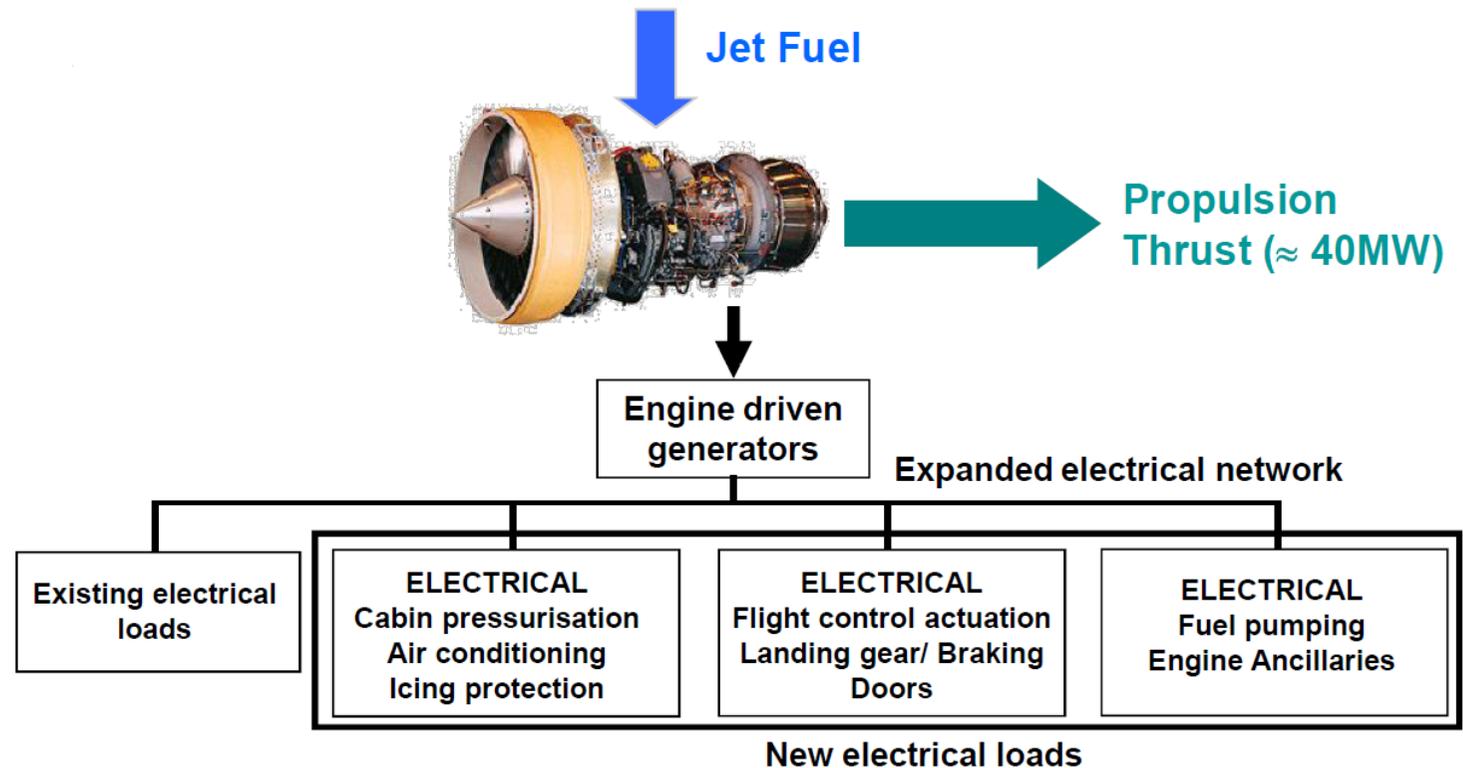


# Aplicaciones Industriales de la Electrónica de Potencias: Aviones



“More Electric Aircraft”



