UIC Energy Efficiency Workshop

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ALSTOM
Designing fluidity

Ours Levers to reduce the Energy Consumption

Weight Reduction

Line receptivity in Braking

Intelligent Traction Control

Energy Storage

High efficient HVAC "Climpac"

OBJECTIVE: -20% by 2020 vs 2014

Efficient Traction and Auxiliary Converters

Train Motion Resistance

Efficient Traction Motors

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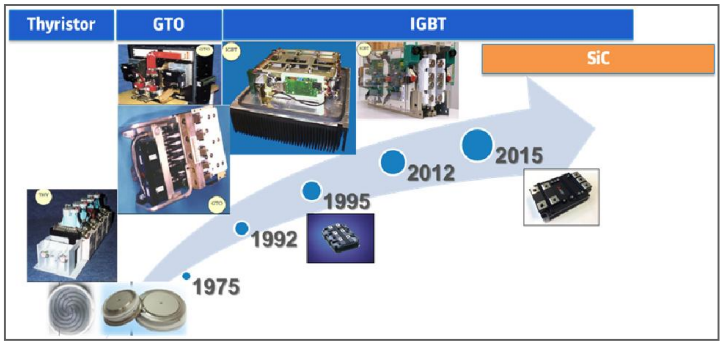
Efficient Traction and Auxiliary Converters

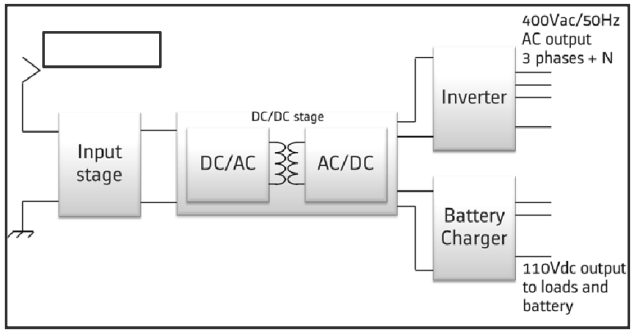
Traction SiC

- Energy saving : - 10% @ train level (Regional train)
- Operator should implement in tenders energy criteria with a high weight and a dedicated cost model



Medium Frequency Architecture

- Automatic reversible mode to supply (HVAC & Traction) from auxiliary batteries (ie: can move train in depot without catenary)
- IGBT or Full SiC technology , Naturally Cooled or by air forced
- Up to 30% less volume and weight. Efficiency (full power) : 96%



Optimized Traction Converter & Cooling Systems

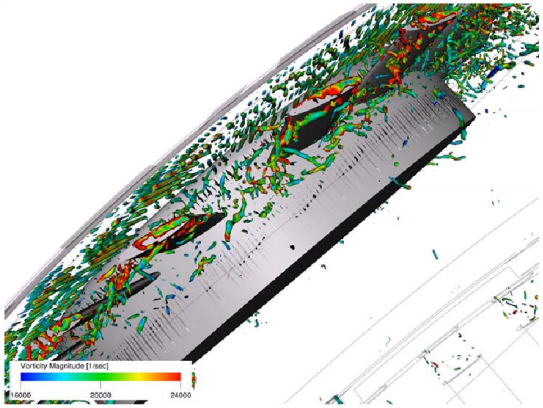
- Optimized converter PWM & control strategy limiting inverter & traction motor losses and maximizing the regeneration in brake
- Move from forced air to natural cooling (fan removed)
- Maintenance gain for the operator

Efficient Traction Motors

- **Latest generation high energy efficient Permanent Magnet Motors**
  - Lighter than an asynchronous motor for a given power
  - Energy consumption : up to -15%

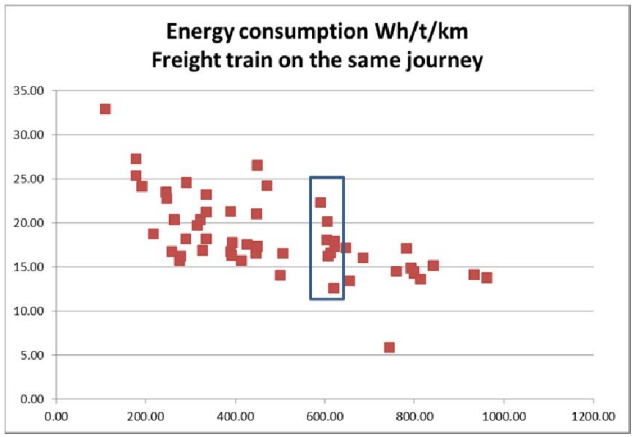
Alstom Citadis Tramway PMM

- **High speed Motors**
  - Less weight & volume → less energy
  - Prediction of cooling noise by CFD (Computational Fluid Dynamics)

