VIERNES 16 DE

NOVIEMBRE DE 2018

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COORDINADOR DE PROYECTOS

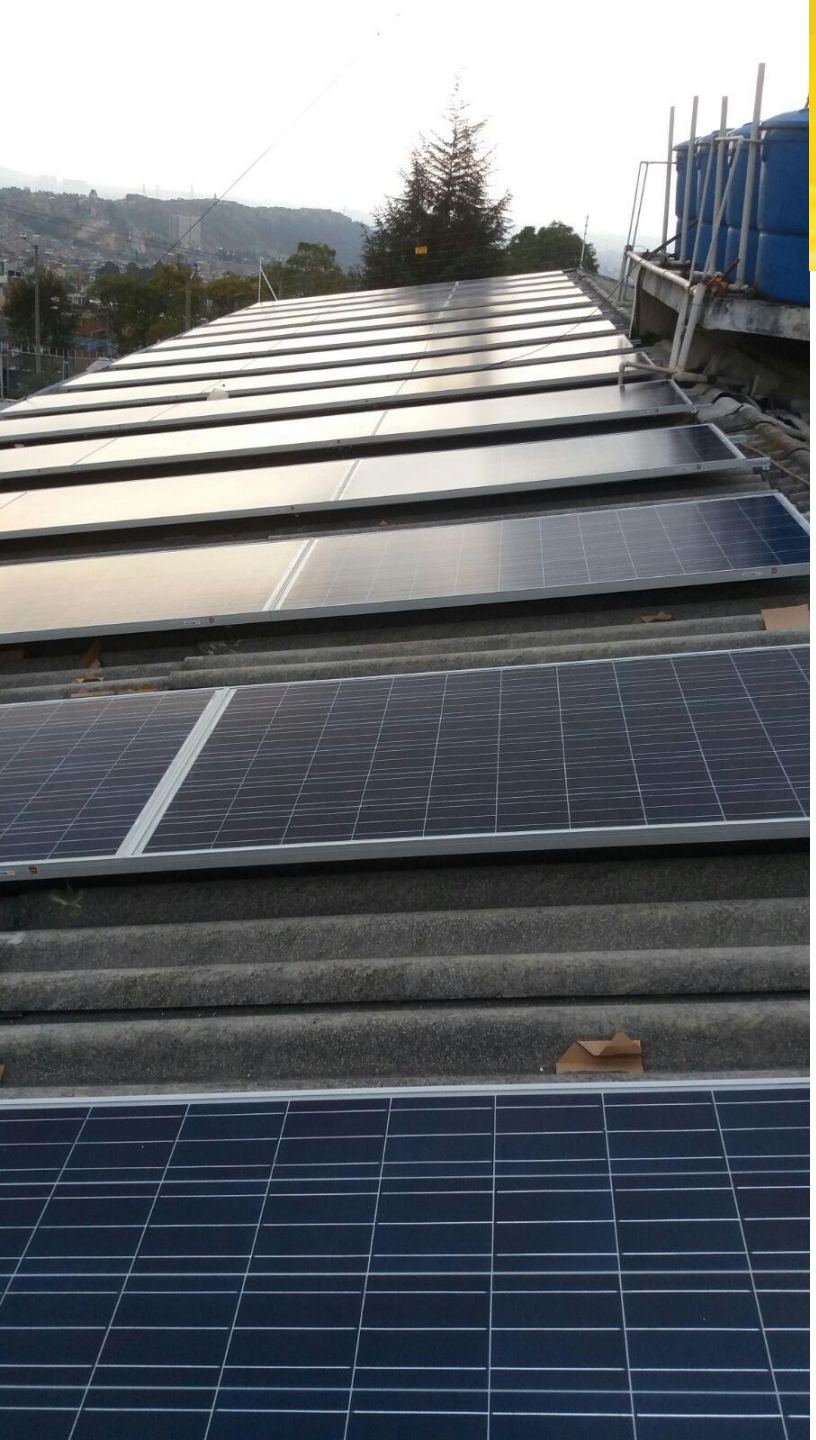
COL ENERGY S.A.S.

ExpoSolar® Colombia 2019

SISTEMAS HÍBRIDOS

CRITERIOS DE DISEÑO Y BUENAS PRÁCTICAS DE INSTALACIÓN

EJEMPLOS DE APLICACIÓN



AGENDA

- **Tipos de sistemas:** funcionamiento, aplicaciones, ventajas, nuevas oportunidades y modelo de negocio
- **Criterios de diseño y buenas prácticas de instalación:** topología, datos técnicos
- **Ejemplo de aplicación**
- **Ejercicio de dimensionamiento**

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TIPOS DE SISTEMAS

- Funcionamiento
- Aplicaciones
- Ventajas de los sistemas híbridos
- Nuevas oportunidades
- Modelo de negocio

TIPOS DE SISTEMAS:

Off Grid

SUMINISTRO DE ENERGÍA

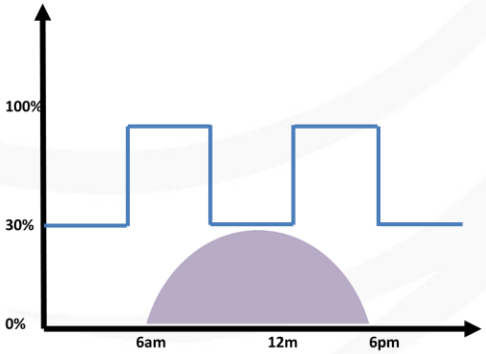
Onda de Tensión

ZNI

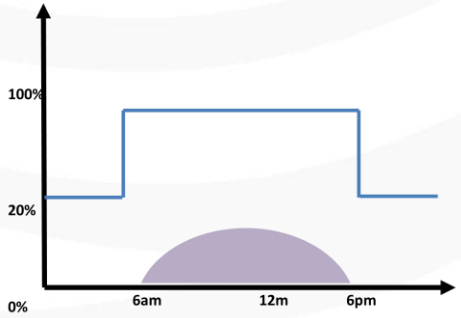
Garantía 2 años
Precio $ 2X.

On Grid

AHORRO



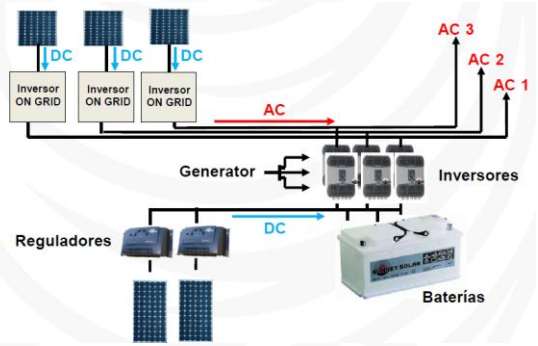
Onda de Corriente



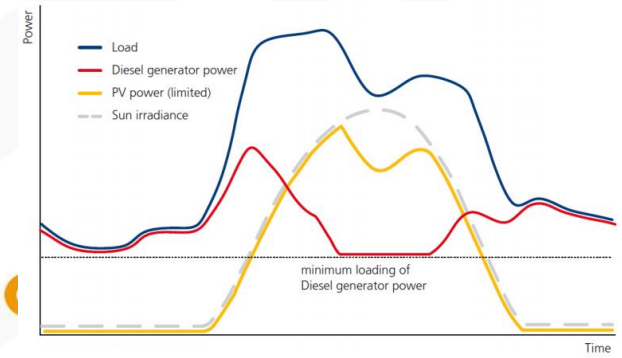
Garantía 7 -10 años
Precio $ X.

Hybrid

CONFIABILIDAD

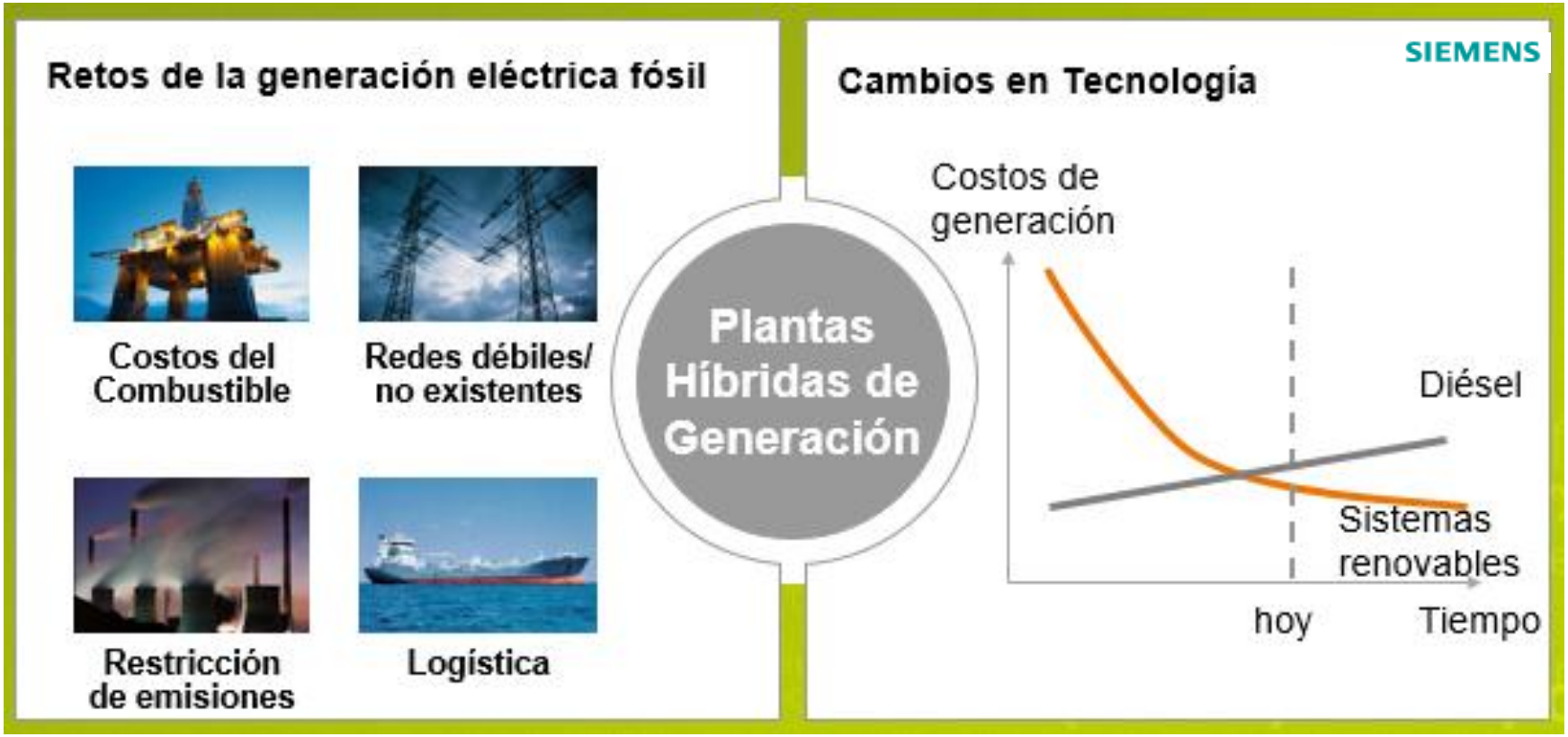


Bidireccional



TIPOS DE SISTEMAS:

Oportunidad de negocio



Cambios en los mercados

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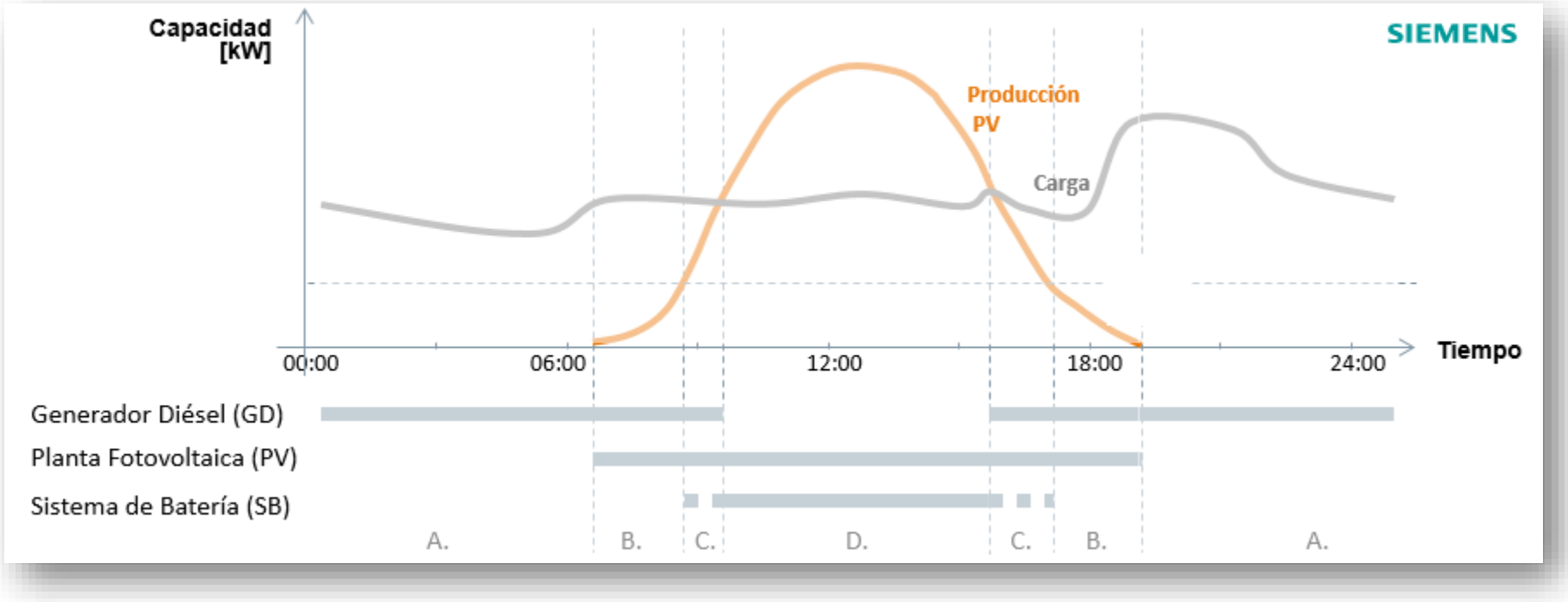
TIPOS DE SISTEMAS:

Funcionamiento

Planta Híbrida [2]

TIPOS DE SISTEMAS:

Funcionamiento



Lógica de funcionamiento [2]

TIPOS DE SISTEMAS:

Funcionamiento

IREN2 – Wilpoldsried, Germany

Project: Installation of Biofuel gensets and automation system to bring community with existing renewable assets off-grid with high renewable penetration

Gensets: 500kVA (diesel);100kVA (bio diesel)
250kW Biogas CHP

PV: 660 KWp, rooftop and industrial type

ESS: 300kW/168kWh Li-Ion battery

Automation: SIEMENS Fleet Control Syst.

Status: in execution (October – 2015)

Experiencia SIEMENS

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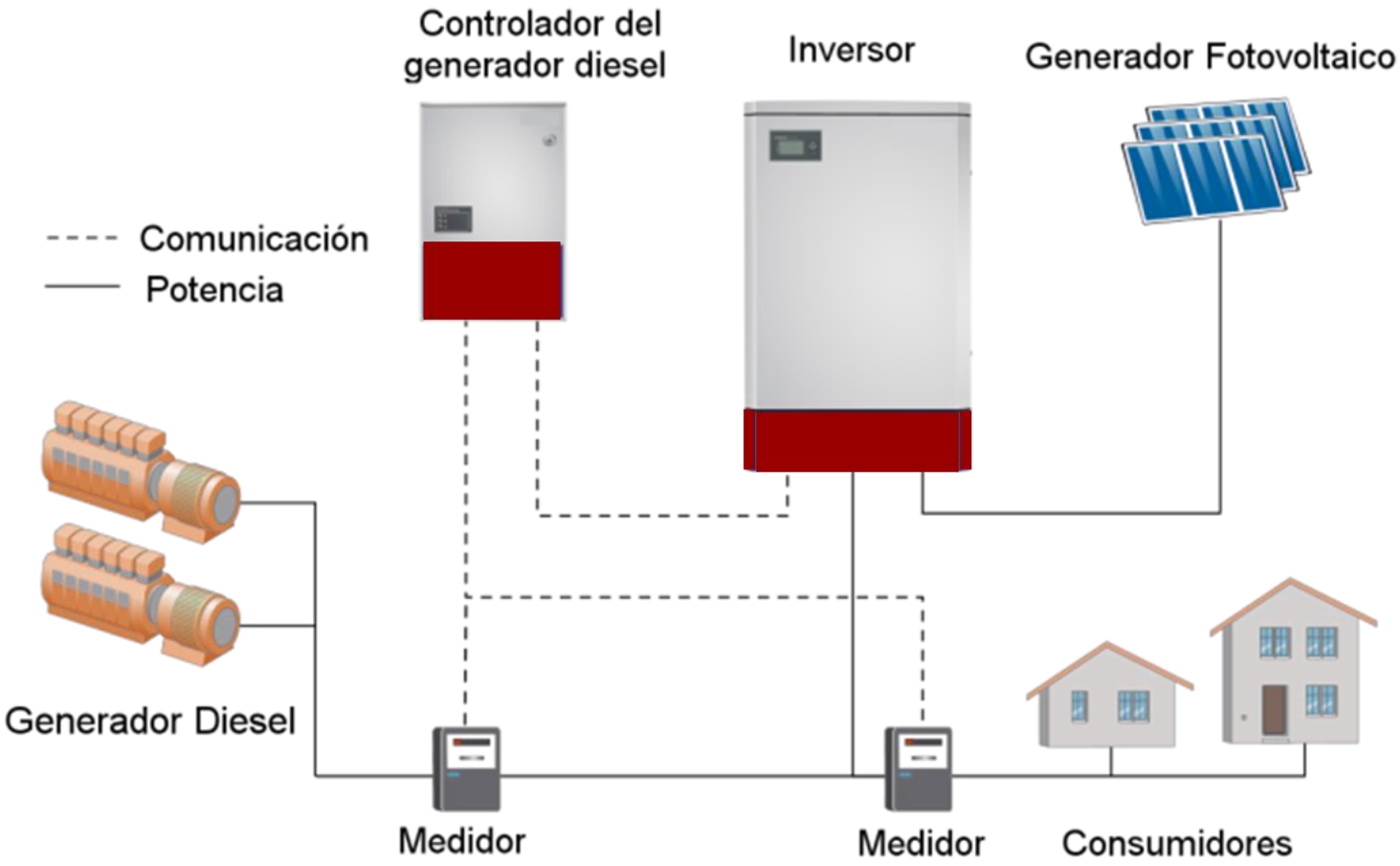
TIPOS DE SISTEMAS:

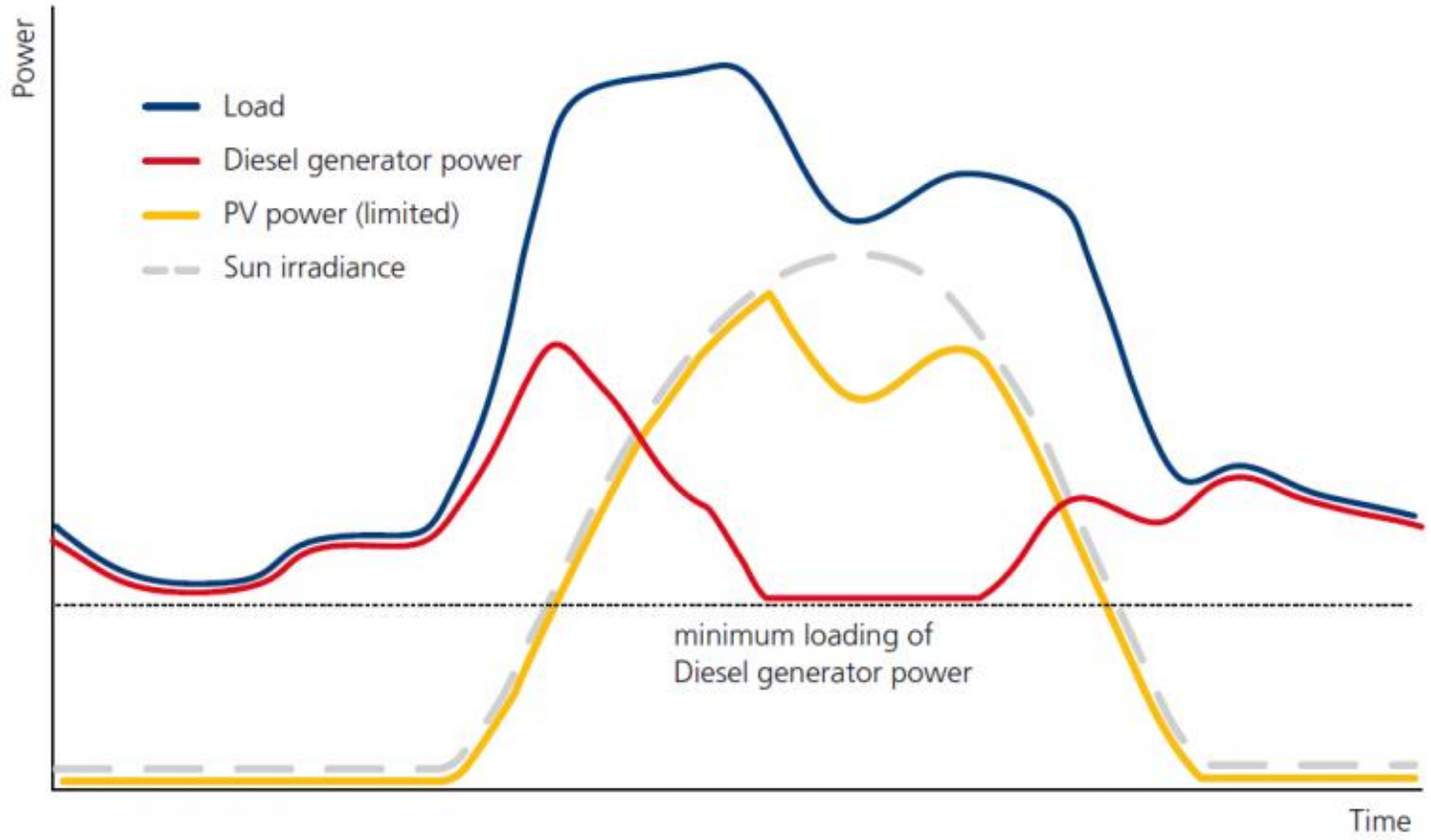
Funcionamiento



Sistema “Fuel saver” [3]

TIPOS DE SISTEMAS:

Funcionamiento

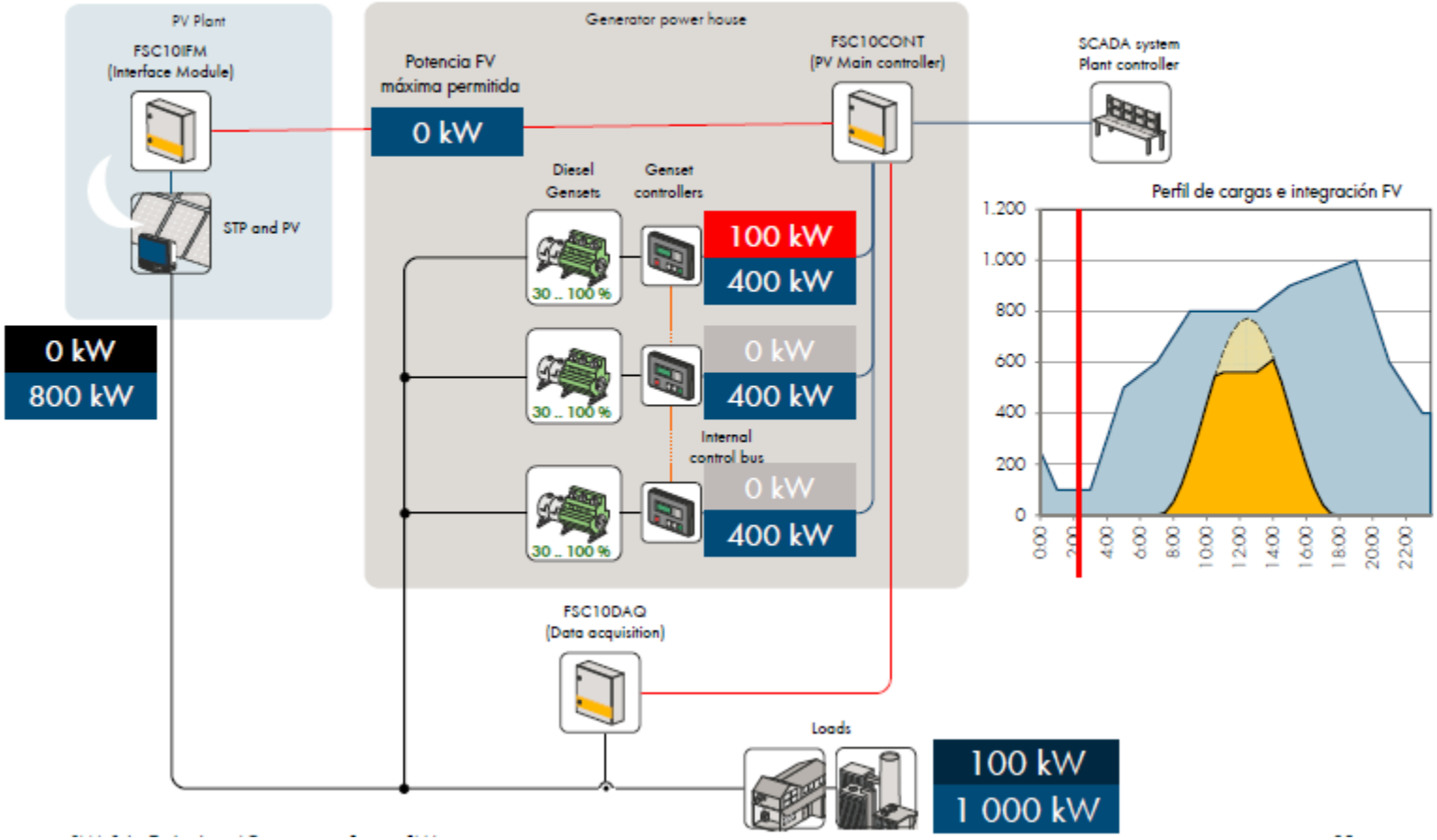


Sistema “Fuel saver” [3]

TIPOS DE SISTEMAS:

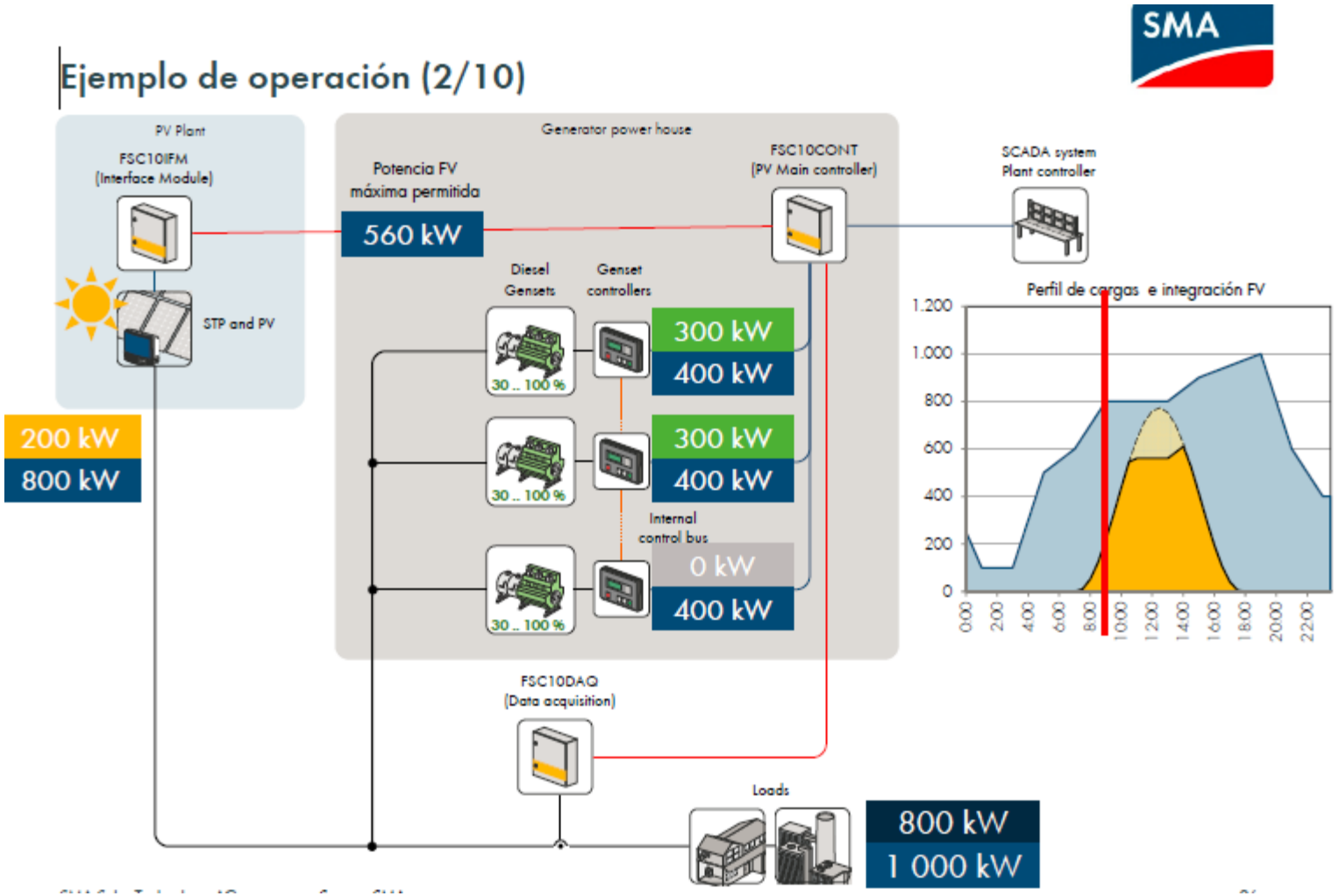
Funcionamiento

Ejemplo de operación (1/10)



TIPOS DE SISTEMAS:

Funcionamiento



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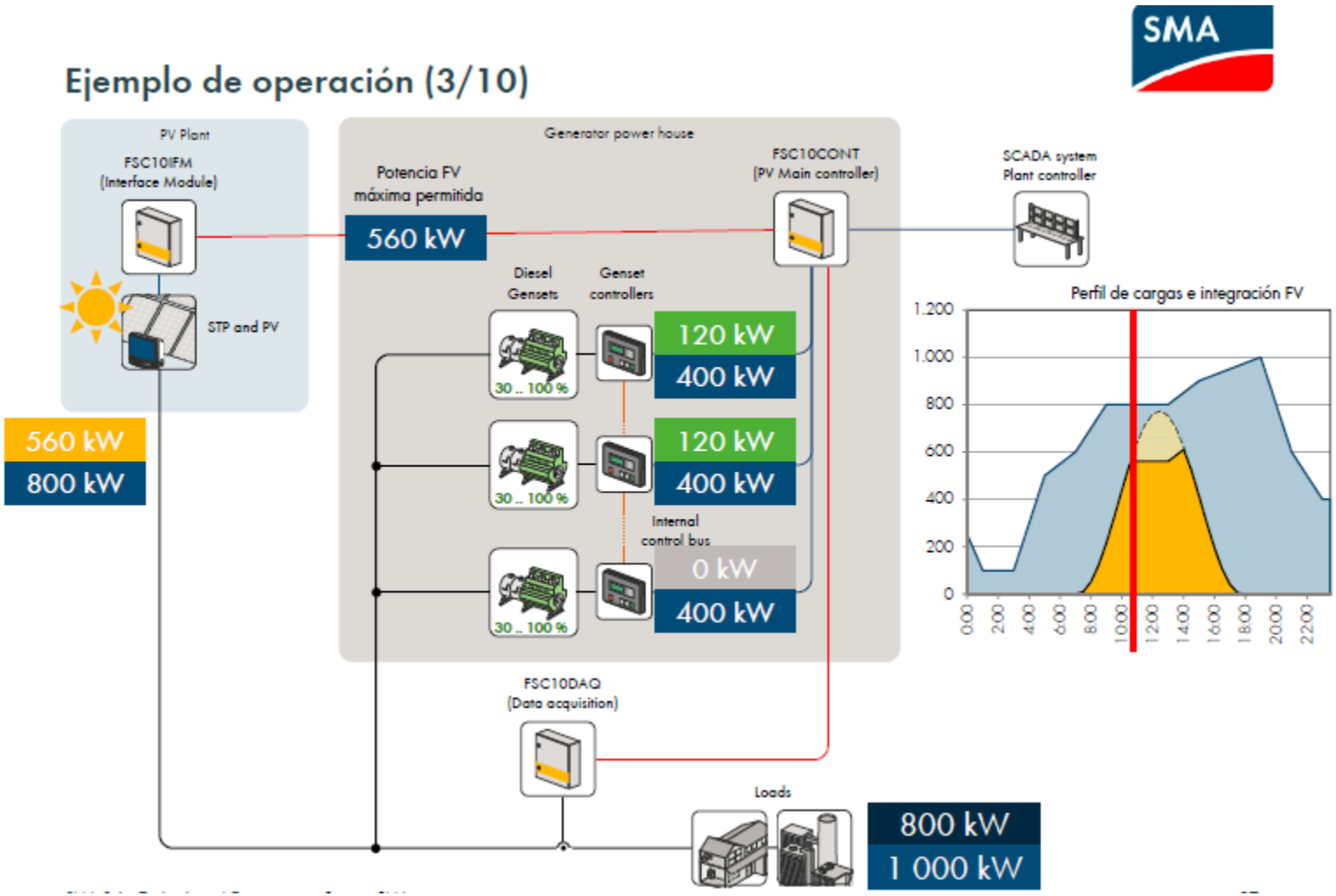
TIPOS DE SISTEMAS:

Funcionamiento



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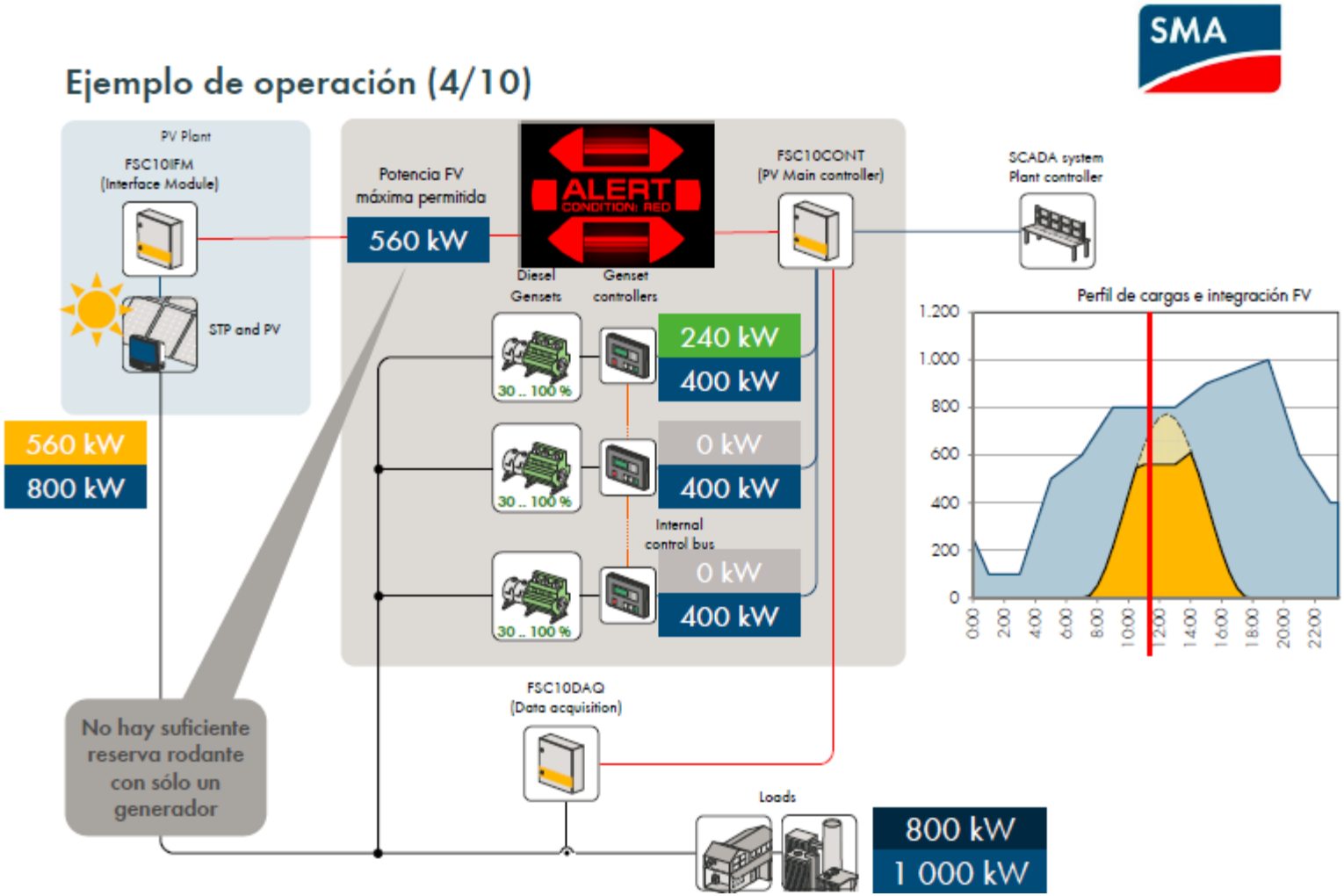
TIPOS DE SISTEMAS:

Funcionamiento



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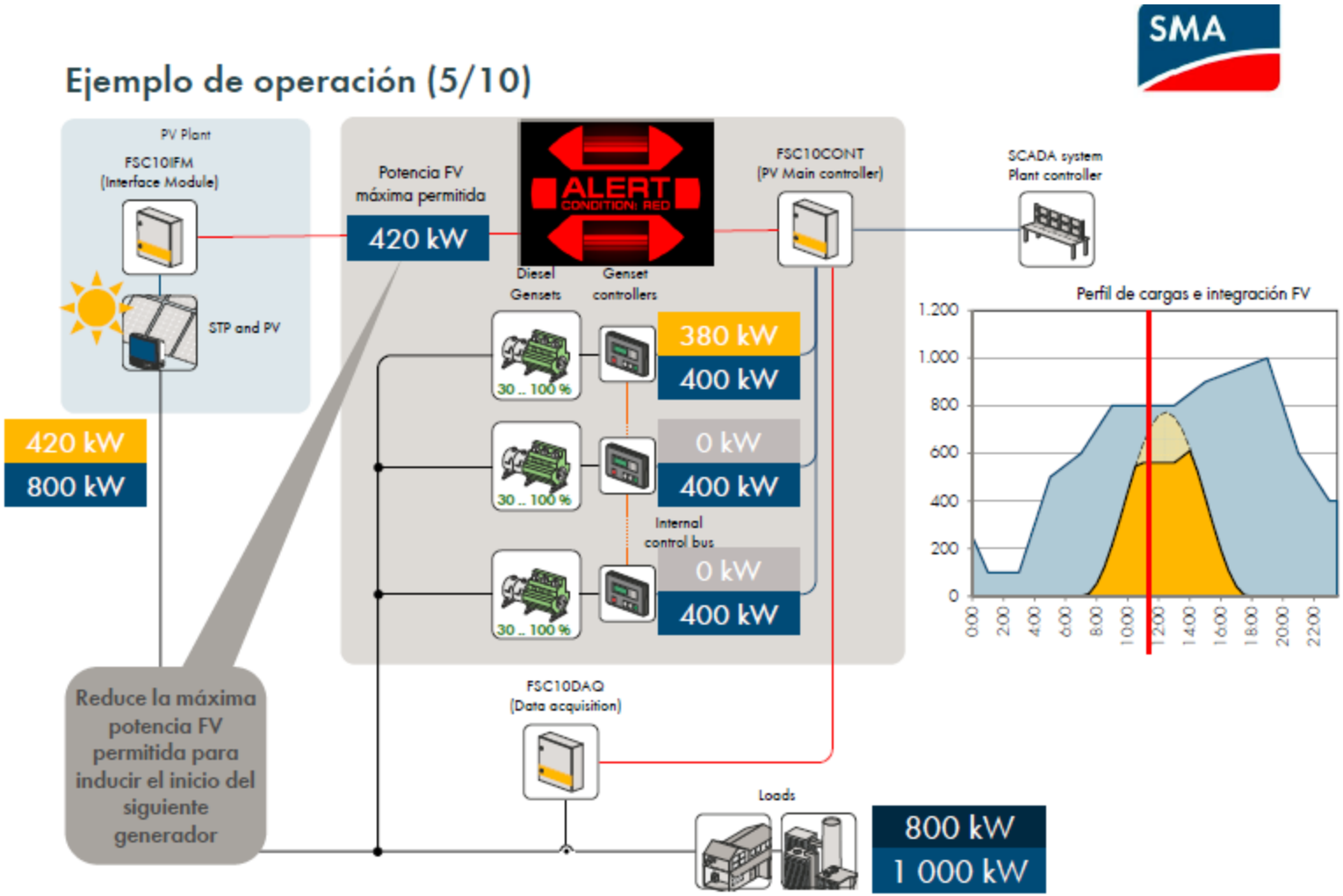
TIPOS DE SISTEMAS:

Funcionamiento



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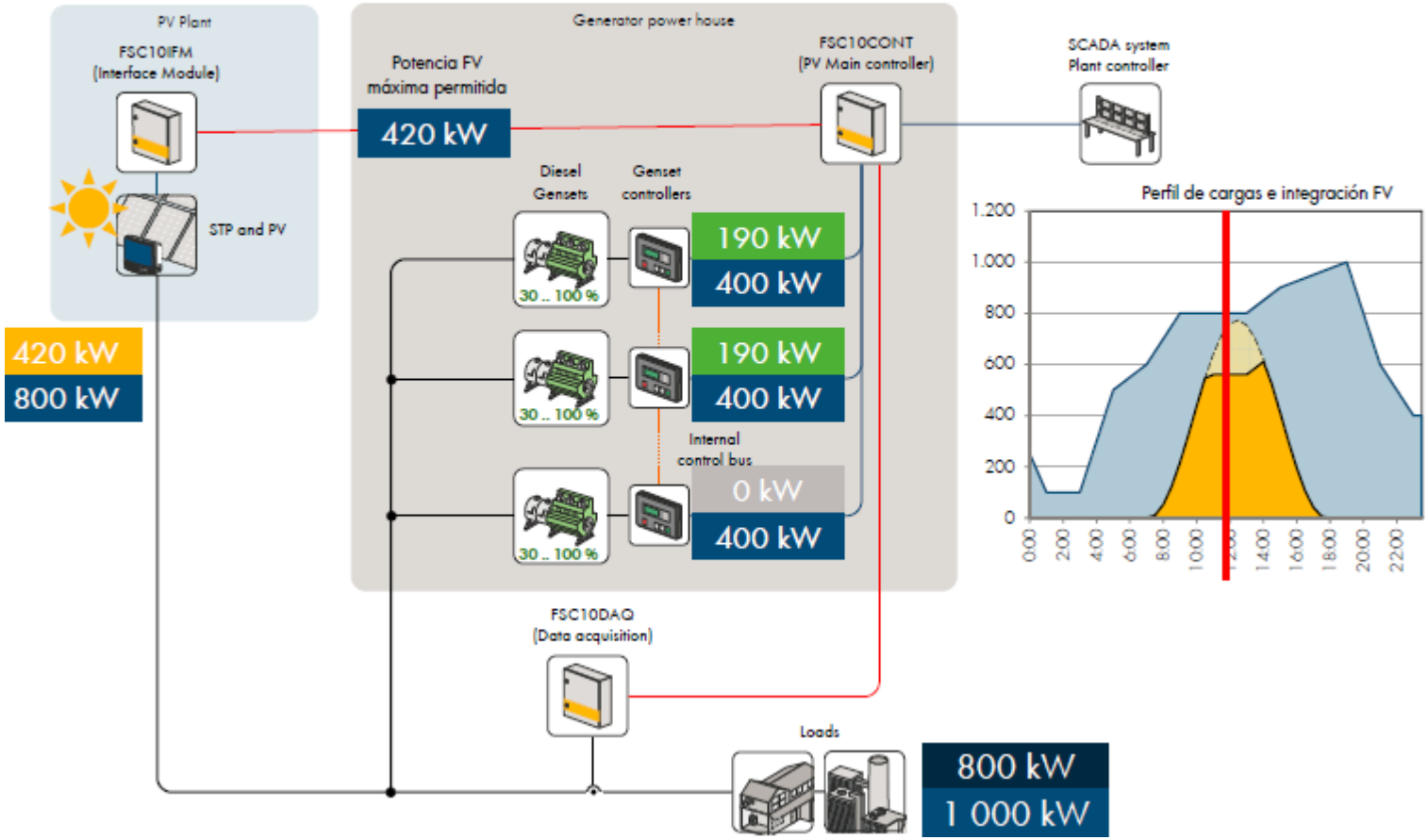
TIPOS DE SISTEMAS:

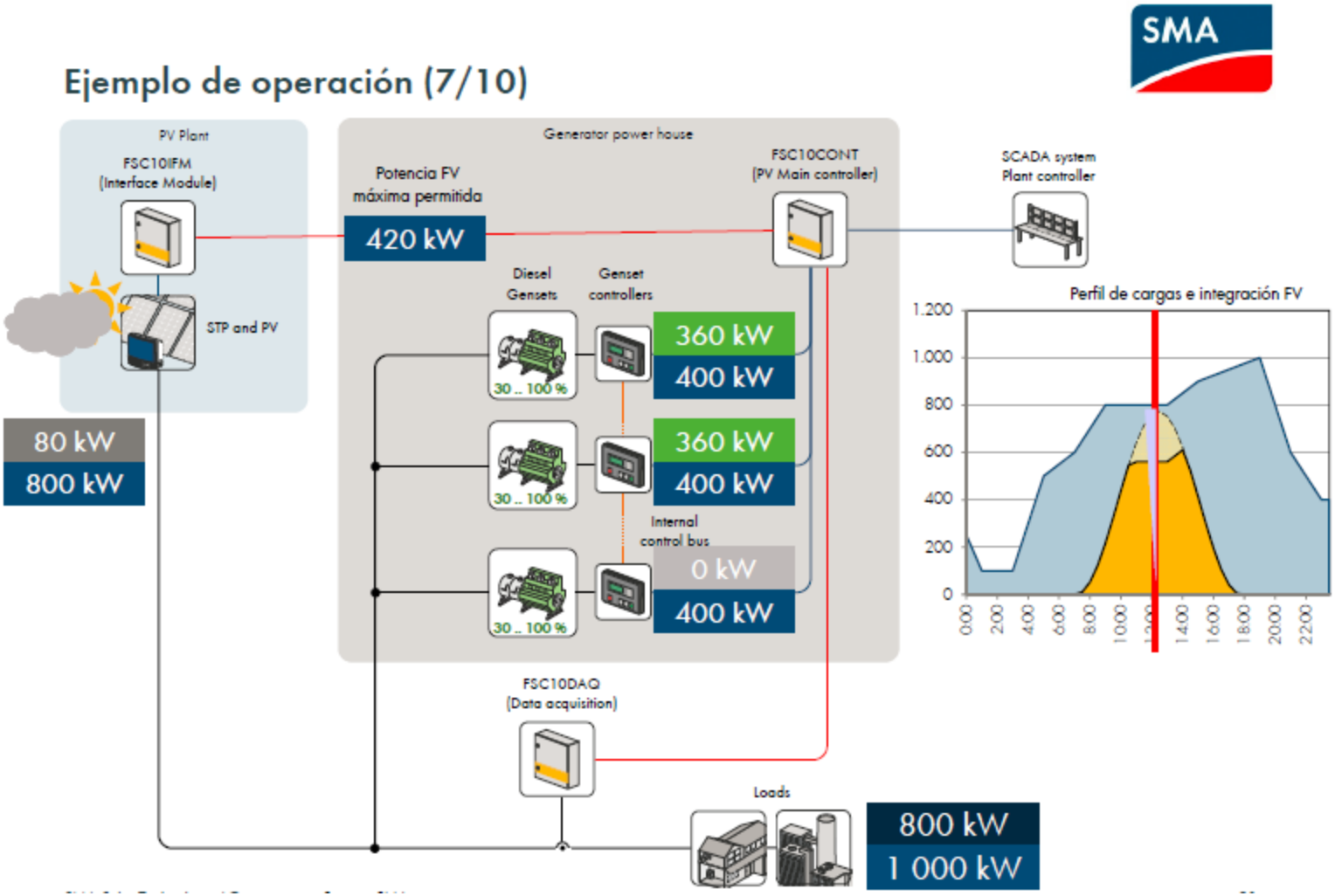
Funcionamiento

Ejemplo de operación (6/10)



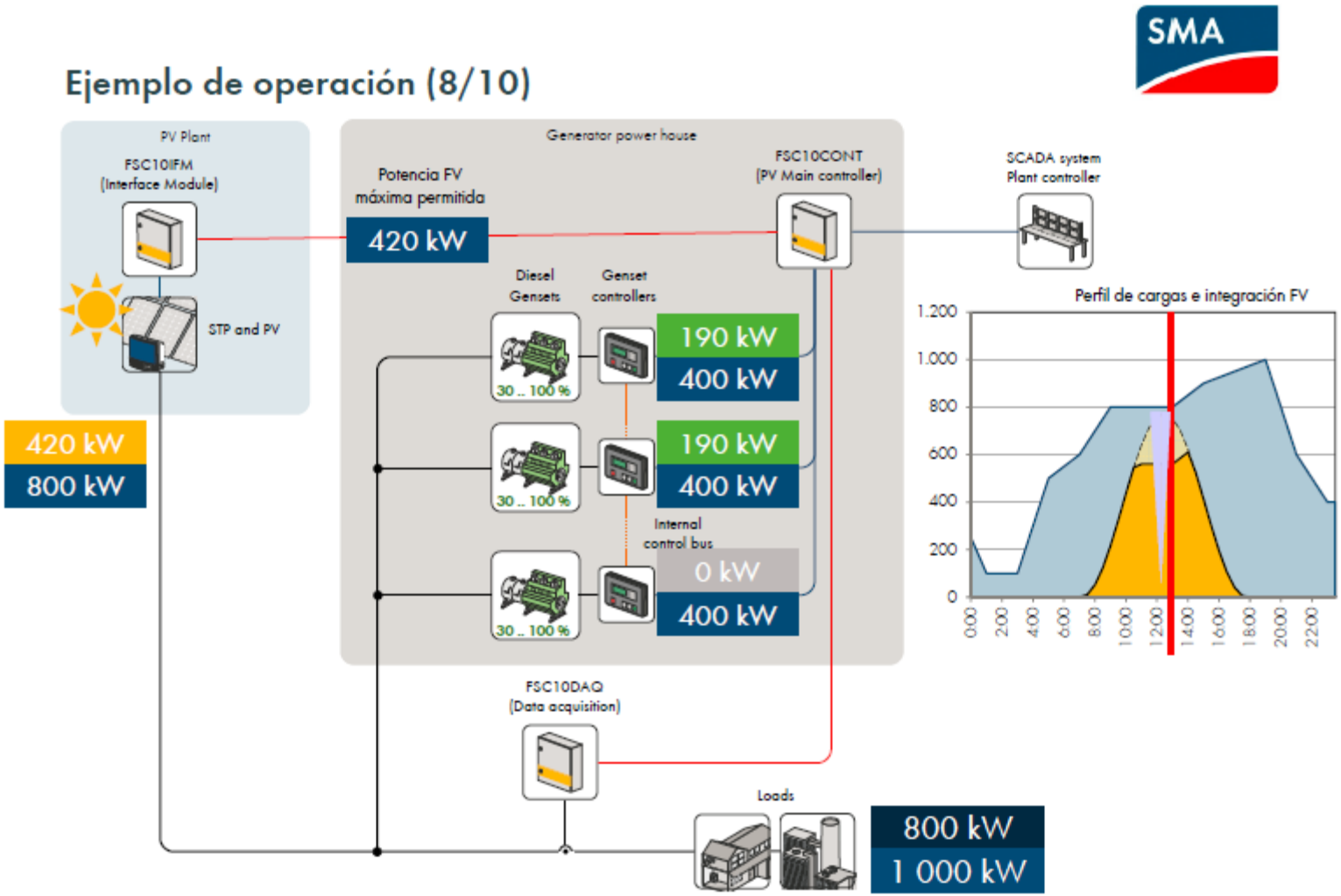
TIPOS DE SISTEMAS:

Funcionamiento



TIPOS DE SISTEMAS:

Funcionamiento



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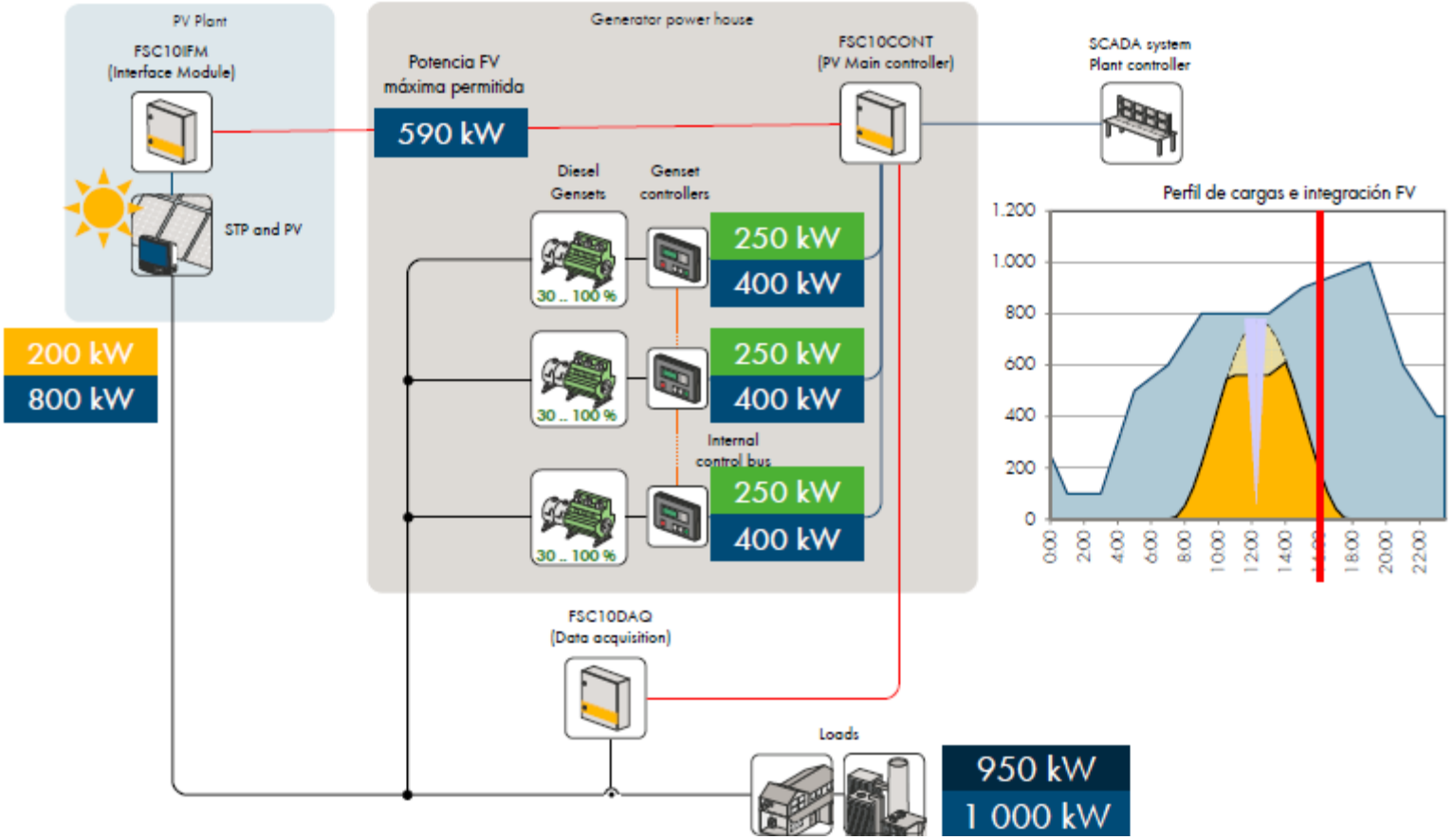
TIPOS DE SISTEMAS:

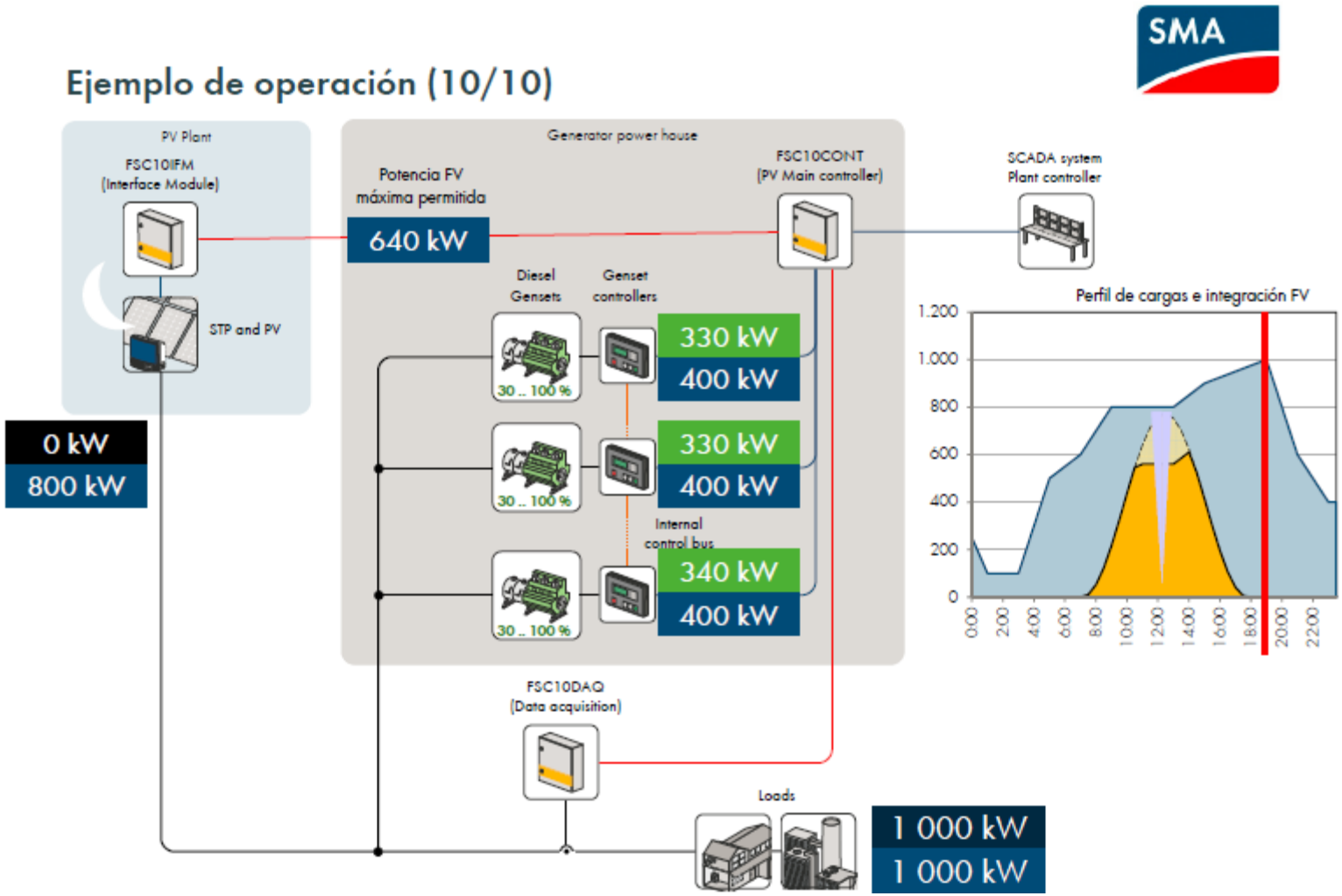
Funcionamiento

Ejemplo de operación (9/10)