**Electrical system power  $\approx 1\text{MW}$**

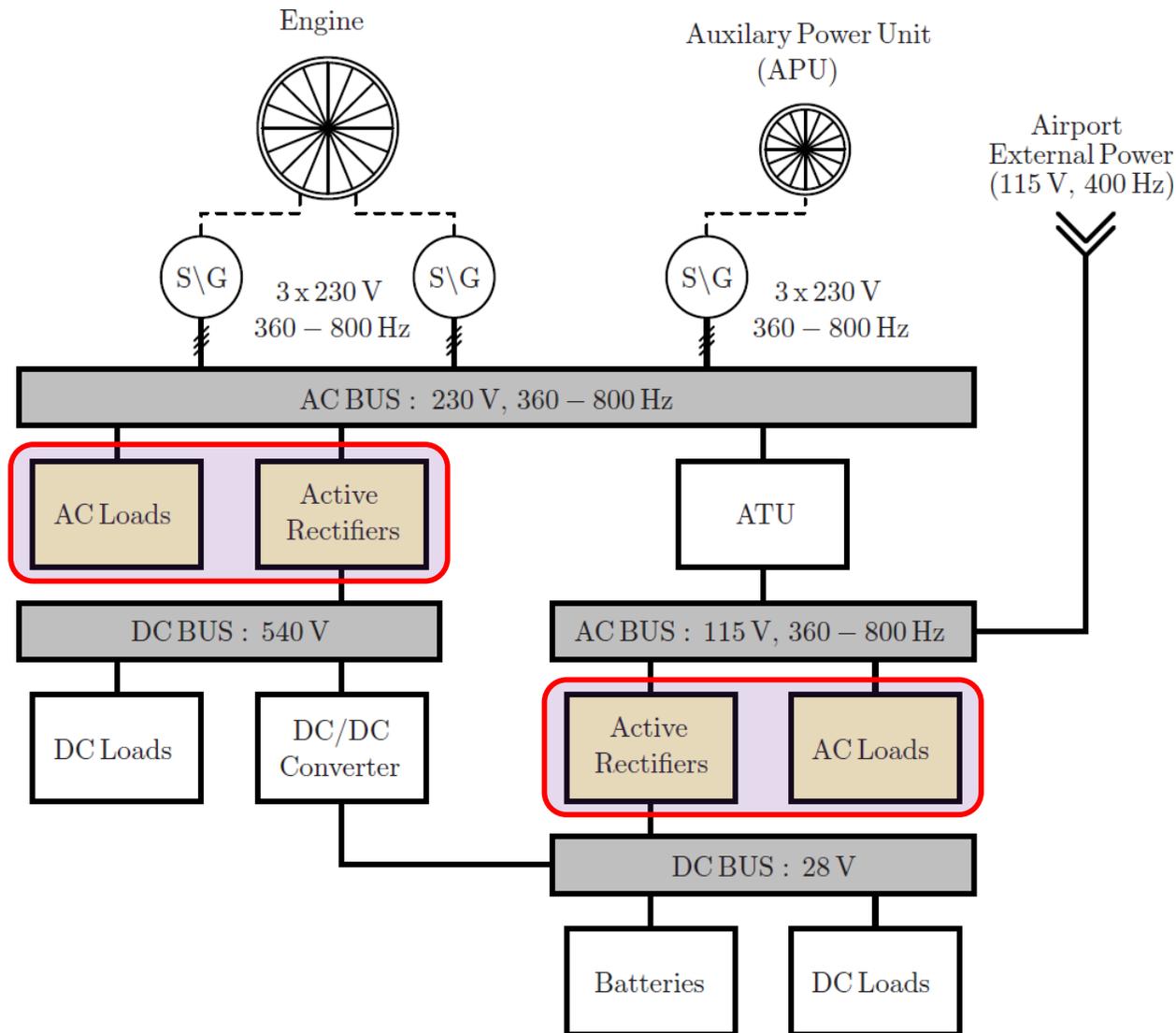
- ✓ Menor peso
- ✓ Mejor rendimiento
- ✓ Reducción del consumo de combustible
- ✓ Reducción del impacto ambiental



