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Energy Storage

Superconducting
Magnetic Energy Storage

Challenges in developing tools for hybrid energy and energy storage systems: SMES Interfacing, a Case of study

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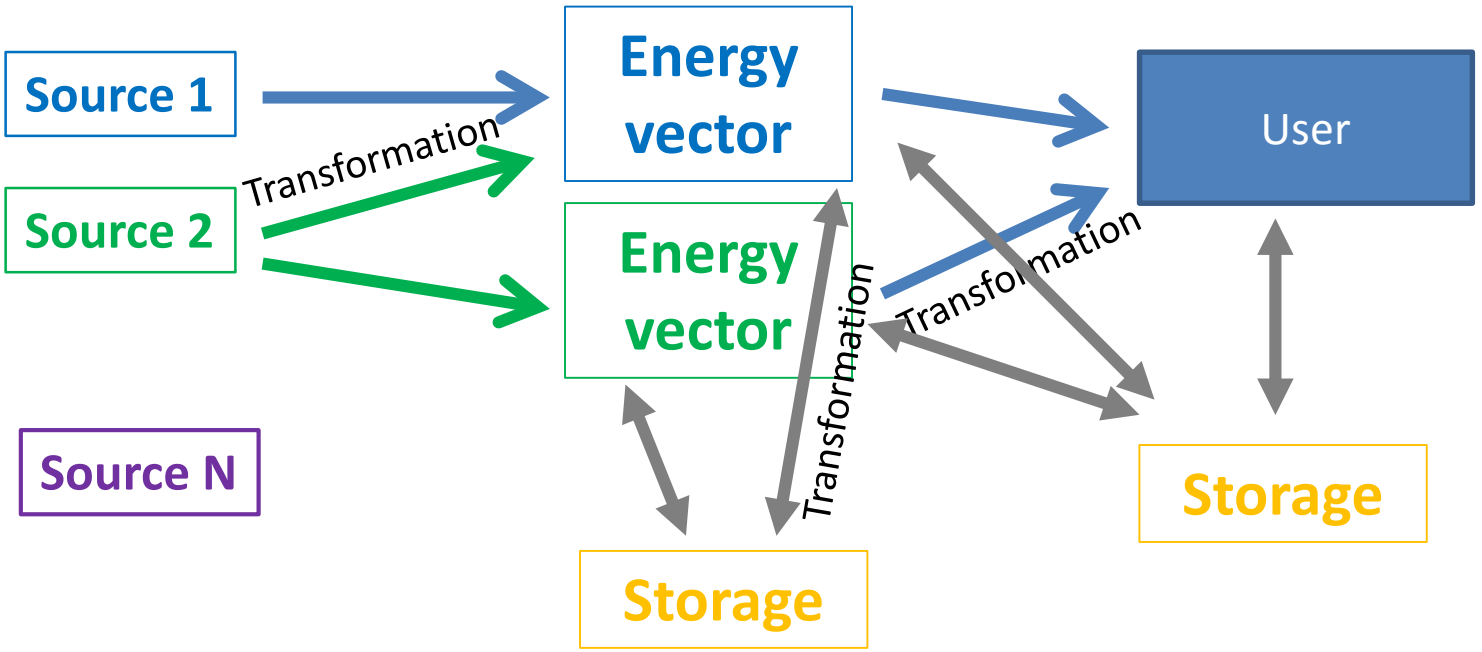
Mixed energy supply