TIPOS DE SISTEMAS:

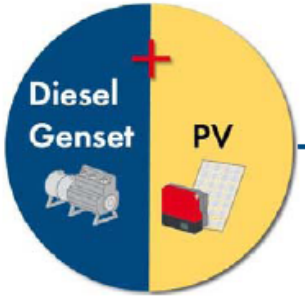
Funcionamiento



TIPOS DE SISTEMAS:

Factores clave

Sistema PV-Diesel



1. **Reducción de costes variables**
   Reducción significativa del consumo de combustible
2. **Reducción de emisiones CO_2**
   Cumplimiento con obligaciones venta de certificados verdes
3. **Escalabilidad**
   La tasa/penetración de FV se puede ir ampliando

Nuevas oportunidades de negocio / costes minimizados

4. **Independencia energética**
   El sol siempre está presente en la instalación
5. **Planificación segura**
   Los precios variables del combustible influyen menos en los resultados económicos de su proyecto
6. **Aspectos sociales**
   Su proyecto será más sostenible y será aceptado más fácilmente por la sociedad

Suministro reforzado / riesgo minimizado

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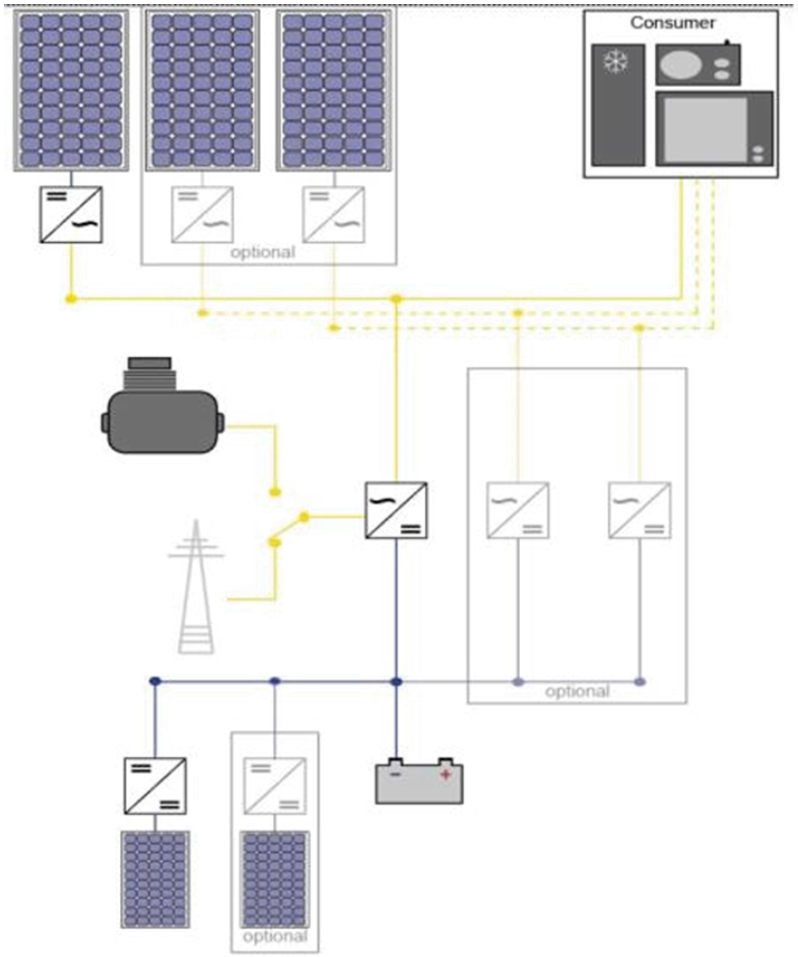
TIPOS DE SISTEMAS:

Funcionamiento



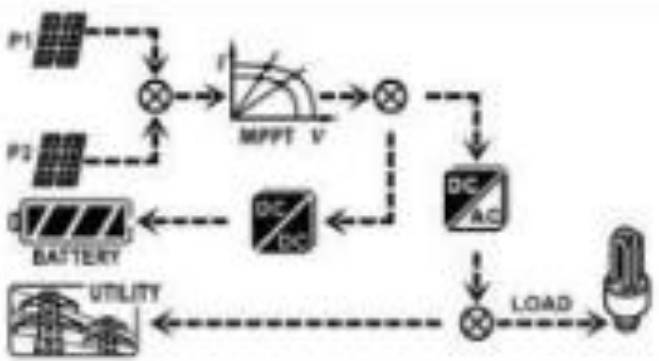
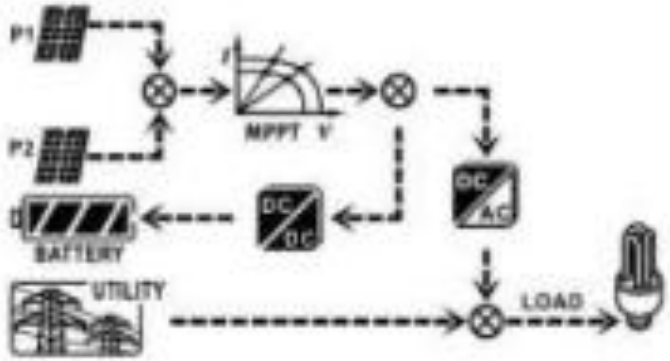
Aplicación residencial [3]

TIPOS DE SISTEMAS:

Funcionamiento

Inverter mode with grid connected

This inverter is connected to grid and working with DC/INV operation.

LCD Display	Description
	PV power is sufficient to charge battery, provide power to loads, and then feed in to the grid.
	PV power is sufficient to charge the battery first. However, remaining PV power is not sufficient to back up the load. Therefore, remaining PV power and the utility are supplying power to the connected load.

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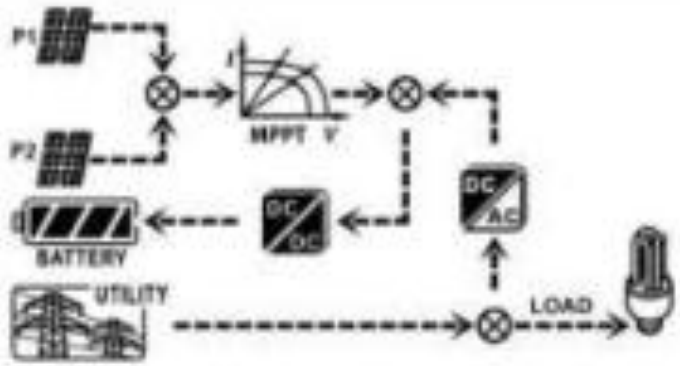
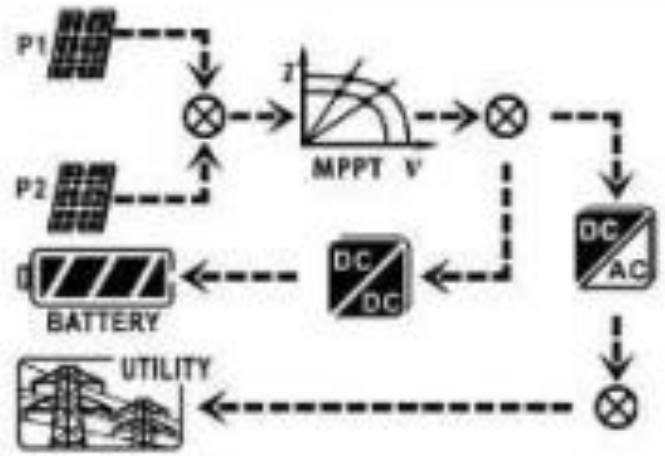
TIPOS DE SISTEMAS:

Funcionamiento

	PV power is generated, but not sufficient enough to charge battery by itself. PV power and the utility are charging battery at the same time. And the utility is also supplying power to the connected load.
	This inverter is disabled to generate power to the loads via AC output. PV power is sufficient to charge battery first. Remaining PV power will feed in back to grid.

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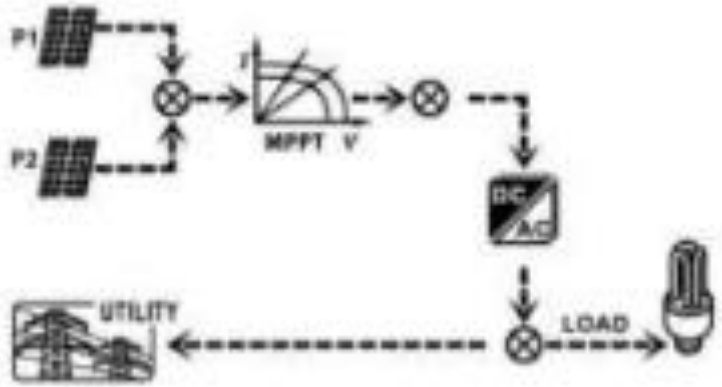
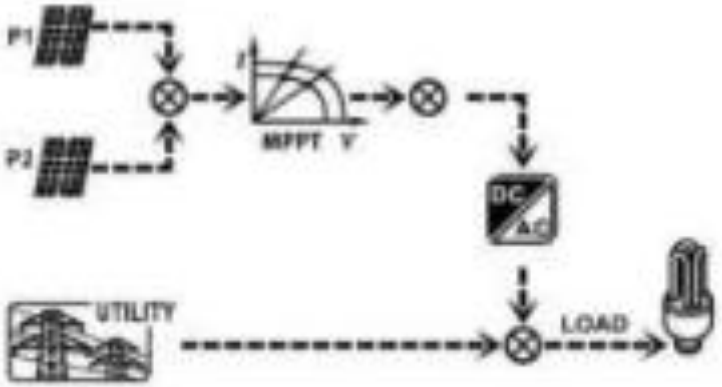
TIPOS DE SISTEMAS:

Funcionamiento

	PV power is sufficient to provide power to loads and feed power back to the grid.
	PV power and utility are providing power to the connected loads because of insufficient PV power.

Inverter mode without grid connected

This inverter is working with DC/INV operation and not connecting to the grid.

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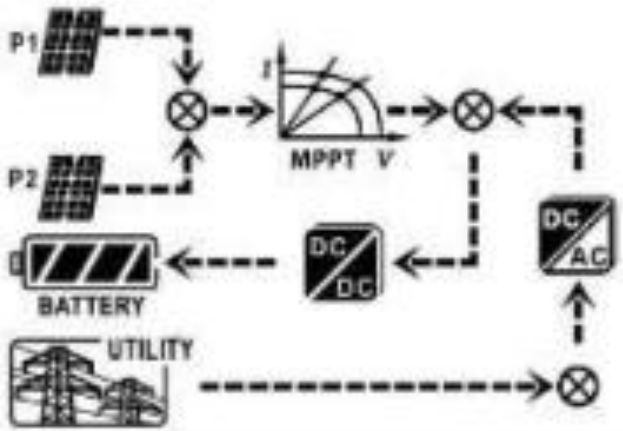
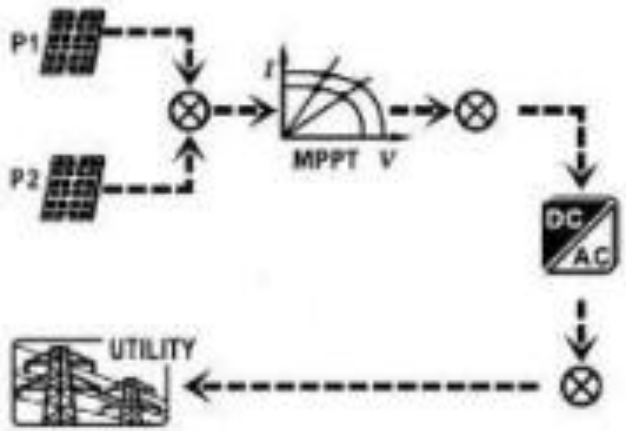
TIPOS DE SISTEMAS:

Funcionamiento

	This inverter is disabled to generate power to the loads via AC output. PV power and utility are charging battery at the same time because of insufficient PV power.
	This inverter is disabled to generate power to the loads via AC output. PV power is feeding power back to the grid.

Voltronic – Infiny Solar

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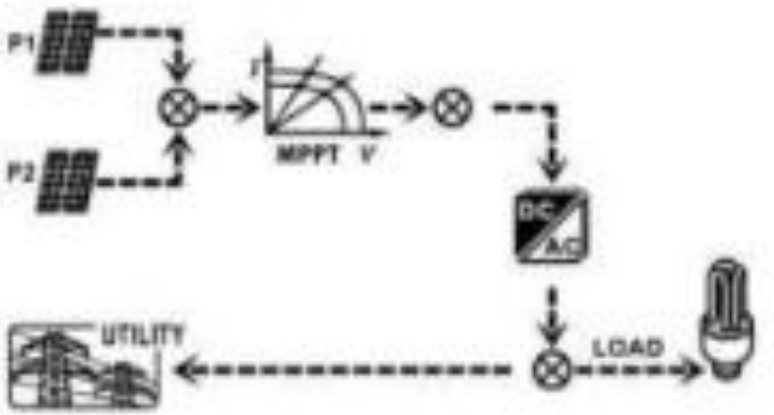
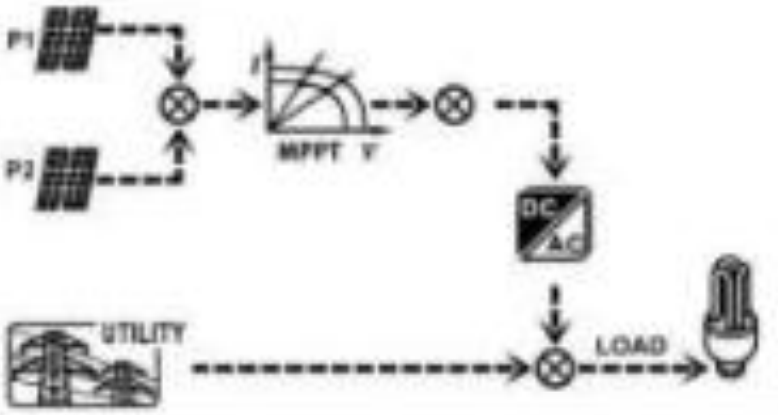
TIPOS DE SISTEMAS:

Funcionamiento

	PV power is sufficient to provide power to loads and feed power back to the grid.
	PV power and utility are providing power to the connected loads because of insufficient PV power.

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TIPOS DE SISTEMAS:

Aplicación

Criterios de factibilidad de sistemas híbridos

- Cantidad significativa de generadores (grupos electrógenos) de carga con base 24/7
- El perfil de cargas coincide con el perfil diario de generación FV
- Suficiente espacio disponible para una instalación FV
- Tamaño del sistema FV > 0,3 MW
- Precio efectivo del Diésel[3] > 1 USD/litro para el operador del generador Diesel
- Responsabilidad del usuario final: obligación de reducir OpEx[1], emisiones CO_2, y/o deseo de invertir en "soluciones verdes"

Aplicaciones FV-Híbridas

Compañias eléctricas/ PIE[2]
(en redes aisladas/zonas con redes débiles)

Industrias en zonas remotas
(p.e. minería, petróleo y gas, desalinización, agropecuaria)

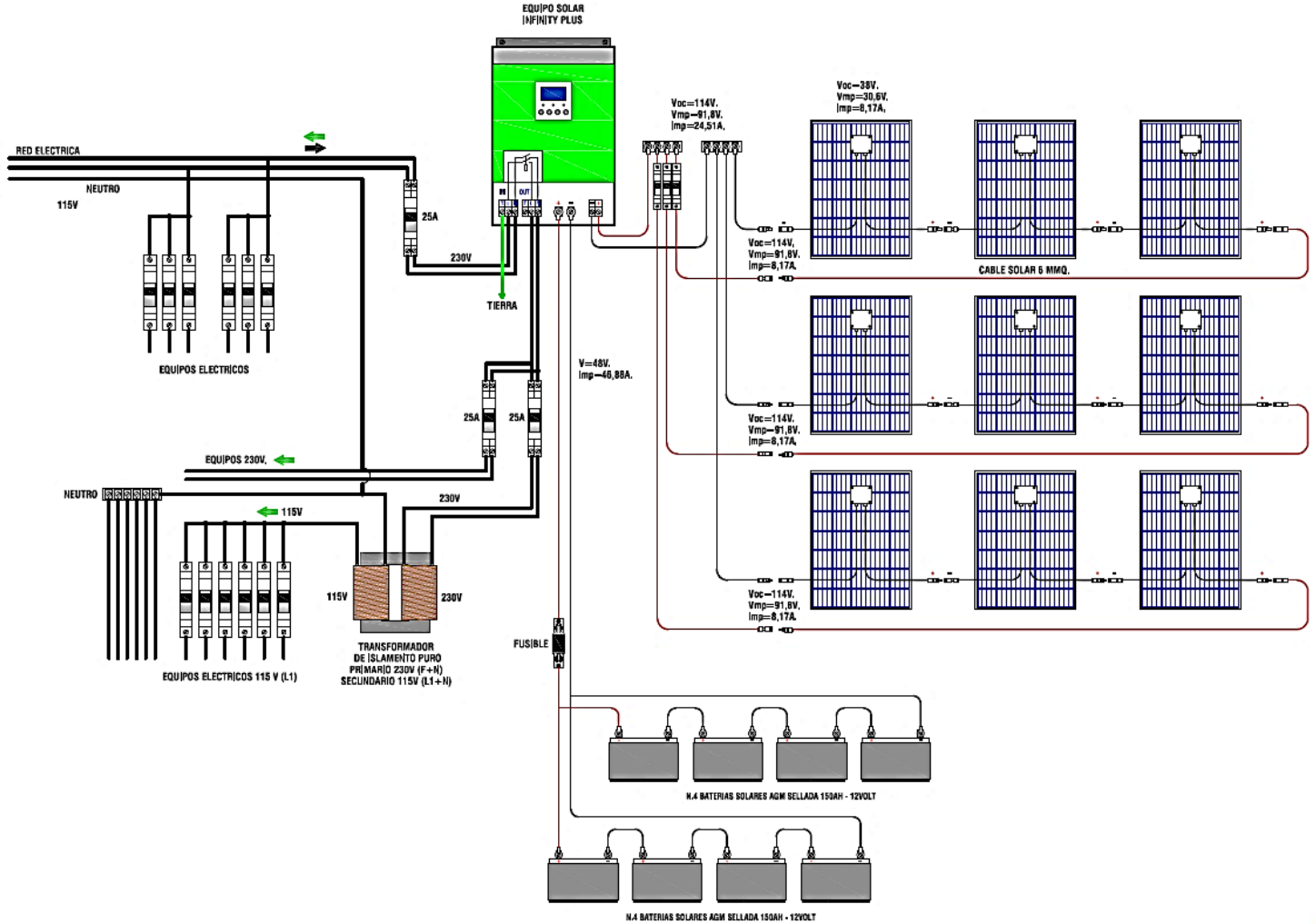
Agricultura de gran escala
(p.e. sistemas de riego)