P. Wheeler. The More Electric Aircraft: Why Aerospace Needs Power Electronics? In *2009 13th European Conference on Power Electronics and Applications*, pages 1-30, Sep. 2009



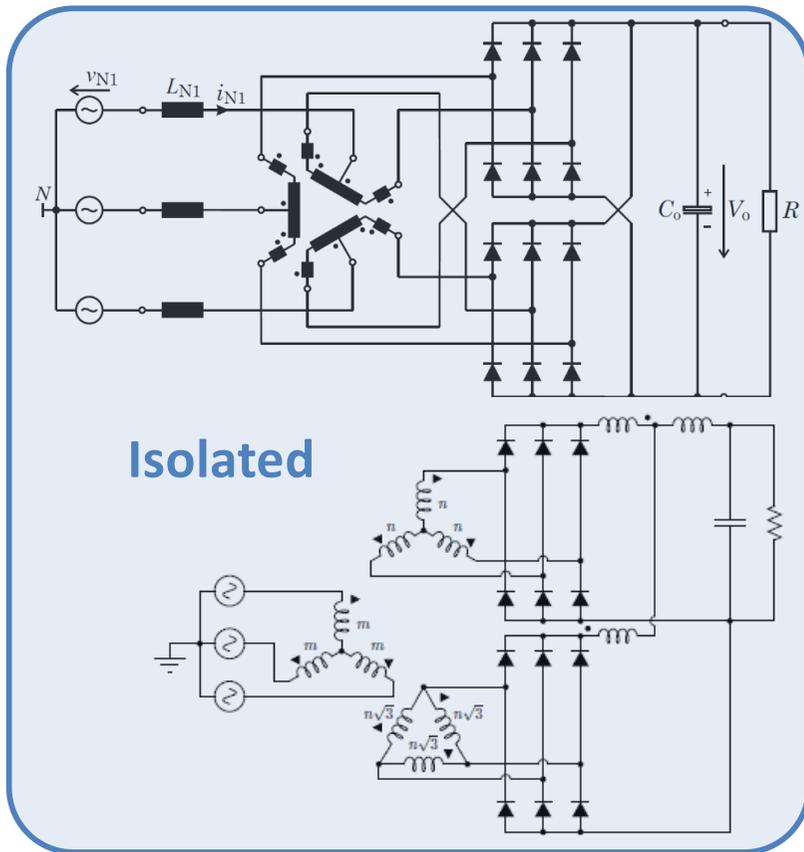
# Distribución típica del circuito de potencia



