General Information

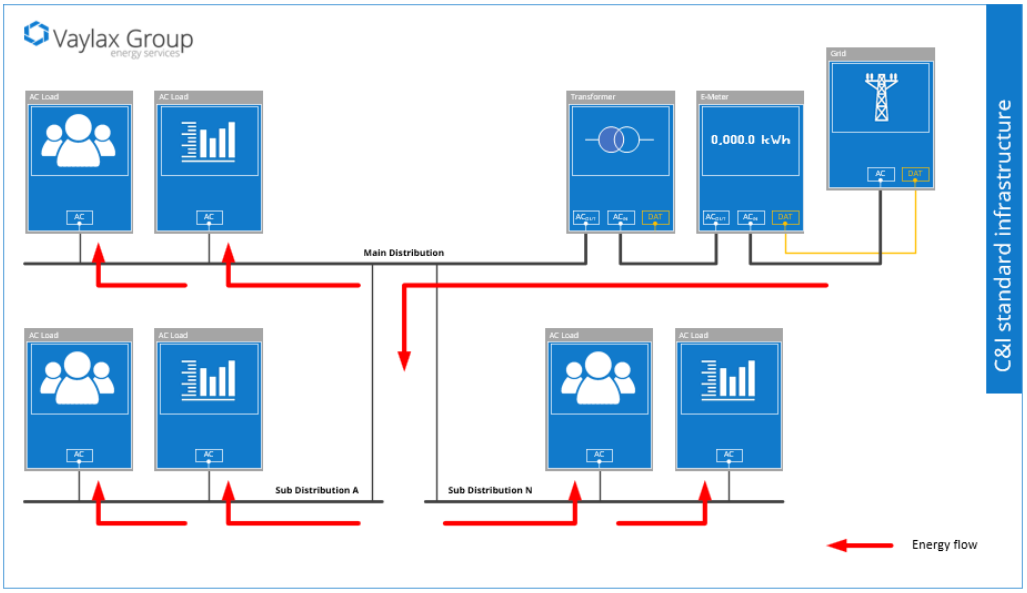
Integration of PV & BESS in standard C&I Infrastructure

1. Standard C&I electricity infrastructure

From grid, the energy for a consumer is transformed to a suitable voltage level and metered before it enters the main distribution board of the consumer. From there energy is distributed to sub-distribution boards and further on to the individual loads.

Various safety measures (load switches, fuses, power controller) are integrated on main and sub-distribution board to ensure secure operation and safety of staff and equipment.

The entire system is defined by its total nominal power for which the system is designed and by its load pattern. The load pattern describes the use of power (measured in kW) over time (measured in hours). The energy consumption of the consumer is therefore the total power used over a defined period of time and expressed in kilowatt-hours (kWh).



2. PV-System Integration

A PV system is either grid-tied or an island system. Grid-tied means the inverter is following the voltage and frequency pattern of the grid and cannot function without. This grid could also be provided by a diesel gen-set or an additional PV island system.

An island system “generates“ a grid pattern itself and forms together with all other attached components a private or micro-grid. Therefore, island systems cannot work directly attached