Turismo
(p.e. hoteles, resorts)

Sector commercial
(p.e. oficinas, almacenes)

TIPOS DE SISTEMAS:

Aplicación



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TIPOS DE SISTEMAS:

Aplicación

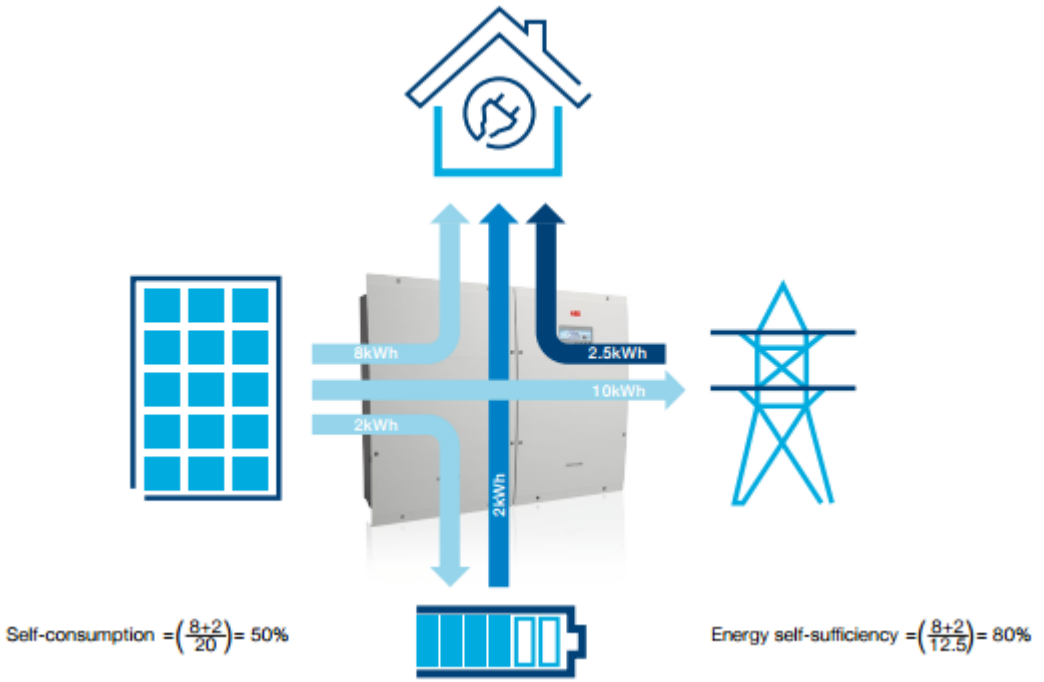

ABB – REACT

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TIPOS DE SISTEMAS:

Aplicación

Inverter	REACT-UNO-3.6-TL	REACT-UNO-4.6-TL
Backup output		
AC connection type	Single-phase	
Rated apparent power - S_{acr}	3000 VA	
Rated AC Voltage - V_{acr}	230 V	
Maximum AC current - $I_{ac\ max}$	13 A	
Contributory fault current	27 A rms (60 ms)	
Maximum external AC overcurrent protection	16 A	
Rated frequency - f_r	50 Hz	
AC connection type	Screw terminal block, cable gland M25	
Operating performance		
Maximum efficiency - η_{max}	97.1 %	
Weighted efficiency (EURO/CEC)	96.6 % / -	
Typical battery efficiency (full cycle)	94.0 %	

ABB – REACT

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TIPOS DE SISTEMAS:

Aplicación

Battery unit	REACT-BATT-AP1
Manufacturer	Panasonic
Battery type	Li-Ion
Typical/Max power discharge	1.5 kW / 1.8 kW
Max power charge	1.1 kW
Initial capacity (typ.)	2.42 kWh
Nominal capacity (during the life time)	2 kWh (6 kWh, with 3x battery unit)
Battery lifetime	> 4500 cycles with DOD=100% and residual capacity=60%
Battery calendar lifetime, typical	10 years (Max 9 MWh discharged)
Depth of Discharge (DOD)	100%
Dimension (H x W x D)	740 mm x 490 mm x 229 mm
Weight	< 37 kg
Environmental protection rating	IP21
Optimal battery operational temperature range	+5...+35°C
Full battery function operational temperature range charge	0...+40°C
Full battery function operational temperature range discharge	-10...+45°C
Relative humidity	5...95 % without condensing
Safety and EMC	EN62109-1, EN62109-2, compliance to applicable requirements of EN60950-1, EN61000-6-2, EN61000-6-3, UN38.3, UN3480

ABB – REACT

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TIPOS DE SISTEMAS:

Aplicación

Meter	REACT-MTR-1PH	REACT-MTR-3PH
Measures	P/ Q/ A/ V/ I	
Measures accuracy and resolution	< 1%, 1%	
Current capability	30 A	65 A
AC phases	1	3
Rated grid voltage / voltage range	230 V / 85...265 V	400 V / 380 V...415 V
Rated grid frequency	50 Hz	
Communication	RS485	
Power supply and consumption	Integrated, < 1 W	
Protection class	IP20	
Installation	DIN rail	
Operational temperature range	-20...+55°C	

ABB – REACT

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TIPOS DE SISTEMAS:

Aplicación

XTH

3 -> 8 kVA

XTM

1,5 -> 4 kVA

XTS

0,9 -> 1,4 kVA

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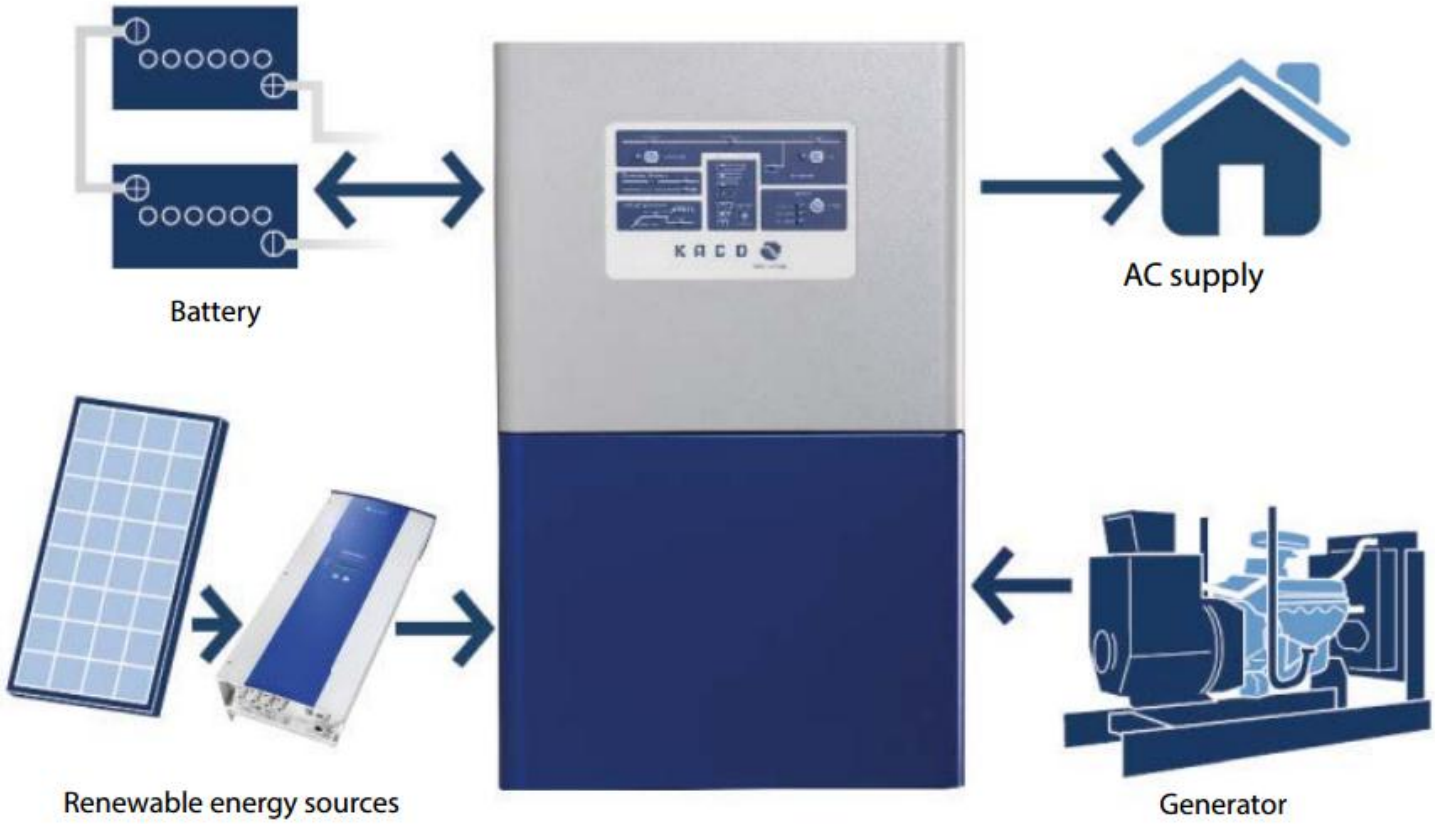
TIPOS DE SISTEMAS:



Kaco Powador - gridsave eco

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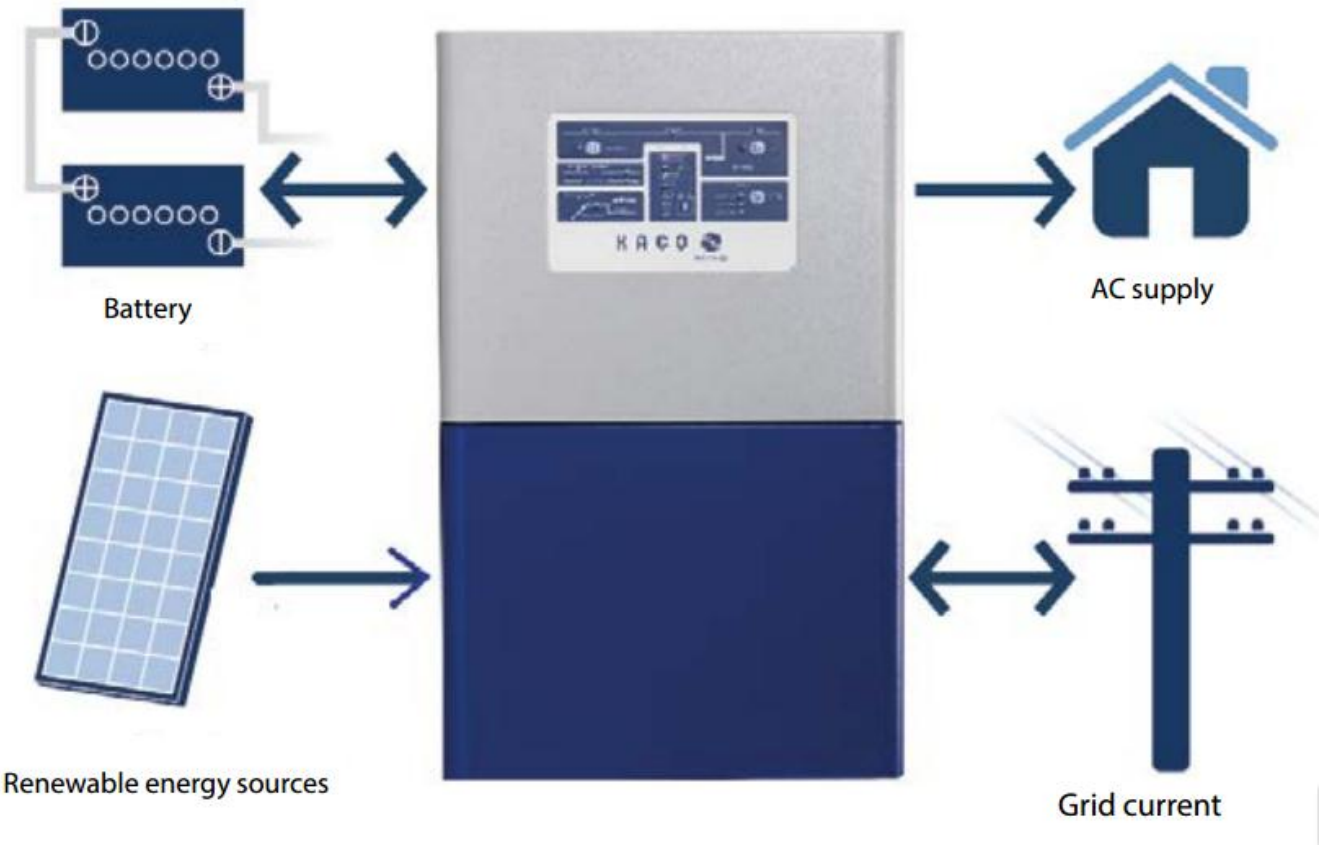
TIPOS DE SISTEMAS:

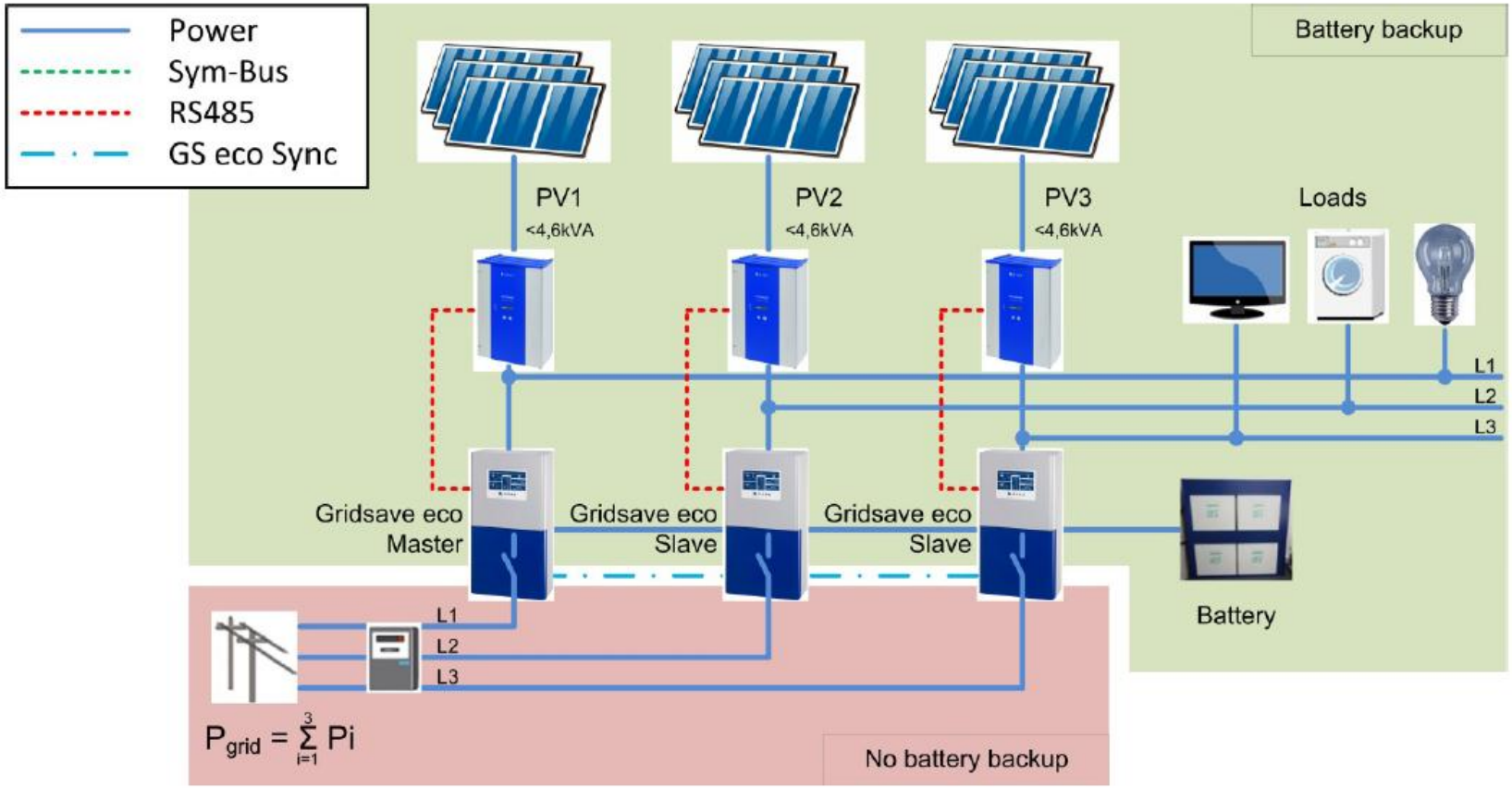
Aplicación



Kaco Powador - gridsave eco

TIPOS DE SISTEMAS:

Aplicación



Kaco Powador - gridsave eco

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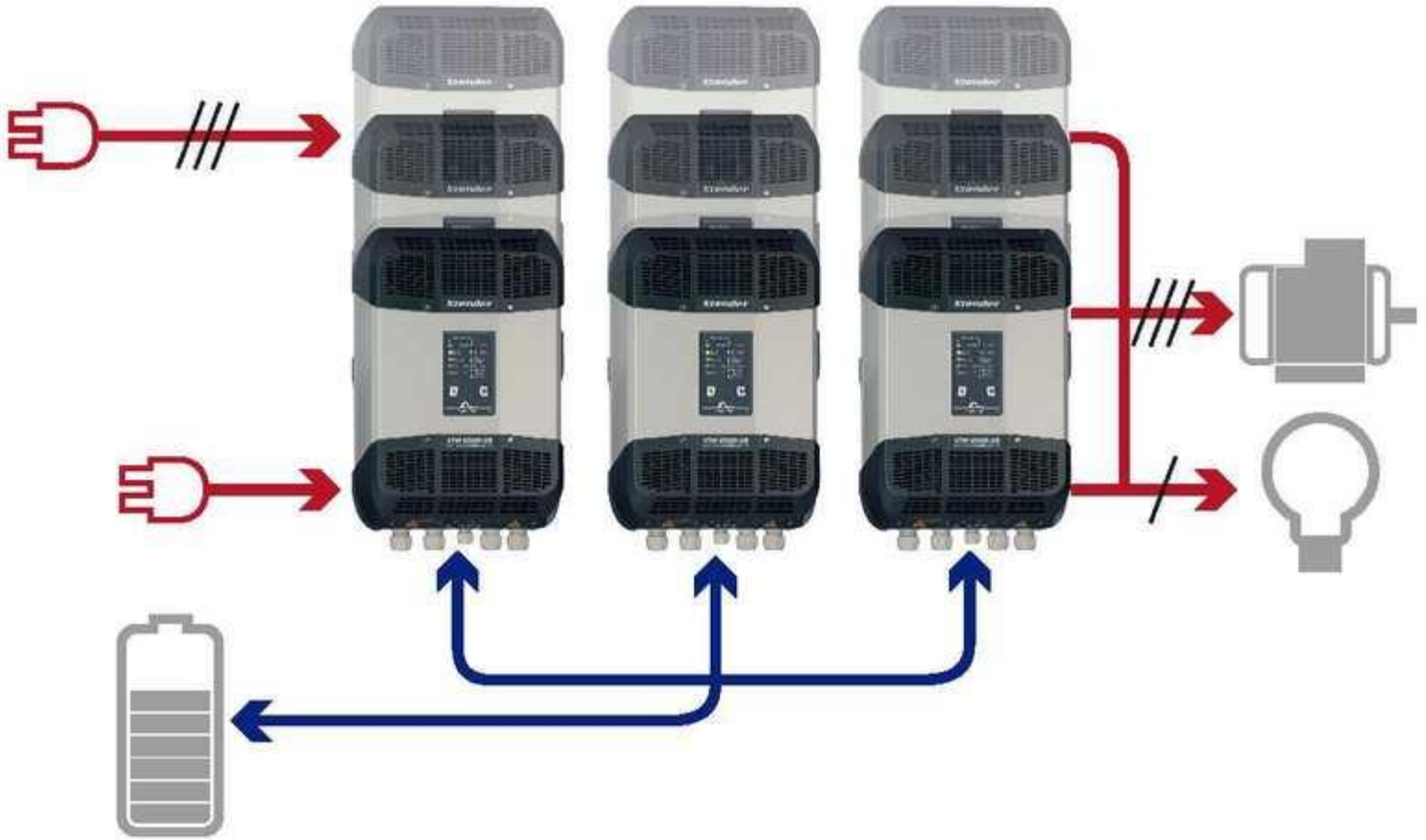
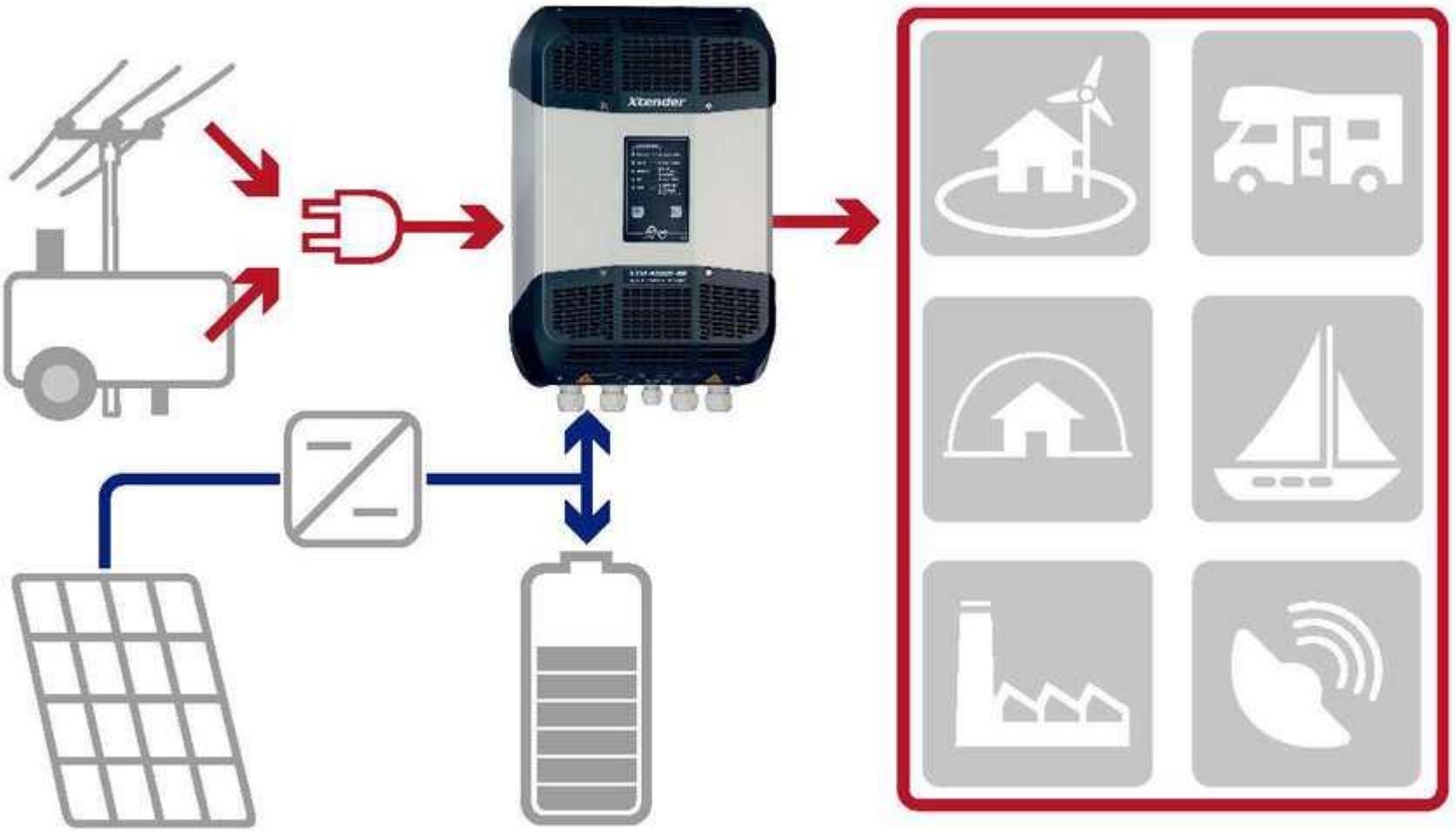
Aplicación



Studer – Xtender

TIPOS DE SISTEMAS:

Aplicación



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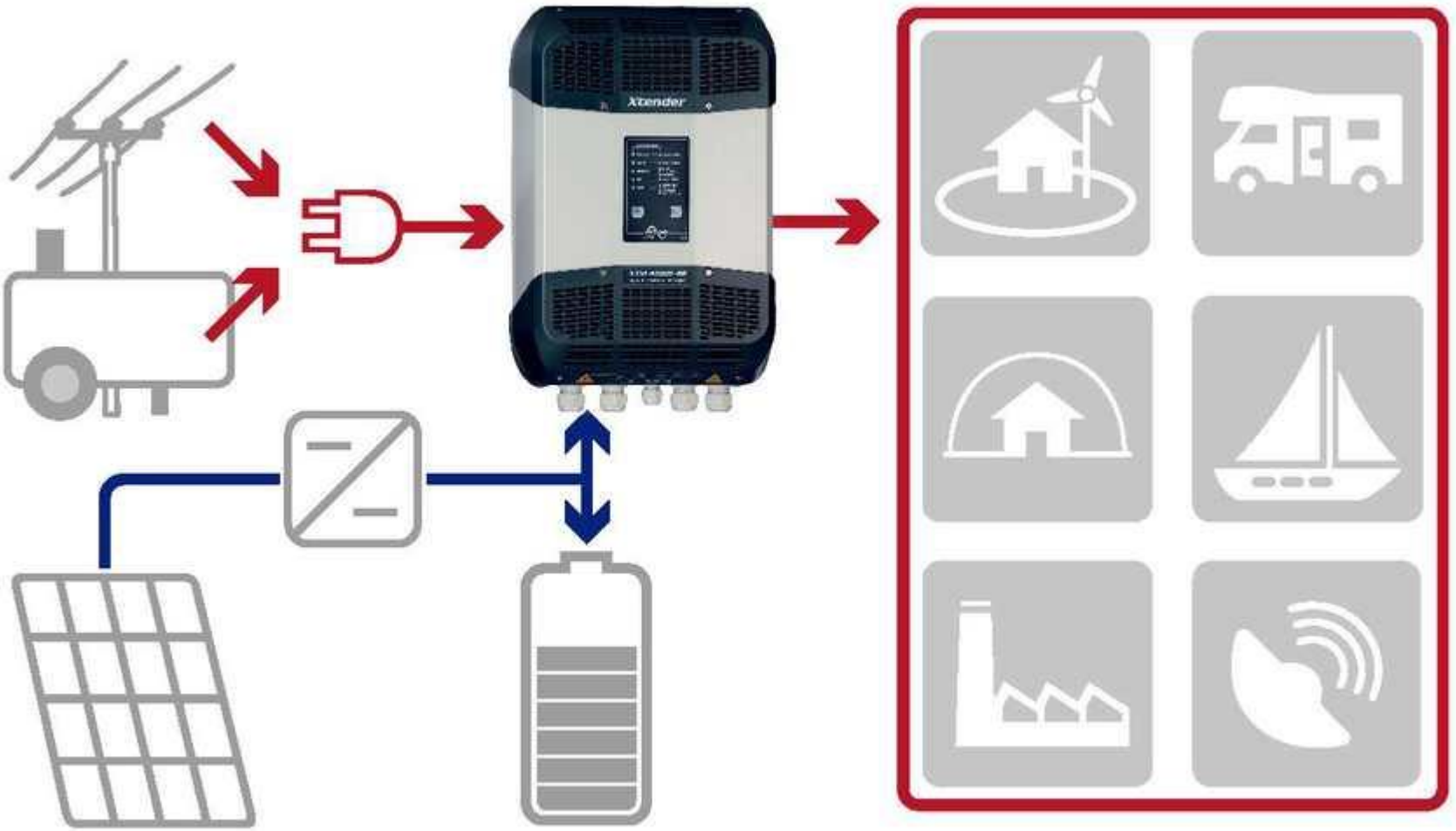
TIPOS DE SISTEMAS:

Aplicación



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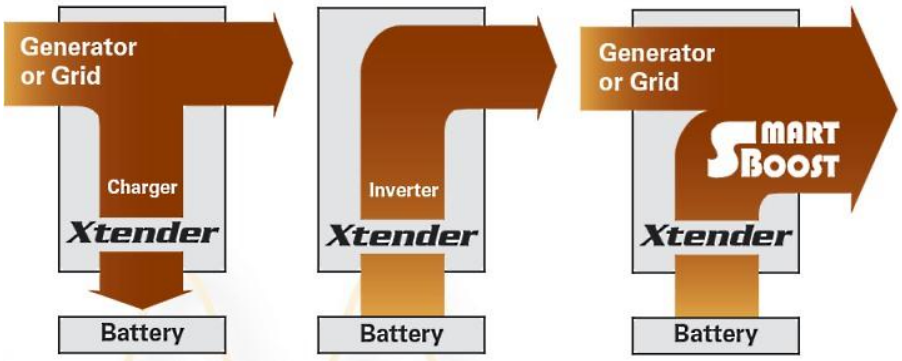
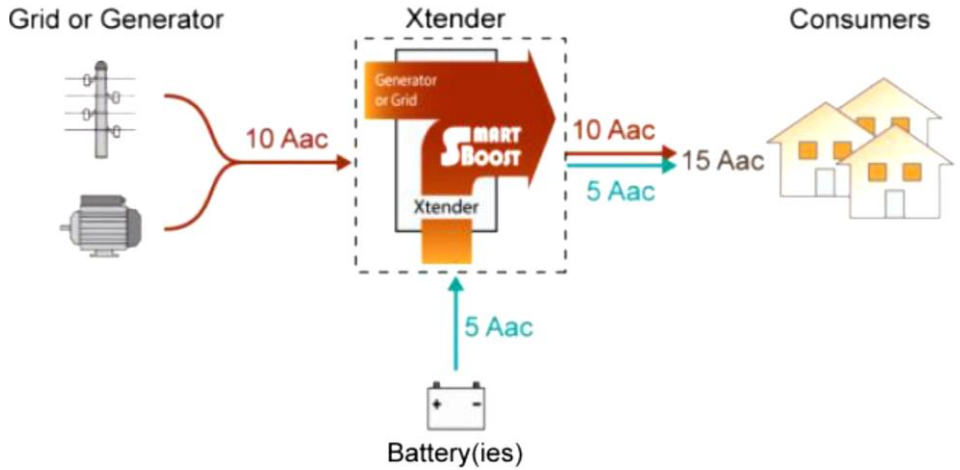
TIPOS DE SISTEMAS:

Aplicación





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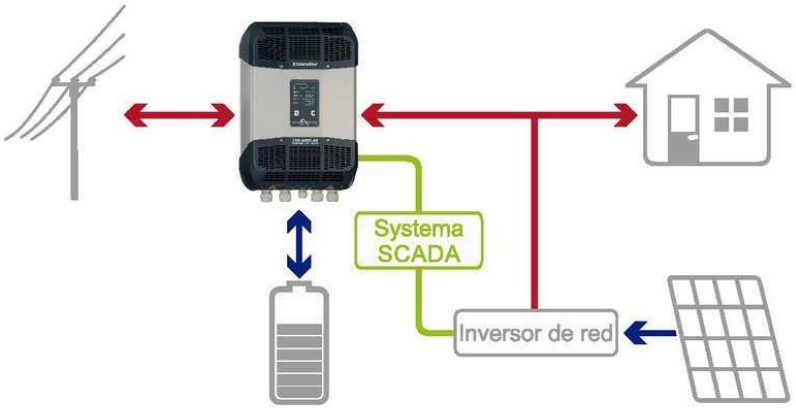
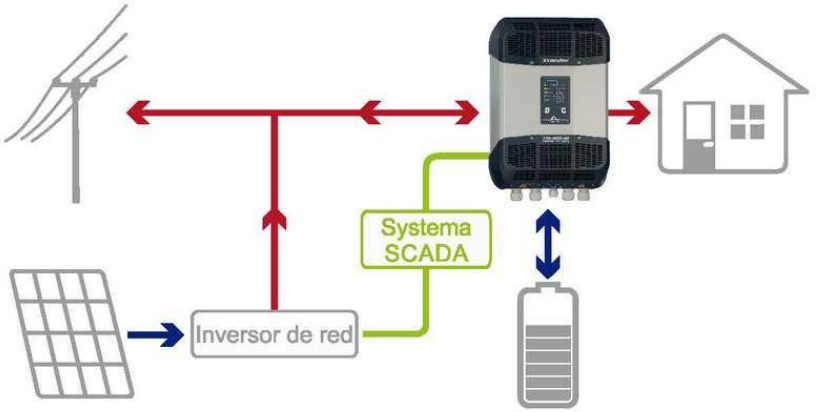
TIPOS DE SISTEMAS:

Aplicación





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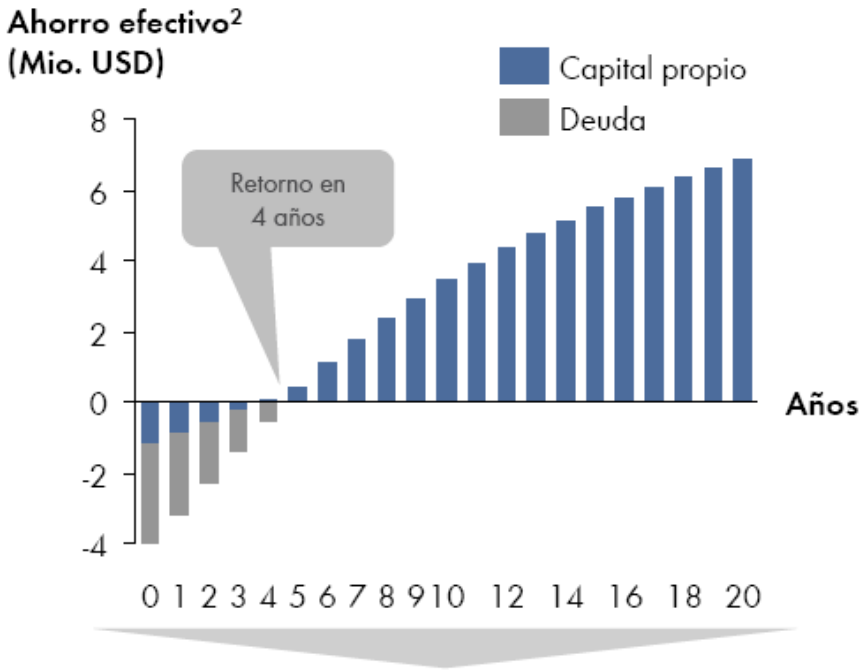
TIPOS DE SISTEMAS:

Nuevas oportunidades

Parámetros (caso base)

- El sistema está diseñado para que se aproveche toda la energía solar FV
- No hay aumentos anuales en el coste del combustible
- Tamaño de planta FV: 2 MWp
- Producción fotovoltaica: 1600 kWh/kWp año
- Coste sistema FV[1]: 2000 USD/kWp CapEx (+ OpEx 2% p.a.)
- Coste efectivo del Diésel: 1.30 USD/littro
- Eficiencia del generador: 3.5 kWh/litro
- Financiación FV: 30% fondos propios, 70% crédito (con 7% de interés y 5 años de amortización); Tasa de descuento para el flujo de caja : 8%

Análisis DCF[2]



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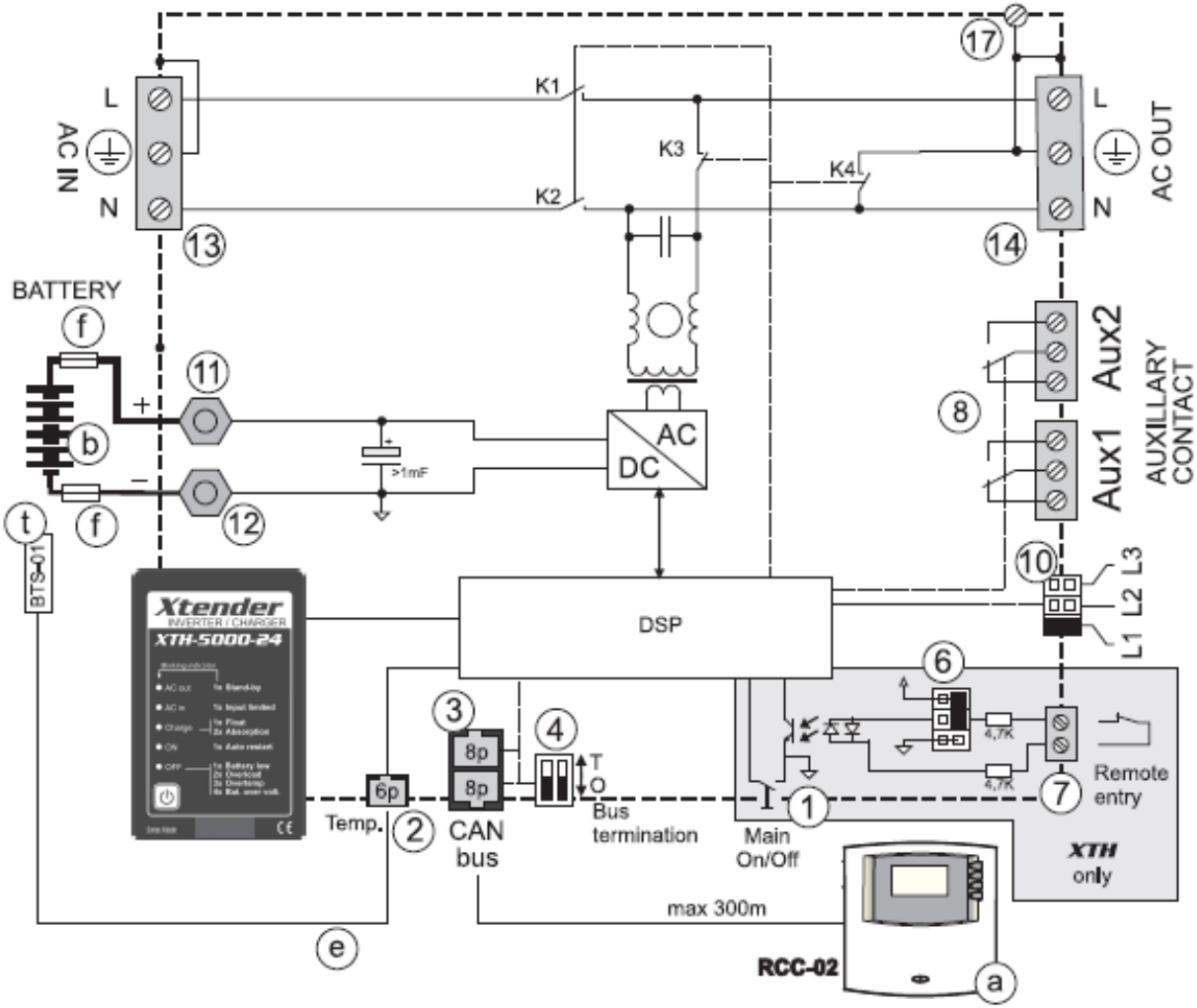
CRITERIOS DE DISEÑO

- Topología
- Datos técnicos

CRITERIO DE DISEÑO:

Topología



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CRITERIO DE DISEÑO:

Datos técnicos

	Potencia P30 / Pnom [VA]	Tensión de batería Unom [V]	Transfer current Imax [A]	Corriente del cargador Imax [A]
XTS 900-12	900**/500	12	16	35
XTS 1200-24	1200** / 650	24	16	25
XTS 1400-48	1400** / 750	48	16	12
XTM 1500-12	1500 / 1500	12	50	70
XTM 2000-12	2000 / 2000	12	50	100
XTM 2400-24	2400 / 2000	24	50	55
XTM 2600-48	2600 / 2000	48	50	30
XTM 3500-24	3500 / 3000	24	50	90
XTM 4000-48	4000 / 3500	48	50	50
XTH 3000-12	3000 / 2500	12	50	160
XTH 5000-24	5000 / 4500	24	50	140
XTH 6000-48	6000 / 5000	48	50	100
XTH 8000-48	8000 / 7000	48	50	120

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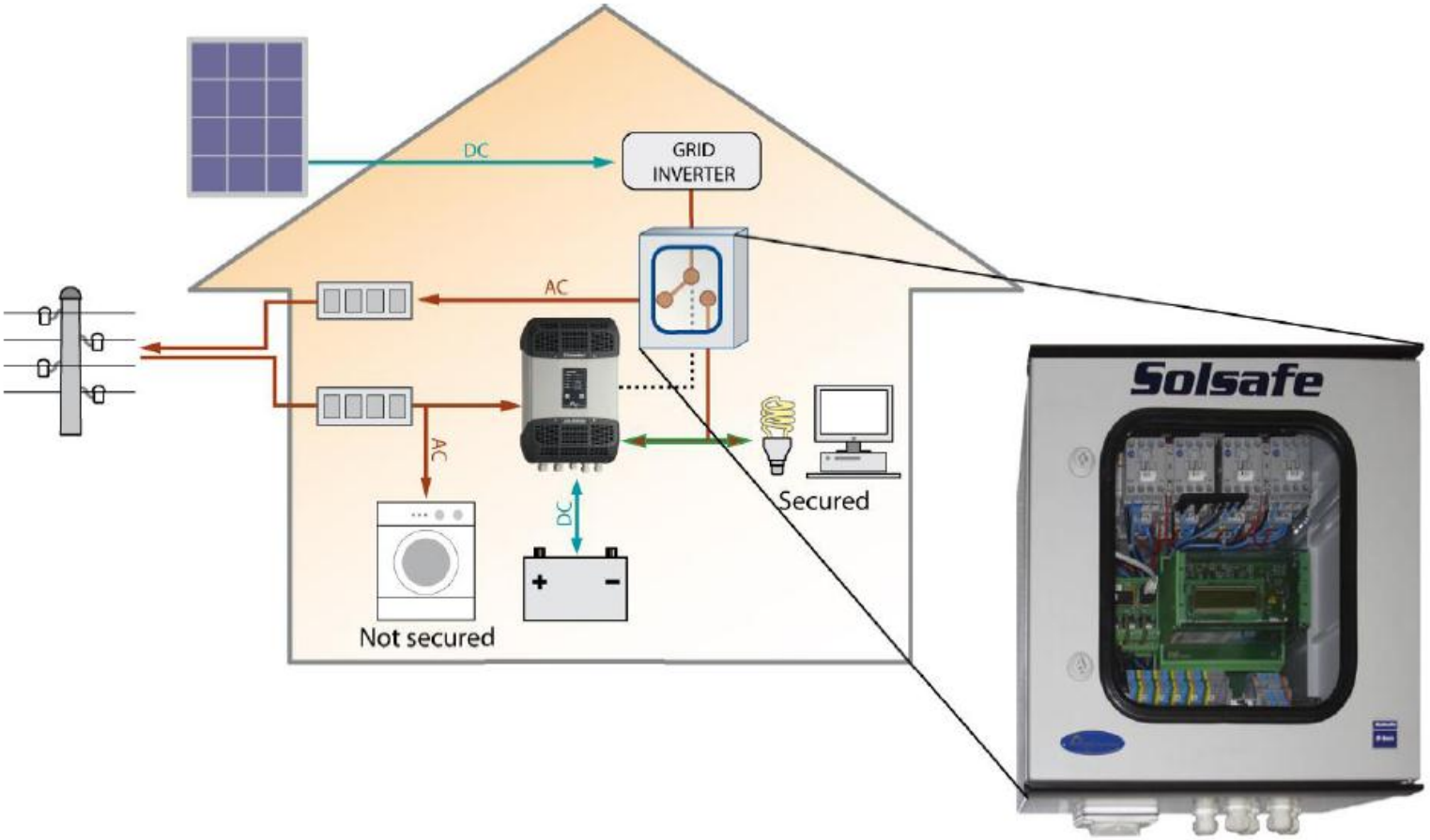
CRITERIO DE DISEÑO:

Datos técnicos



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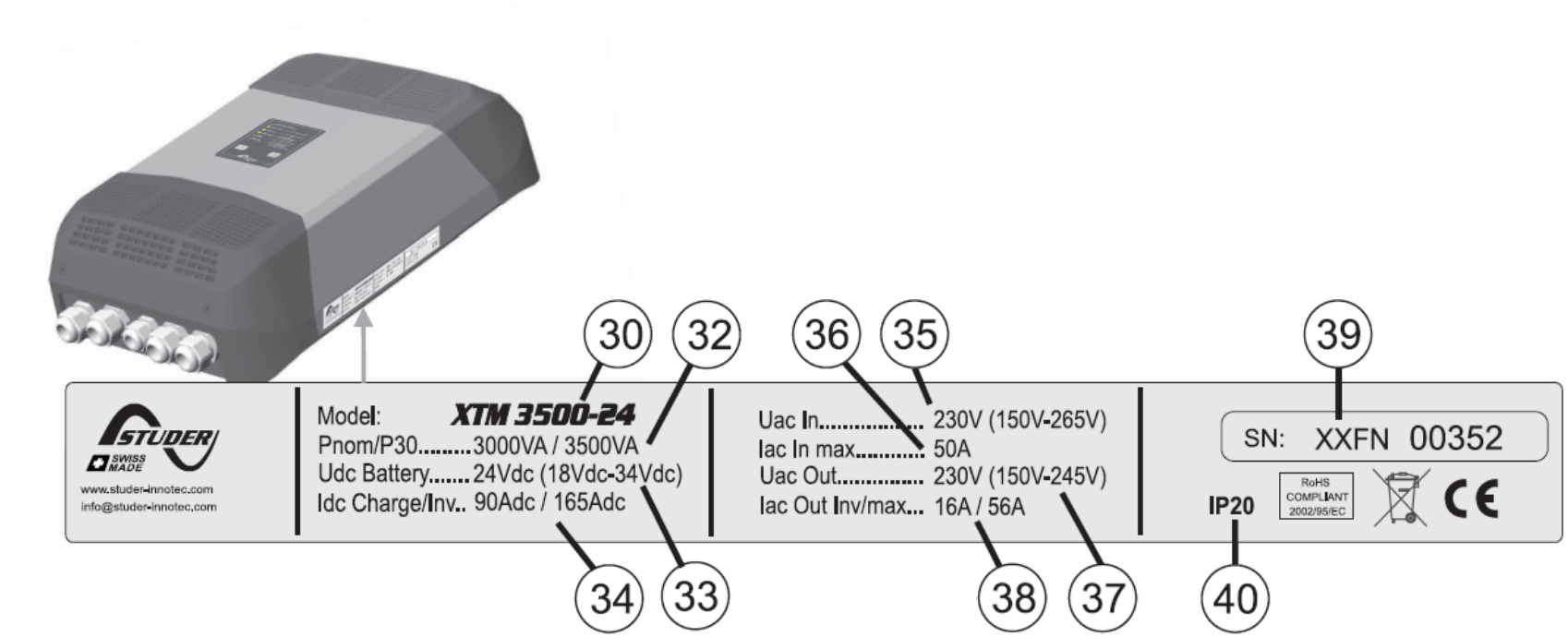
Datos técnicos



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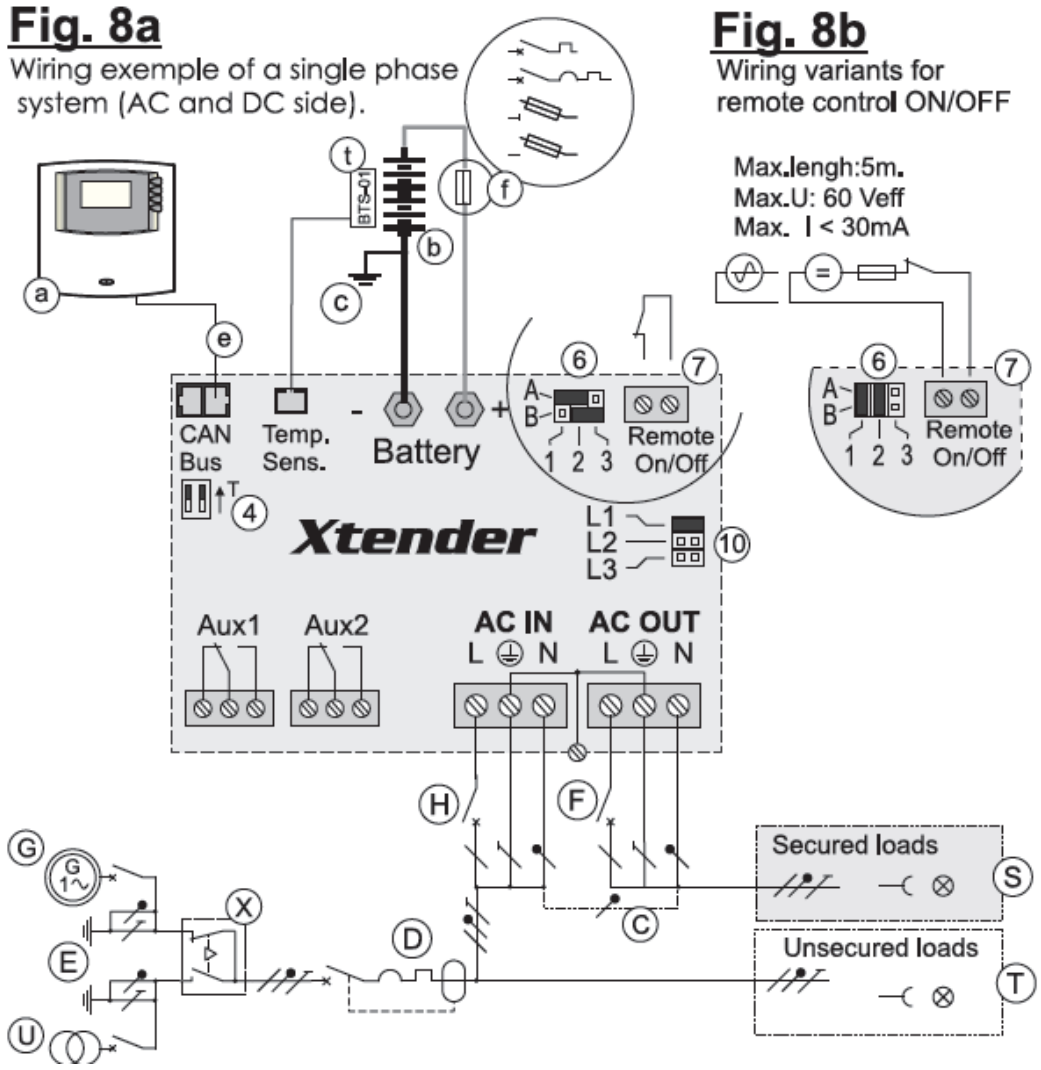
CRITERIO DE DISEÑO:

Datos técnicos



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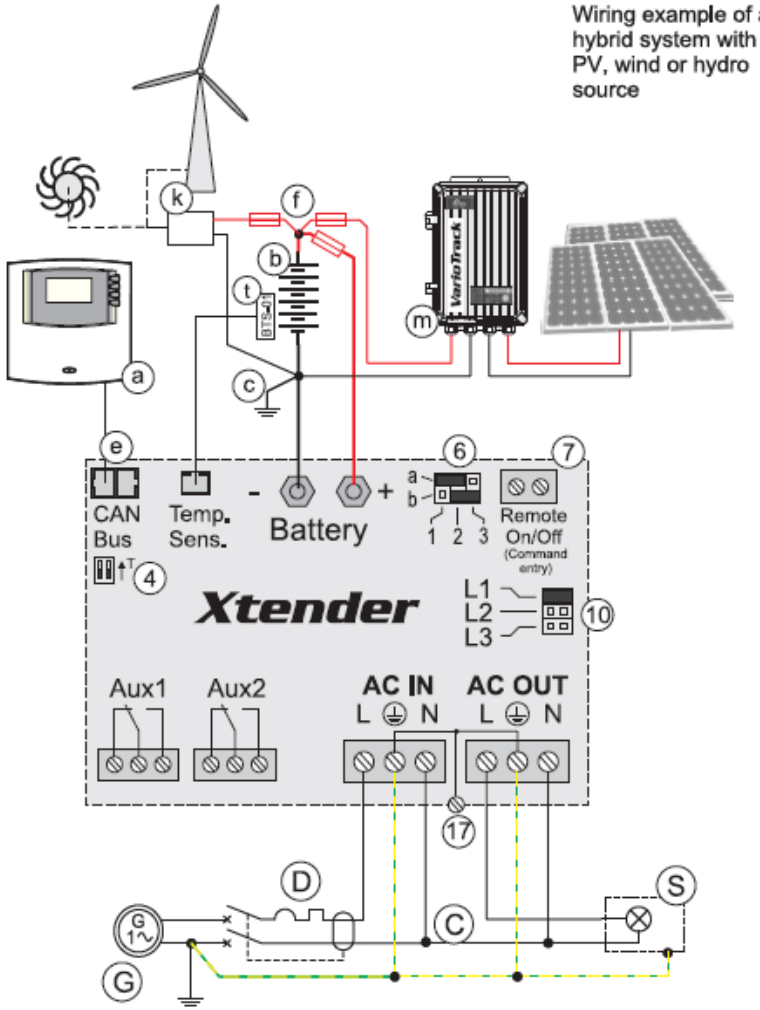
CRITERIO DE DISEÑO:

Datos técnicos

Fig. 11

Wiring example of a hybrid system with PV, wind or hydro source



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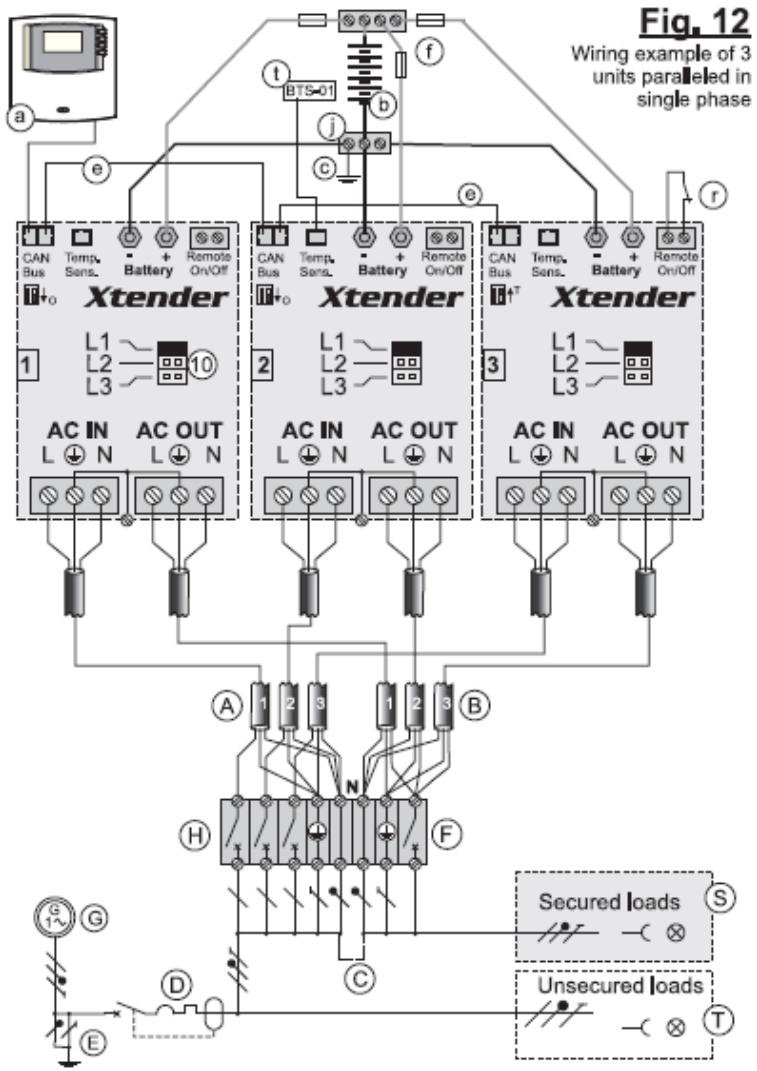
Datos técnicos



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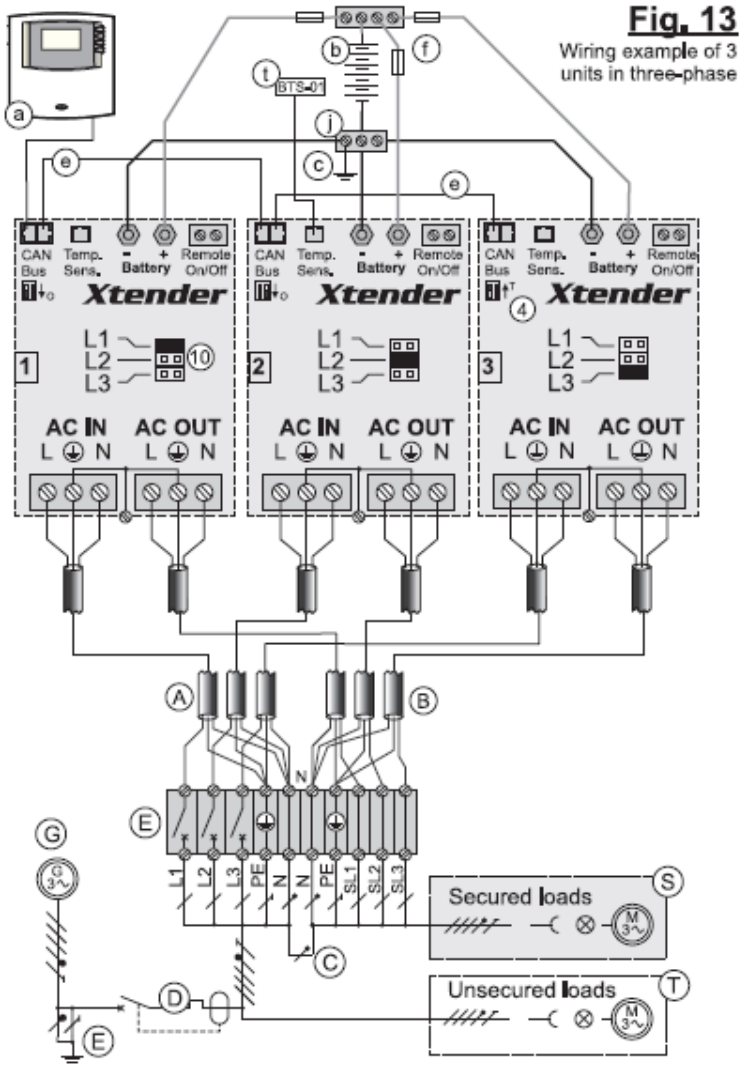
CRITERIO DE DISEÑO:

Datos técnicos



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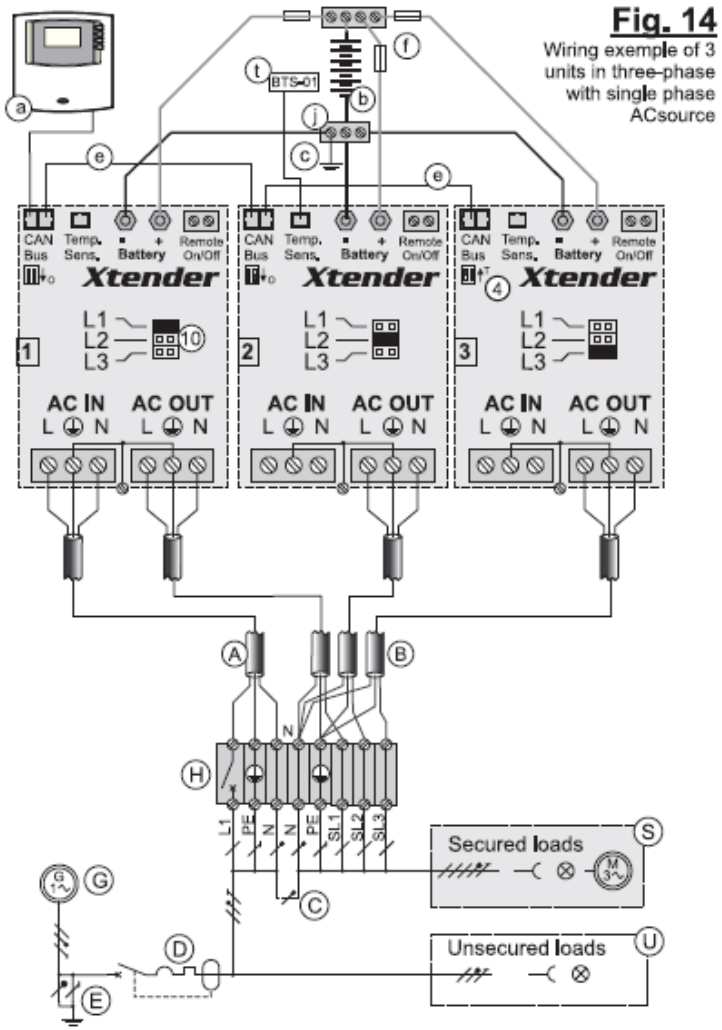
Datos técnicos



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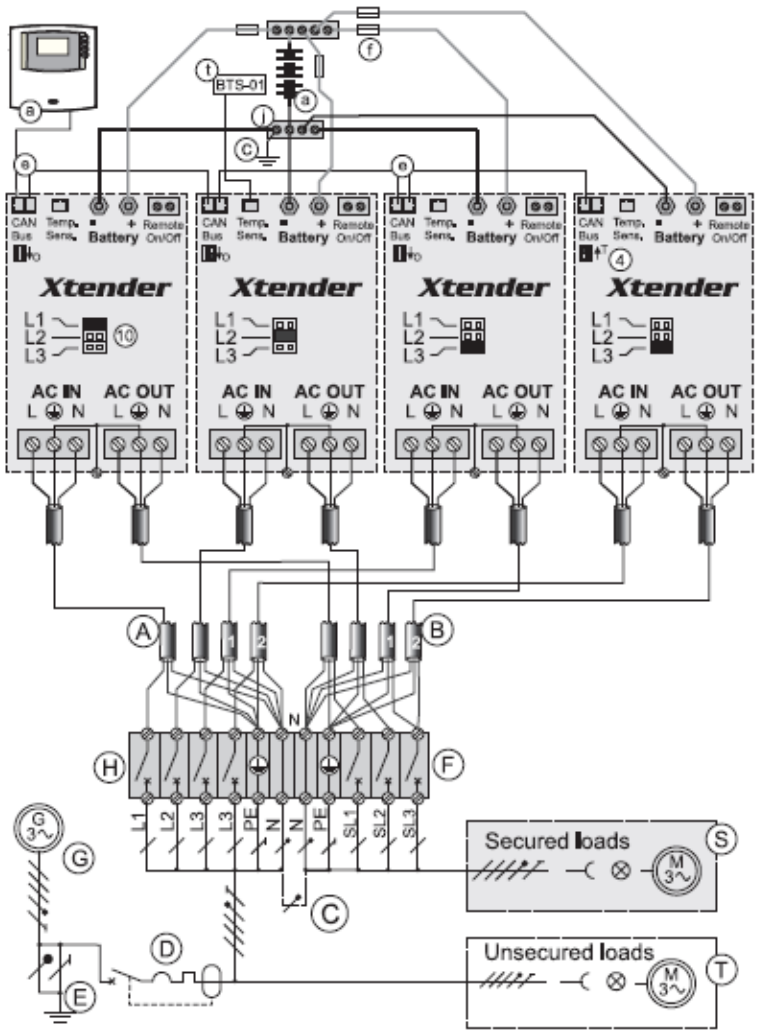
CRITERIO DE DISEÑO:

Datos técnicos

Fig. 15 Wiring example of 3 units in three-phase + one phase (L3) paralled



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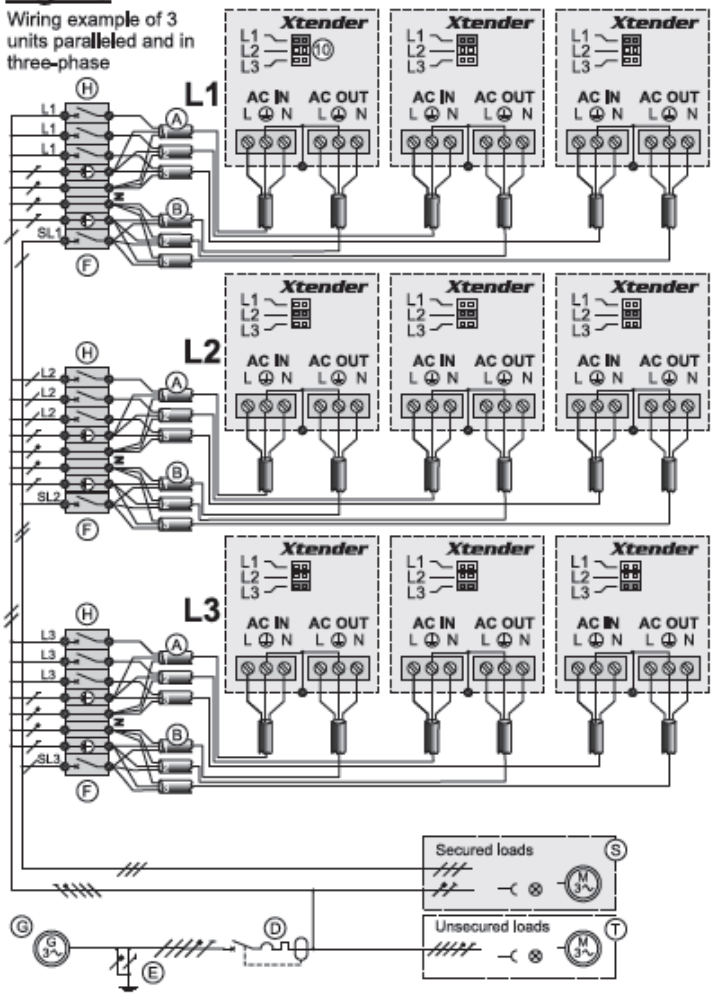
CRITERIO DE DISEÑO:

Datos técnicos

Fig. 16

Wiring example of 3 units paralleled and in three-phase



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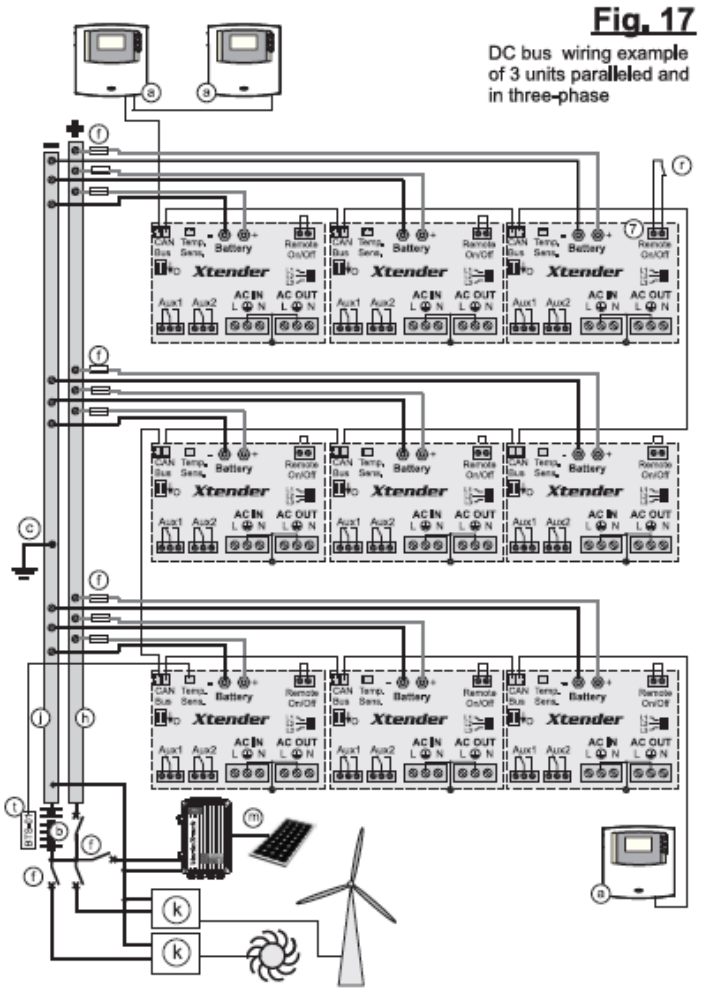
CRITERIO DE DISEÑO:

Datos técnicos



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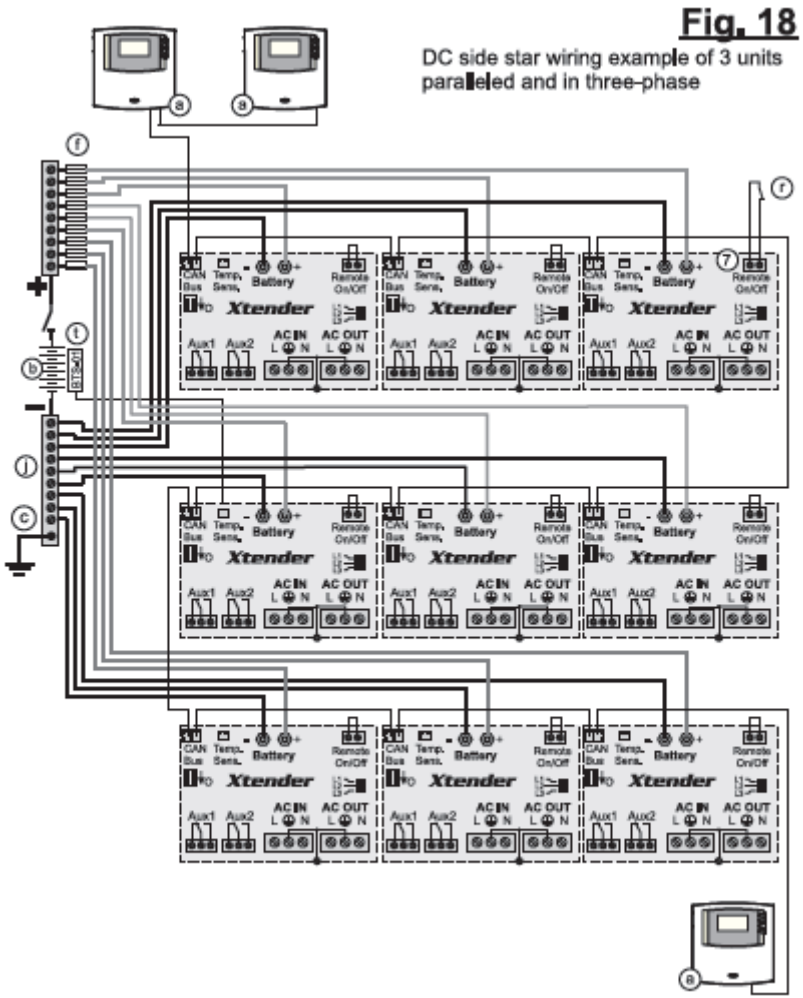
CRITERIO DE DISEÑO:

Datos técnicos



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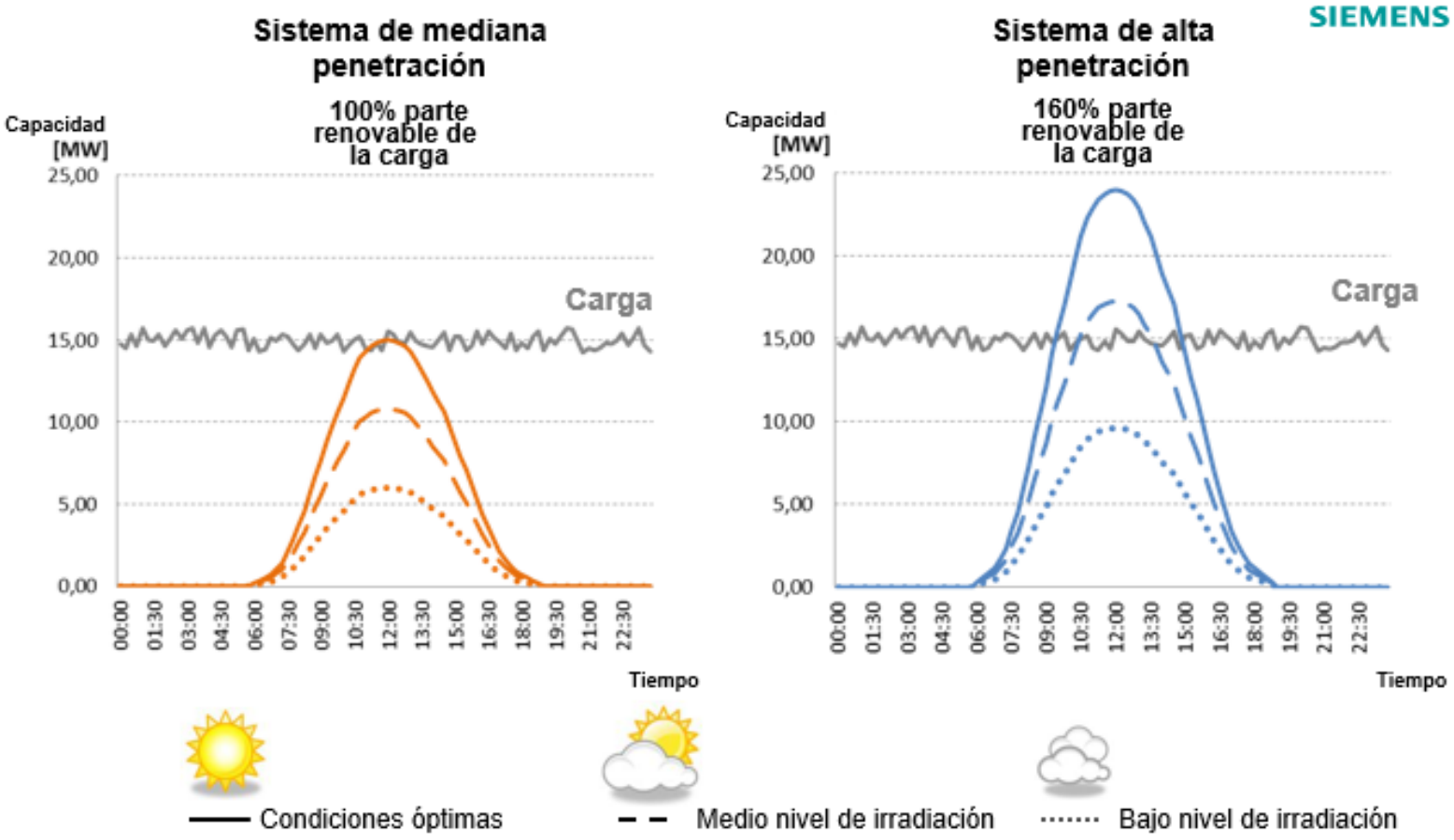
CRITERIO DE DISEÑO:

Datos técnicos



Nivel de penetración [2]

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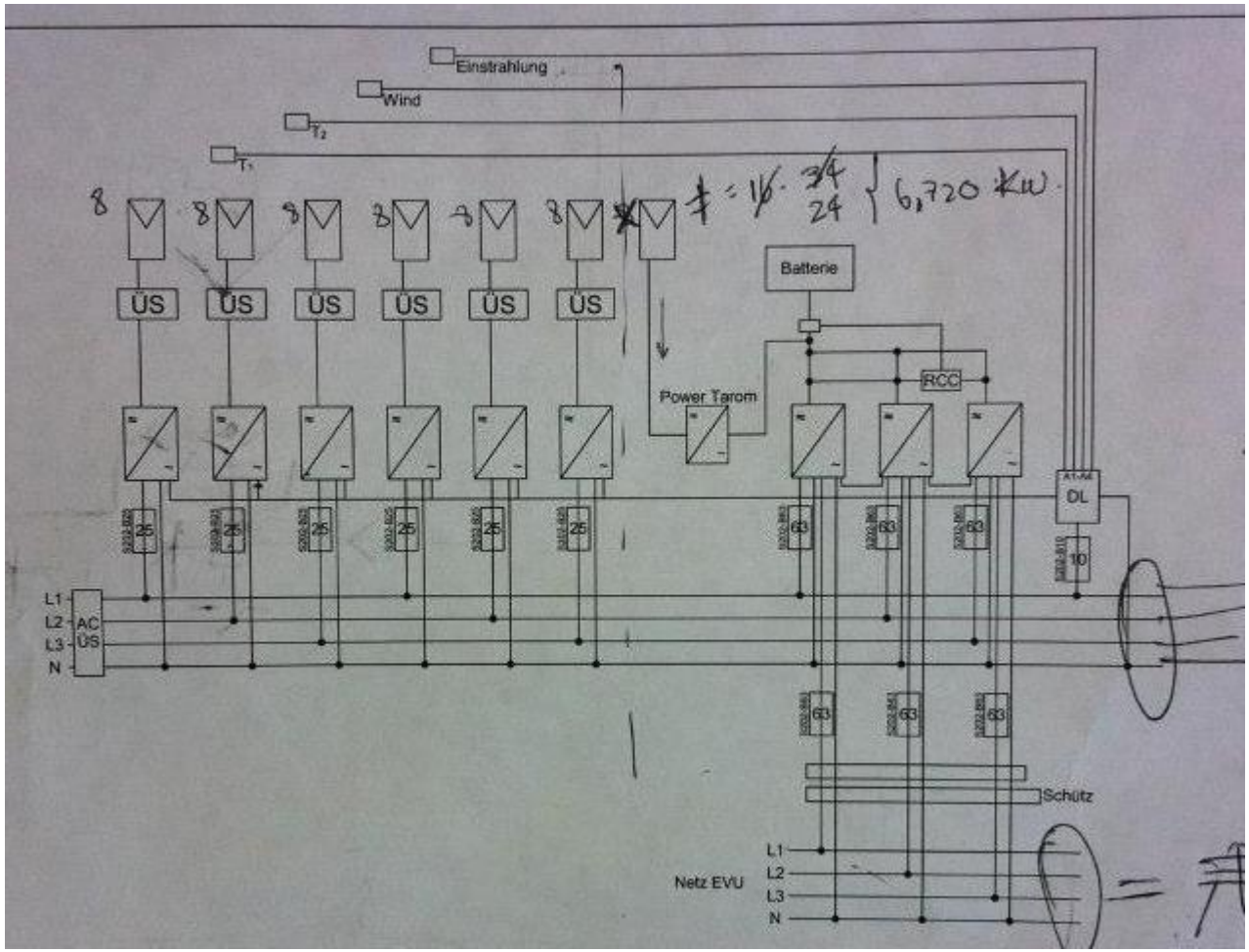
EJEMPLOS DE APLICACIÓN

- Topología
- Datos técnicos

EJEMPLOS DE APLICACIÓN:

Topología



Proyecto SENA Puerto Carreño [3]

EJEMPLOS DE APLICACIÓN:

Datos técnicos

Proyecto SENA Puerto Carreño [3]

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EJEMPLOS DE APLICACIÓN:

Proyecto Siapana (La Guajira)

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EJEMPLOS DE APLICACIÓN:

Proyecto Siapana (La Guajira)

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EJEMPLOS DE APLICACIÓN:

Proyecto Siapana (La Guajira)

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EJERCICIO DE DIMENSIONAMIENTO

- Formulación
- Cálculo
- Validación