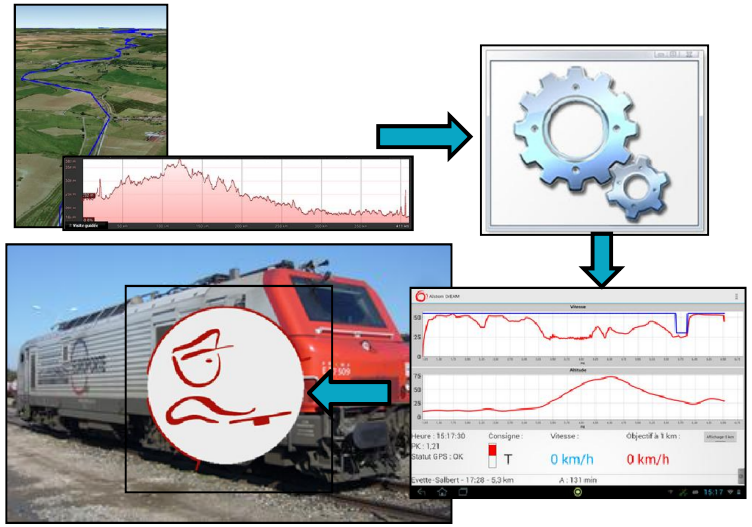


Intelligent Traction Control

- **Energy consumption between drivers**
  - Up to 30% more in freight trains
  - Up to 10% in high speed trains
  - Up to 5% in tramways

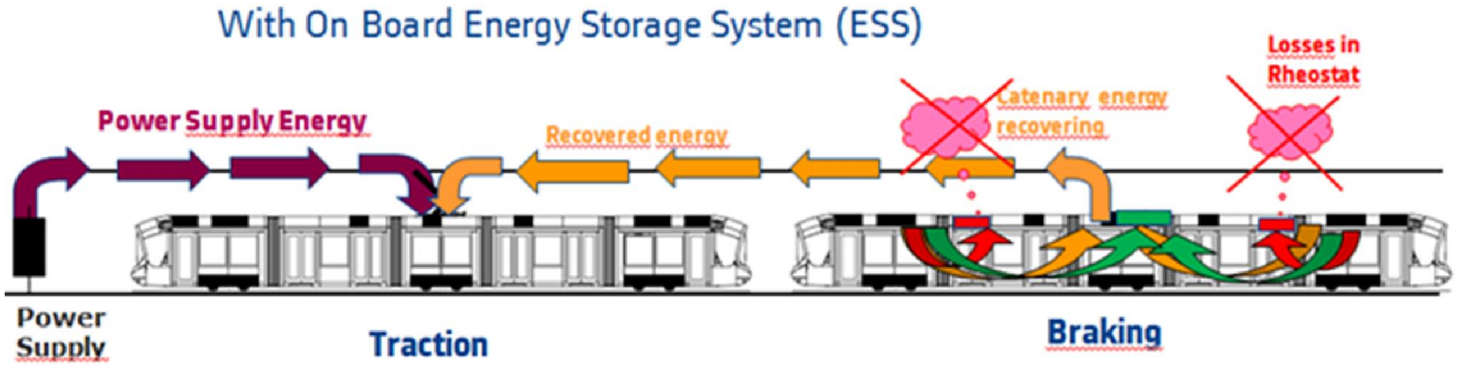


- **Algorithms to optimise the speed profile**
  - Be able to calculate an optimised speed profile
  - Give advices to the driver (embedded or standalone)
  - Automatic eco cruise control



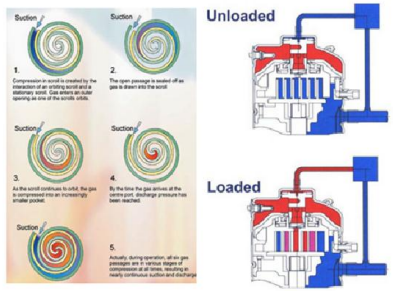
Energy Storage

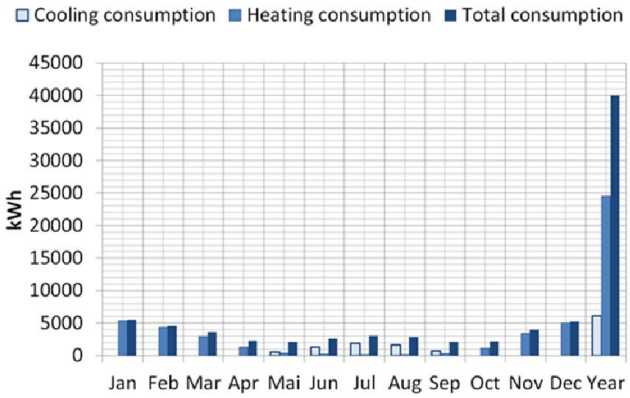
- **On Board Energy Storage System**
  - Energy recovering in regenerative Braking
  - Reusing in Traction phase