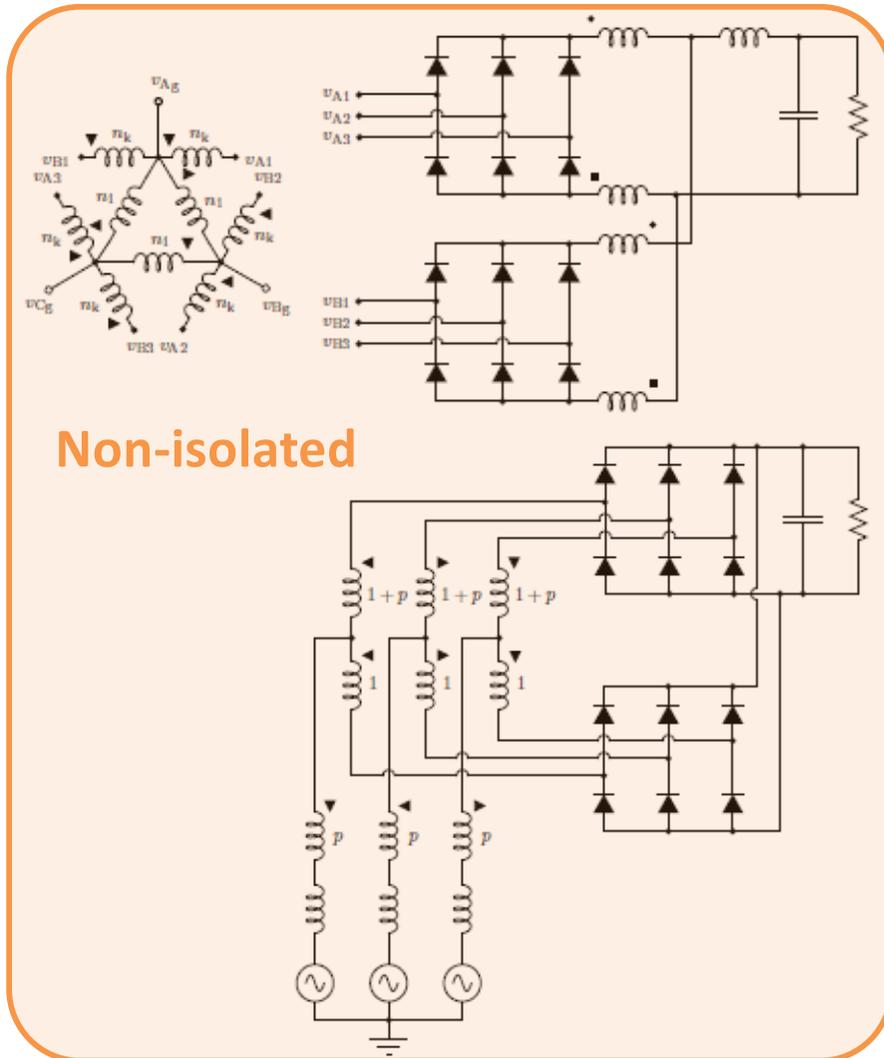
V. Biagini, P. Zanchetta, M. Odavic, M. Sumner, and M. Degano. Control and modulation of a multilevel active filtering solution for variable-speed constant-frequency more-electric aircraft grids. *IEEE Transactions on Industrial Informatics*, 9(2):600-608, May 2013.



# Rectificadores trifásicos



Isolated



Non-isolated

Empleando rectificadores clásicos:

- Tecnología muy conocida
- Muy fiable
- Alto peso y volumen
- Peor comportamiento ante desequilibrios



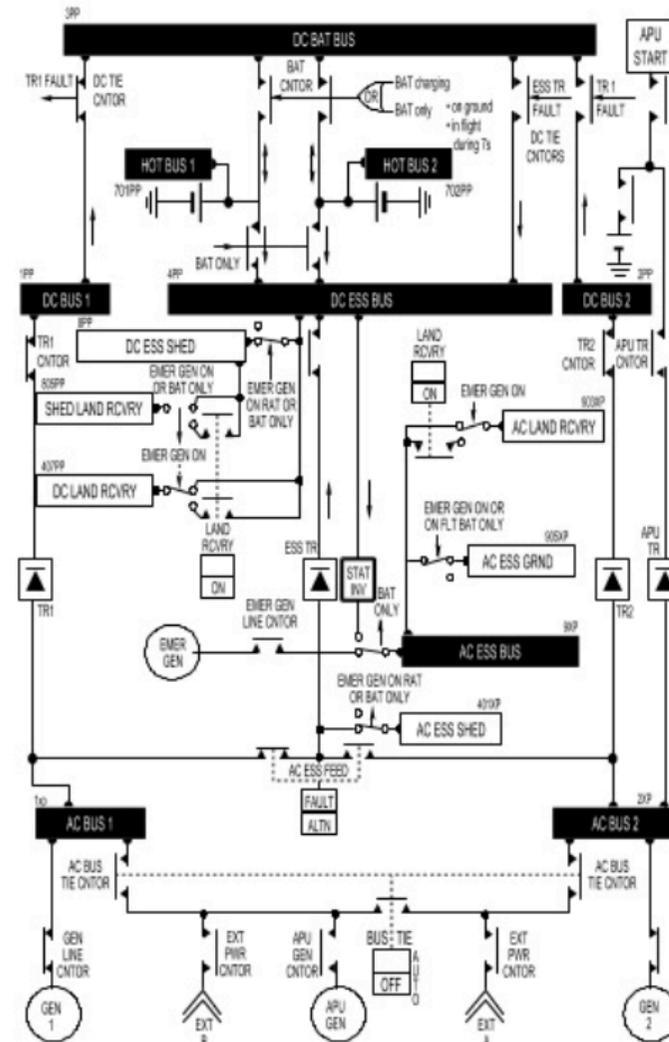
# A330 electrical system

## Electrical power generation

The electrical power generation comprises :

