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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:

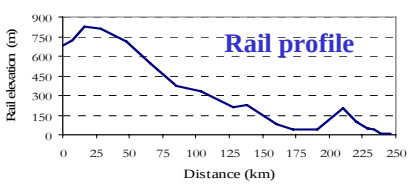
- Locomotive GM JT26TW: 120 t;140km/h

Diesel engine: 2237kW

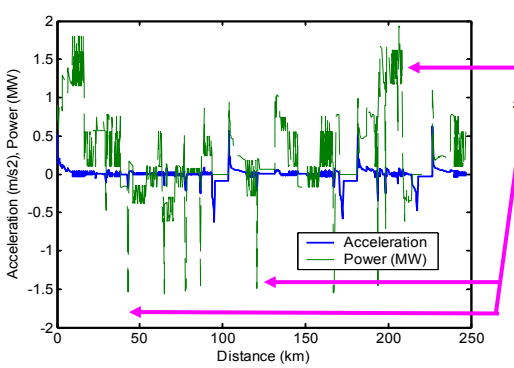
Max. tractive effort: 32kN

Dynamic braking: Resistor

Coaches (TALGO IV)



TRAIN SIMULATOR (by UPCT):



Máx P: 1.9MW

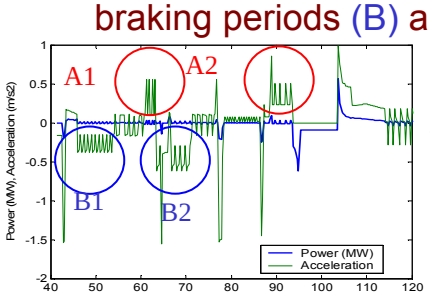
Average P: 0.3MW

Braking losses (in R) up to 1.5MW

En. Recovery! (regenerative)

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 diesel1.3MW + 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 + $C0_2$ costs
- Installation costs + Maintenance + ..(+10%)

►It seems to be cost effective!!!

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

More info: www.demandresponse.eu