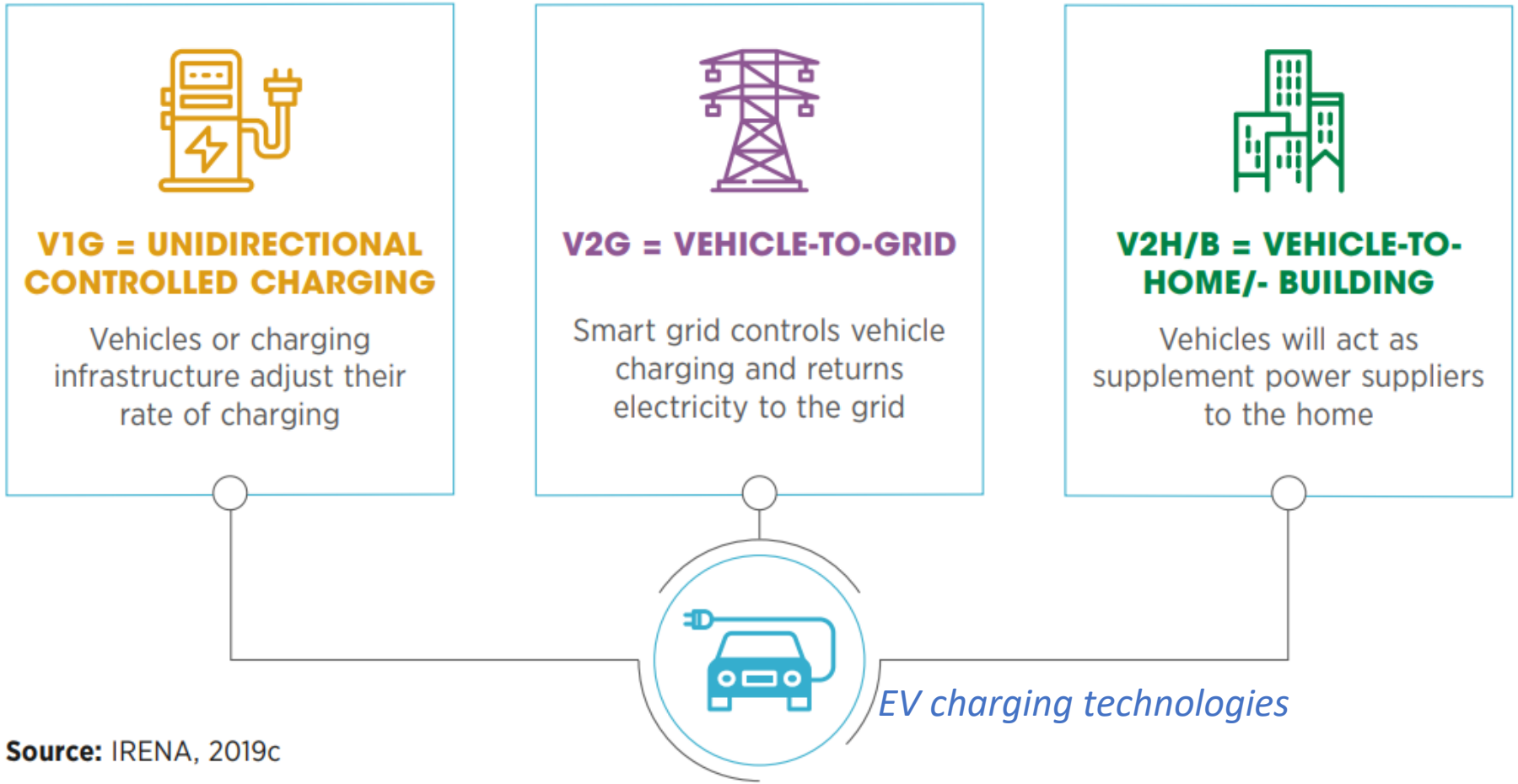
Off-grid solar PV for e-mobility

- Centralized charging depot powered by a solar-hybrid minigrids in Gbamu community
- Composed of 84 kWp PV array, a lead-acid battery bank, and a backup diesel generator
- Serve as a reliable electricity for local transportation needs in electric two-wheelers
- Minigrid tariffs are competitive from diesel generation or the nearest grid access point
- Business model: e-motocycle leasing and battery swapping

Example: Nigeria Pilot: Leasing Two-Wheeled EVs at a Solar-Hybrid Minigrid

Source: https://sun-connect.org/wp-content/uploads/powering-small-format-electric-vehicles-with-minigrids-report.pdf
Source: https://rmi.org/powering-electric-two-wheelers-with-rural-minigrids-in-nigeria-and-india/

EV charging technologies



EV charging technologies

Source: Electric-vehicle smart charging innovation landscape brief https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_EV_smart_charging_2019.pdf

Additional References

- IRENA “Electric-vehicle smart charging innovation landscape brief” 2019 https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_EV_Smart_Charging_2019.pdf
- IRENA “Innovation outlook: smart charging for electric vehicles” 2019 https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Innovation_Outlook_EV_smart_charging_2019.pdf
- Solar Electric Systems for Africa: A Guide for Planning and Installing Solar Electric Systems in Rural Africa: https://books.google.co.ke/books?id=nPfp9CgTDxcC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
- Andrew Allee, et al “Powering Small-Format Electric Vehicles with Minigrids Assessing the Viability of Two- and Three-Wheeled EVs for Rural Mobility” April 2022 https://sun-connect.org/wp-content/uploads/powering-small-format-electric-vehicles-with-minigrids-report.pdf
- Alana Valero and Emma Wink “How to drive decarbonisation: accelerating e-mobility in Africa”, 2022 How to drive decarbonisation: Accelerating E-mobility in Africa | BASE (energy-base.org)

THANK YOU

sesa-euafrica.eu/
toolbox.sesa-euafrica.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement No. 101037141. This material reflect only the views of the Consortium, and the EC cannot be held responsible for any use that may be made of the information in it.