Any change needs time, loss energy and has their own limitations

Coordination is required

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Mixing Storage systems

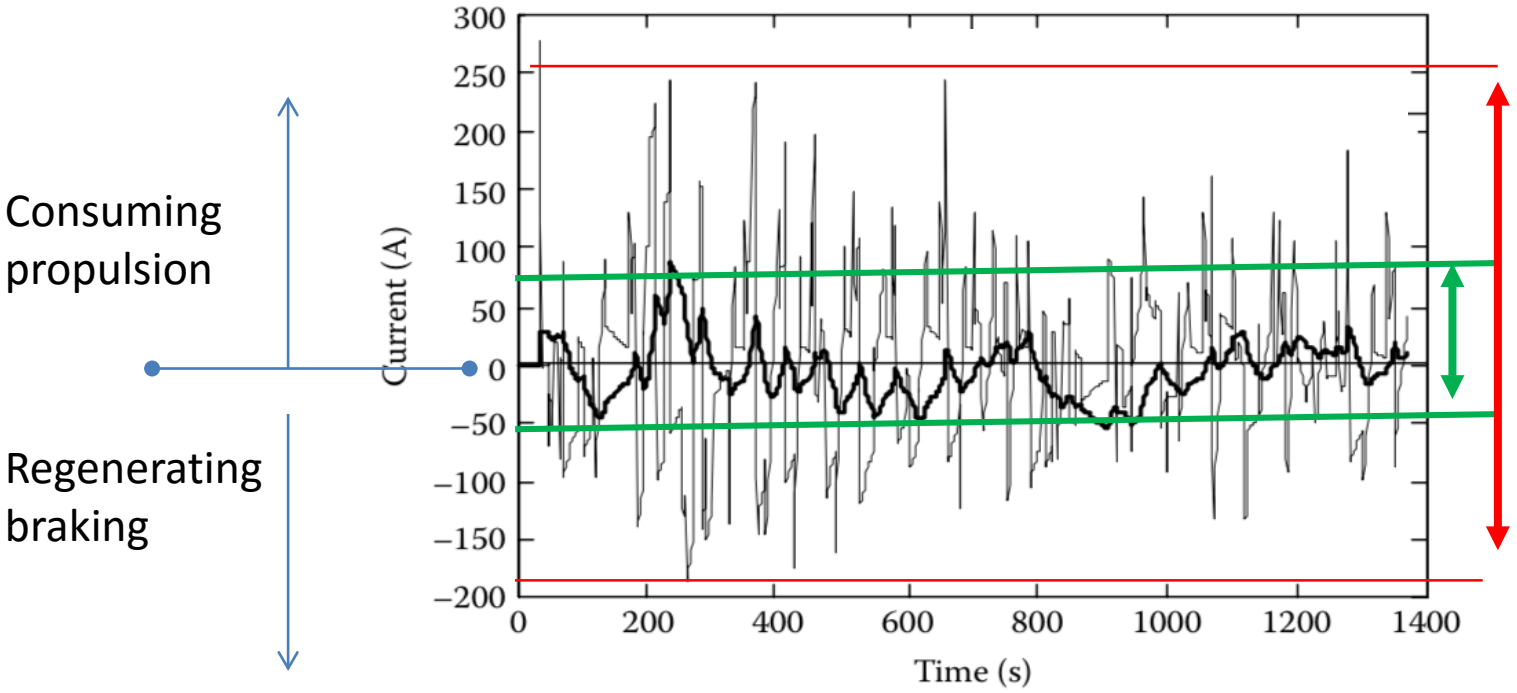
Electrical vector

Objective: improving performance getting the best of each

	Energy amount	Power dynamic range	Starting time	efficiency	movable
Hydro?	Very good	Good	Slow	Good	Not
ACAES?	Very good	Good	Slow	Medium	Yes/not
Batteries? Fuel Cells?	Very good	Limited for transients	Very Fast	good	Yes
Supercaps?	Medium	Good, sensitive to transients	Very Fast	Fair good	Yes
SMES?	Medium	Very Good	Very Fast	Very good	Yes/not