- Two engine-driven AC generators, nominal power 115 kVA
  - One auxiliary power unit (APU) AC generator nominal 115 kVA
  - One emergency generator (Constant Speed Motor /Generator or CSM/G), nominal power 8.6 kVA, hydraulically driven by the Green system.
  - One static inverter fed by two batteries and working either on the ground or when CSM/G inoperative.
  - Two ground connectors, power 90 kVA
  - DC network supplied via two main Transformer Rectifier Units (200 A) and one essential (100 A).
- A fourth TR (100 A) is dedicated to APU start or APU battery charging.

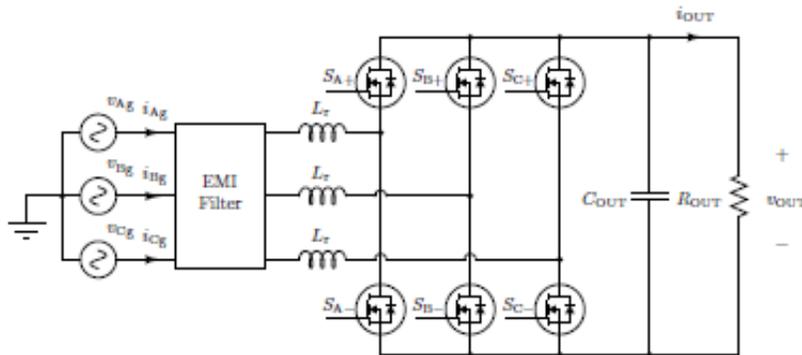
- Three batteries nominal capacity 37 Ah, 28 V each :
  - Two batteries used :
    - . in emergency configuration to feed some equipment during RAT deployment or when CSM/G not operating.
    - . On ground to provide an autonomous source.
  - One dedicated to APU start



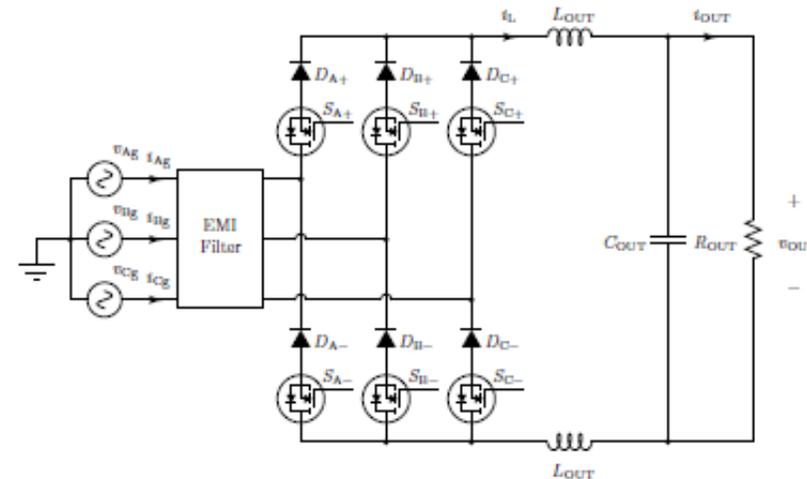
# Rectificadores trifásicos

Empleando rectificadores de alta frecuencia de conmutación:

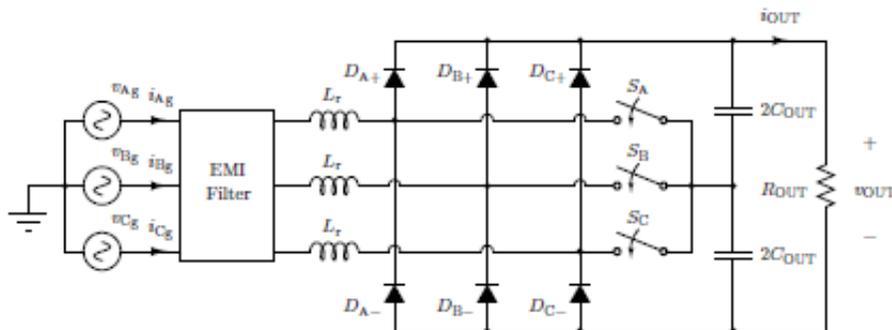
✓ Rectificador elevador



✓ Rectificador reductor



✓ Rectificador de VIENNA



- ✓ Menor THD (<5 %)
- ✓ Pequeño peso y volumen
- ✓ Muy buen comportamiento ante desequilibrios
- ✗ Necesita filtros EMI adicionales
- ✗ Menor fiabilidad



# ¿Es posible tener un avión completamente eléctrico?

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<https://www.youtube.com/watch?v=XzeCQbIYHic>



Combustible:  $H_2$

Additional energy source: Li-ion battery (for take-off and back-up)



# ¿Es posible tener un avión completamente eléctrico?

Gran parte de este trabajo se ha hecho en Madrid, en la UPM, en la ETSII

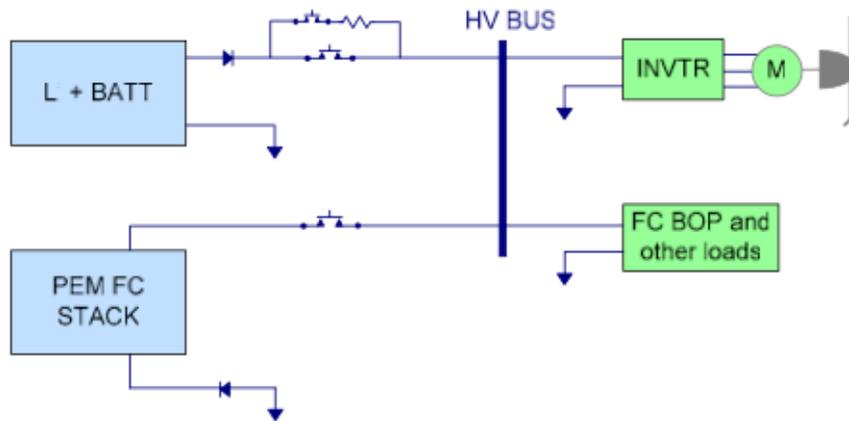


Figure 2. Power architecture with unregulated hybrid power source

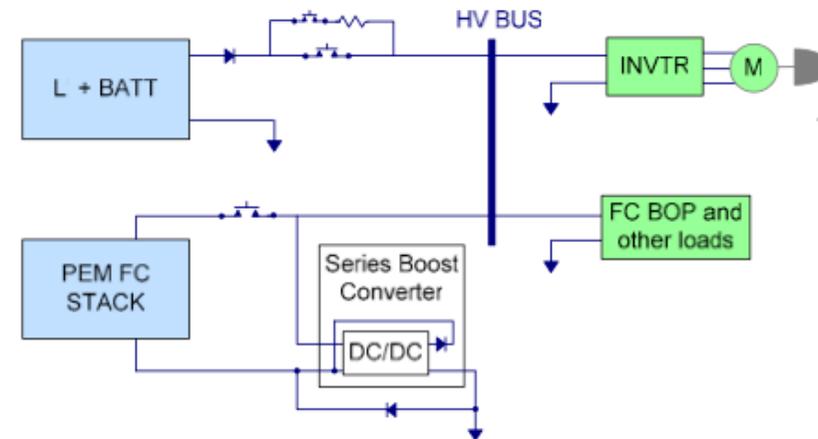


Figure 3. Power architecture with regulated hybrid power source



# ¿Es posible tener un avión completamente eléctrico?

Gran parte de este trabajo se ha hecho en:

Madrid, en la UPM, en la ETSII, en el laboratorio de electrónica



Figure 4. PMAD box



Figure 5. PMAD control board



# Otro ejemplo

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