

ENERGY EFFICIENCY IN RAILWAYS: ENERGY STORAGE AND ELECTRIC GENERATION IN DIESEL ELECTRIC LOCOMOTIVES

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OBJECTIVES:

- To Increase the overall efficiency of diesel-electric haulage and reduce emissions (≈10%). To compete with electric traction.
- To develop and improve tools for evaluating energy efficiency.
- To show through simulation how batteries and SC can be used for this purpose.

STATE OF THE ART: Worldwide

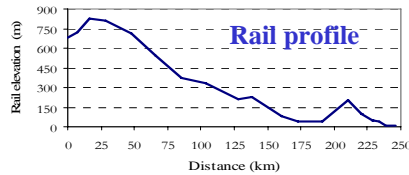
- Plathée (SNCF, France): Diesel + Fuel-cells + SC + Batteries + Flywheels.
- ALPS (FRA, EEUU): Diesel + Flywheels.
- Our case: Batteries vs. Supercapacitors

Parameter	Battery	Super Cap
Energy (Wh/kg)	100-600	2-10
Number of cycles	< 1000	500,000
Cost (€/kWh)	100-500	< 10,000

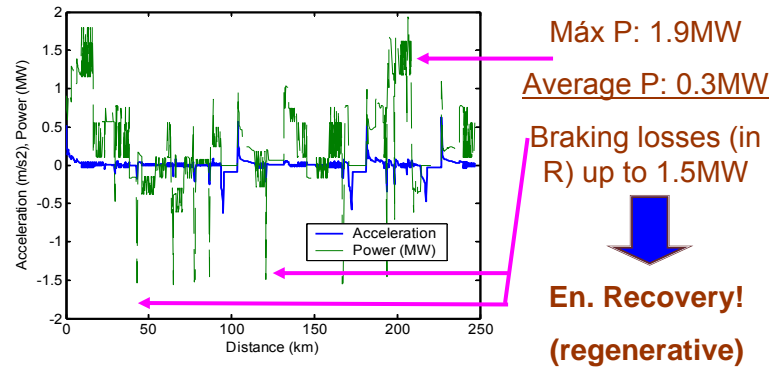
TRAIN CHARACTERISTICS:

- Locomotive GM JT26TW: 120 t; 140km/h
Diesel engine: 2237kW
Max. tractive effort: 32kN
Dynamic braking: Resistor

Coaches (TALGO IV)

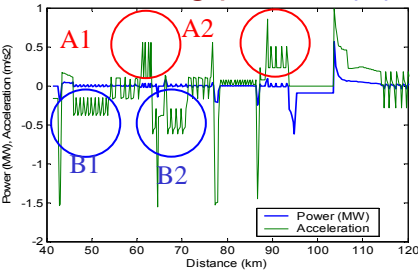


TRAIN SIMULATOR (by UPCT):



SIZING OF STORAGE. Options

- Simple: the energy is stored during braking periods (B) and used later (A).



Not expensive and easy.
Size = Máx (B1+B2-A1...)
In this case 85 MJ

- New diesel engine + storage: the use of old series S-319GM diesel 1.3MW + higher energy reservoir (580MJ).
- Remember! P (average) is about 0.3MW

RESULTS:

Itinerary	Gains in efficiency with SC (%)	Gains in efficiency with batteries (%)
Albacete-Cartagena	16,4%	12,26%
Cartagena-Albacete	4,04%	3,02%

- Fuel costs (without storage): 300-400 k€/year
 - SC costs: < 1.5 M€; Batteries 0.1-0.2 M€
 - Fuel reduction: 30k€/year + CO₂ costs
 - Installation costs + Maintenance + ..(+10%)
- It seems to be cost effective!!!

Further developments: the study of mobile DG generation by diesels in overhead lines.