Power demand in a EU city driving cycle

Transport applications, city car

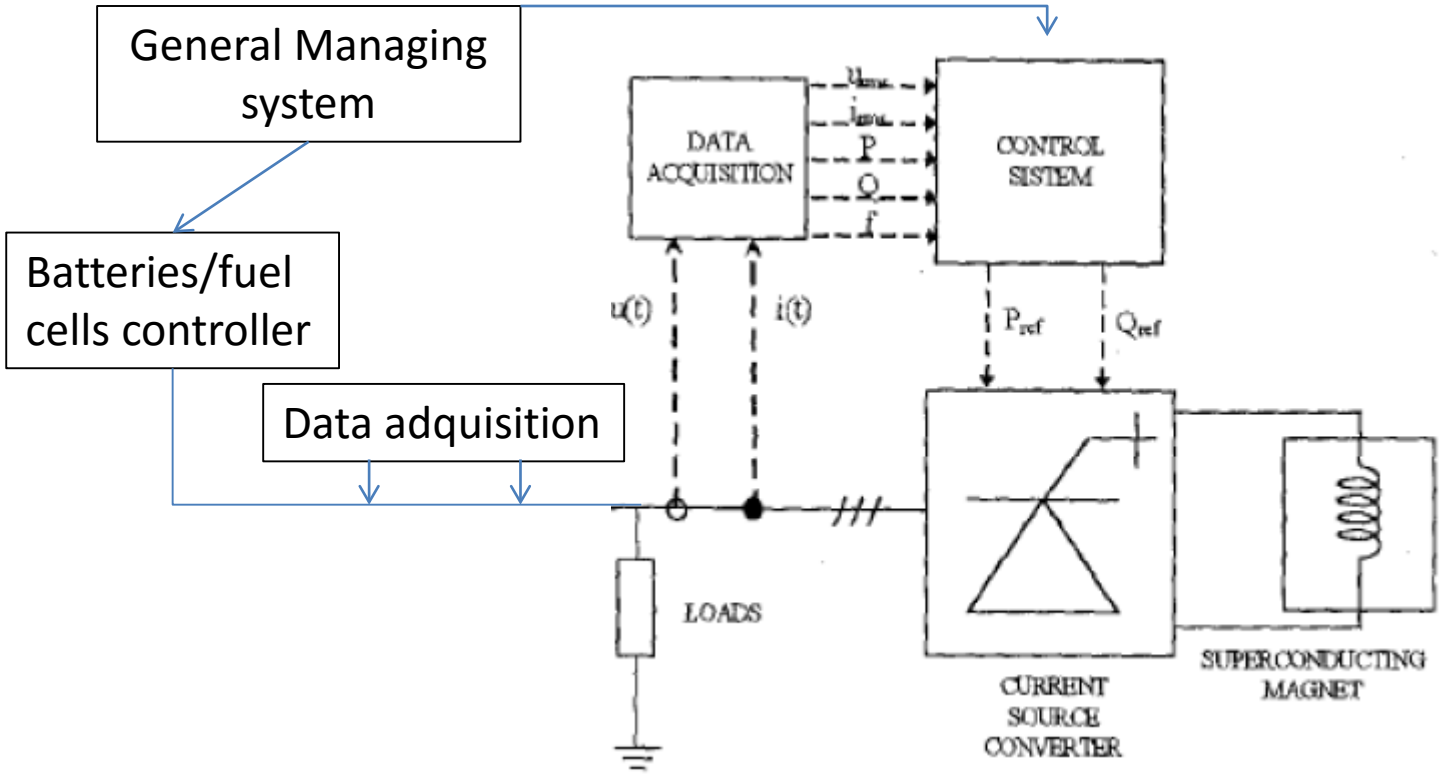


The averaged current supply (power) in 20s is about 50A the peaks achieve 250A

A good managing of the playing energy requires a good managing of transients
Batteries should be over-dimensioned in order to avoid degradation