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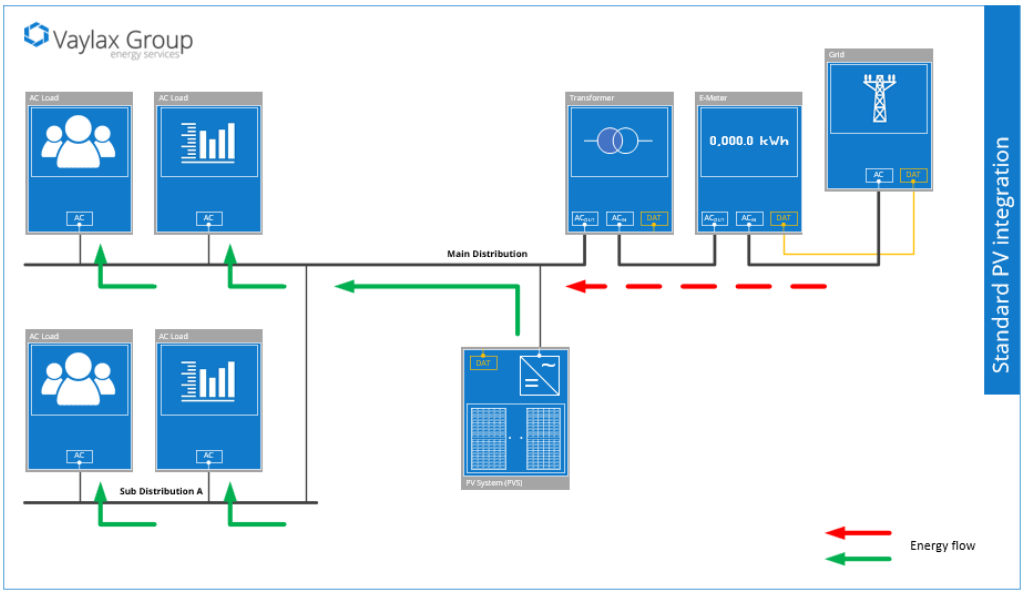
to a public or other micro-grid without being synchronized with their voltage and frequency pattern.



A grid-tied PV system attached to a consumer's infrastructure is technically designed in a way that its produced power will always be consumed first.

No manual or other technical interference is required to organize this.

Based on this, the following scenarios are possible:

A. Power generated by PV is less than power consumed within the consumers infrastructure
   100% of PV generated power will be used and total grid bill will be reduced by power generated from PV.

B. Power generated by PV is more than power consumed within the consumers infrastructure
   A maximum of PV generated power will be used and excess power will be fed back into the grid or is available to be stored in batteries for nighttime or off-peak use.

For the design of a PV system, it is important to know if feed-in is allowed by the grid operator and paid for. In case not, a PV system shall be designed to fulfill scenario A only.

C. Grid failure or unavailability (black out)
   No PV power will be generated as grid-tide PV systems need a grid to follow its voltage and frequency pattern.

After a potential black-out no manual or technical interference is required to restart the PV system – it starts automatically as soon a grid (voltage, frequency) is available.

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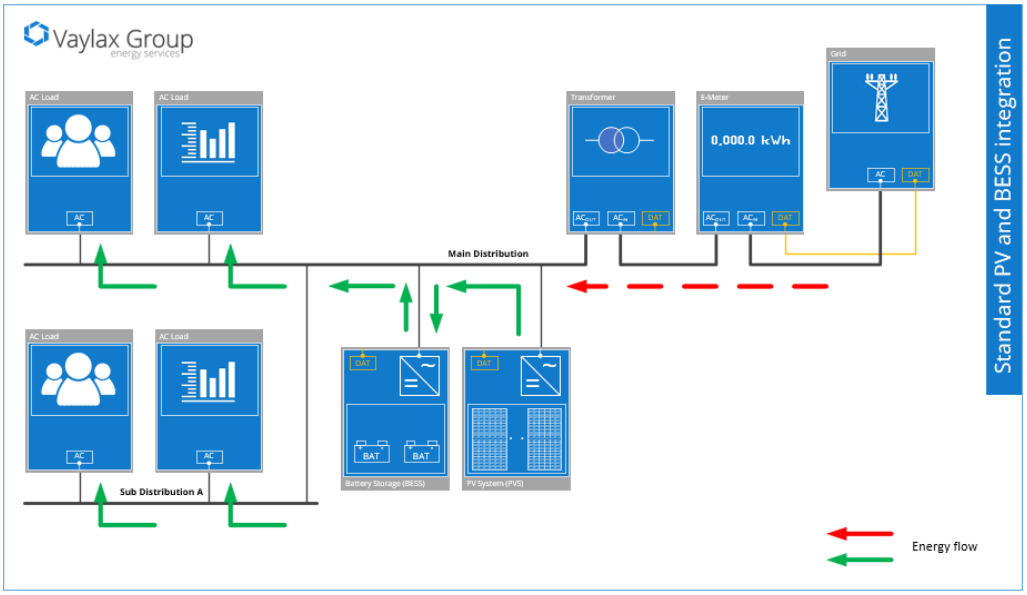
3. BES-System Integration

A Battery Energy Storage System (BESS) can be designed in many different ways. The standard is a battery system attached to a power inverter with charge and discharge management system.