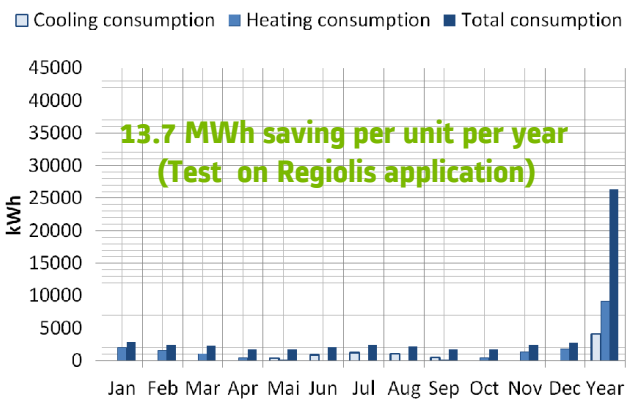
Reversible “Heat Pump” – CLIMPAC

- **New HVAC based on the ”Heat Pump”**
  - To move thermal energy thought an optimized digital control of the compressor to replace the traditional systems using heaters by resistances.





CLIMPAC



Weight Reduction

- **By the using of special materials**
  - Composite materials
  - Ultra High Strength Steel

- **By design optimization of the magnetic parts (less iron and copper)**
  - Medium Frequency Auxiliary Converters
  - High Speed Traction Motors

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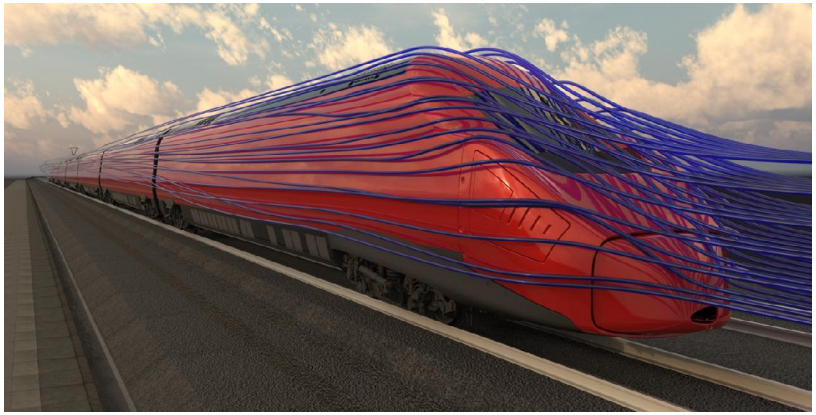
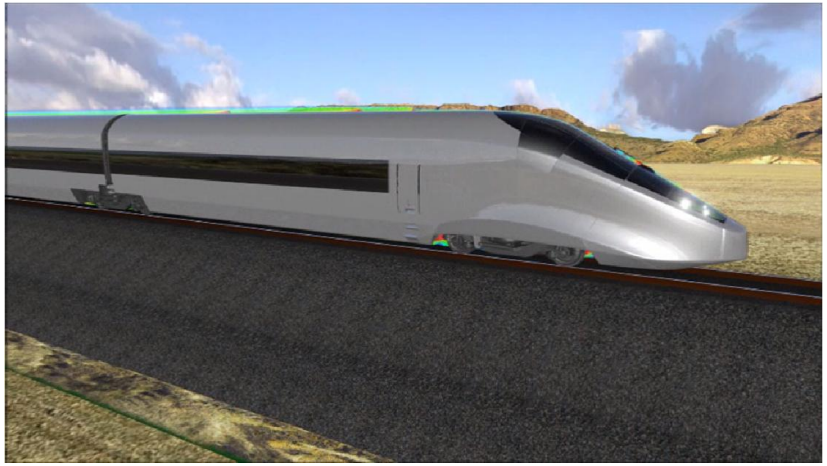
Train Motion Resistance

- **Accurate simulation tools**
  - Pioneers in the application of new technics CFD (Computational Fluid Dynamics) applied to the complete train model
  - CX improvements applying modifications in several parts of the train : nose, bogies, gangway, pantograph..
  - Energy saving : up to 3% (kWh/t) at train level
  - With complete optimisation (Cx & air flow), up to 9% (kWh/t) for global aero resistance





Line receptivity in Braking

- **HESOP: reversible power-supply substation**
  - Designed to deliver better energy efficiency for urban and suburban public rail transport networks (600V/750V/1500V DC)
  - 99% of recoverable energy during braking mode which can be re-injected into the electricity network

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