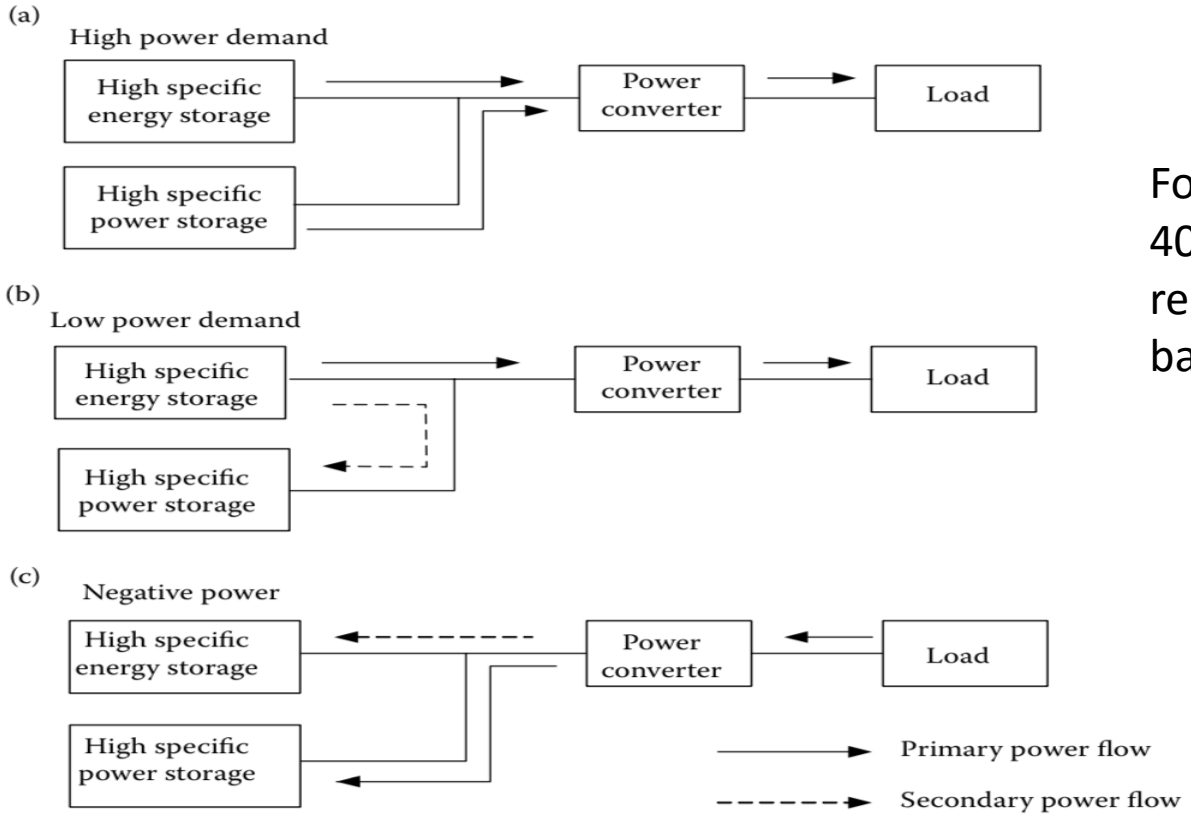
The SMES

The electronics of the SMES allows flexibility enough to be fitted in the batteries controller



SMES –FUELCEL/Batteries HYBRID

an approach



For a city car , a SMES of just 40kW and 700kJ could allow reducing the power of the batteries bank to 10kW

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Hybrid storage SMES assemblies

Mobile systems: transport

Batteries- ---- SMES

Fuel Cells----- SMES

Batteries and Fuel Cells are similar in requirements. Fuel cells can be refueled in an fast and easy way with the network of H2 distribution, now in development. Batteries require some time for recharging but electricity network could support a medium fleet of electrical cars.

Batteries /fuel cells supply energy and SMES levelizes the load

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The challenges:SMES

Magnet

- Energy Stored in the range 500-700kJ
- Power about 40kW (4 wheels of 10kW)

- B-Field Volume 0.5-1 m^3 @5T
  0.12-0.25 m^3 @10T
- Working temperature 30K-40K
- Gas cooled (H2): free piston cryocooler

- Mechanical design for movable system

ITC

- Modelling of the system in working Conditions.
- Specific control design and electronics coordination
  Including Power control and safety of the coil and the batteries/fuel cell bank
- Power managing

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An aircraft (60t) ,when in landing run, delivers an energy of 0.14 GJ at a power of 2.4 MW

Thank you for your kind attention

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