The power inverter of a BESS may run in a grid-tied mode like a PV System or as an Island system.



A standard grid-tied BESS attached to a consumer's infrastructure and accompanied by a PV system is technically designed to follow predefined or individual managed scenarios.

The most common scenario is the following:

A. Excess power generated by PV is stored into the BESS until its 100% charged
   In case PV produces more than needed, times in which PV power could be used will be enlarged and the use of grid power reduced.

B. Power stored in BESS will be consumed prior to grid power, but only in case the PV system cannot fulfill 100% of the demand
   This operational scenario guarantees the maximum use of PV power over grid supply.

C. Grid failure
   No BESS power will be available as grid-tide BESS systems need a grid to follow its voltage and frequency pattern.

To operate a BESS system, it will be connected to an Energy Management System, either integrated into the BESS or installed complementary.

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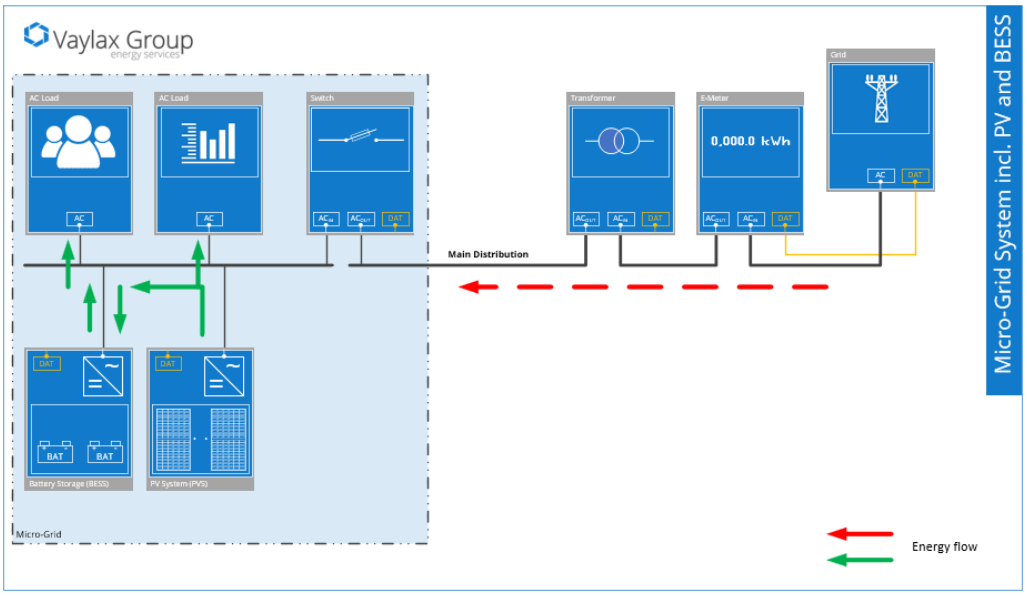
4. Micro-Grid

In combination with an island functionality, PV- and BES-System maybe setup as independent power sources referred to as Micro-Grids.

If a central grid is available, the micro grid operates as an extension from the consumer infrastructure.

In case the grid fails, the Micro-Grid automatically disconnects a part of the infrastructure from main distribution and operates entirely from power stored in the BESS and generated from the PV-System.

As soon as the central grid is again available the Micro-Grid automatically reconnects this part of the infrastructure to the main distribution board.



Designing a suitable Micro-grid requires a comprehensive grid and load study. The components suitable for a particular Micro-Grid may include other power sources like diesel gen-sets, wind turbines, biomass energy systems as well as waterpower systems – all depending on availability and suitability.

For further information and system design please contact us or visit our webpages.

The information provided above are only a very small part of the entire subject and might be outdated soon.

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