Advanced technology: Operation and Energy Efficiency Measurement

Railway Technical Research Institute

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How to save energy in rail ?

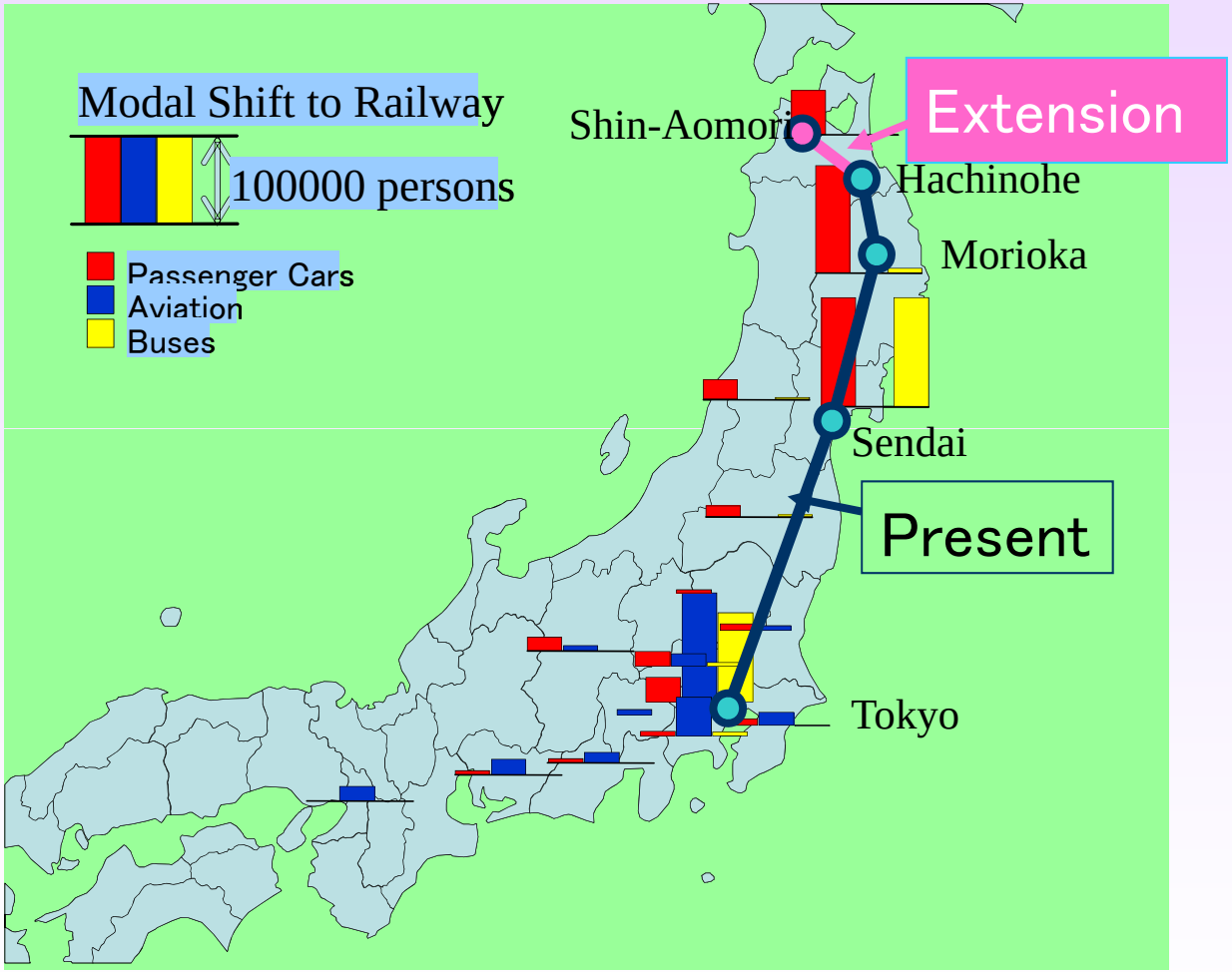
Canalize passengers / goods from cars to rail !

Transportation	Embodied CO_2 emission intensities per unit (t-CO_2/person/km)
Tohoku Shinkansen Line	3.94×10^{-5}
※Tokaido Shinkansen Line	1.90×10^{-5}
Conventional Railway	4.50×10^{-5}
Passenger Cars	27.3×10^{-5}
Buses	8.10×10^{-5}
Aviation	15.1×10^{-5}

Sophisticated technologies for rail

Regenerative energy
Energy storage / New energy

Modal Shift Calculation for Shinkansen extention

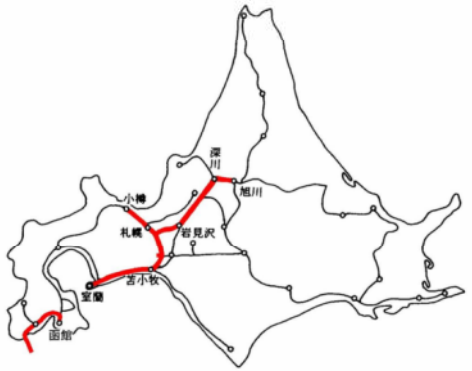


Saving amount of CO_2 emission: 52,725 t

Electrification in Japan (JR group)

20,000km line
(2387km Shinkansen)
12,100km electrified (60.5%)

1,000 electric locomotives
50,000 emus including
5,000 Shinkansen emus



Regenerative energy by chopper control emu since 1970s

TRTA (Tokyo metro) series 6000 in 1971

Inverter control emu since 1982

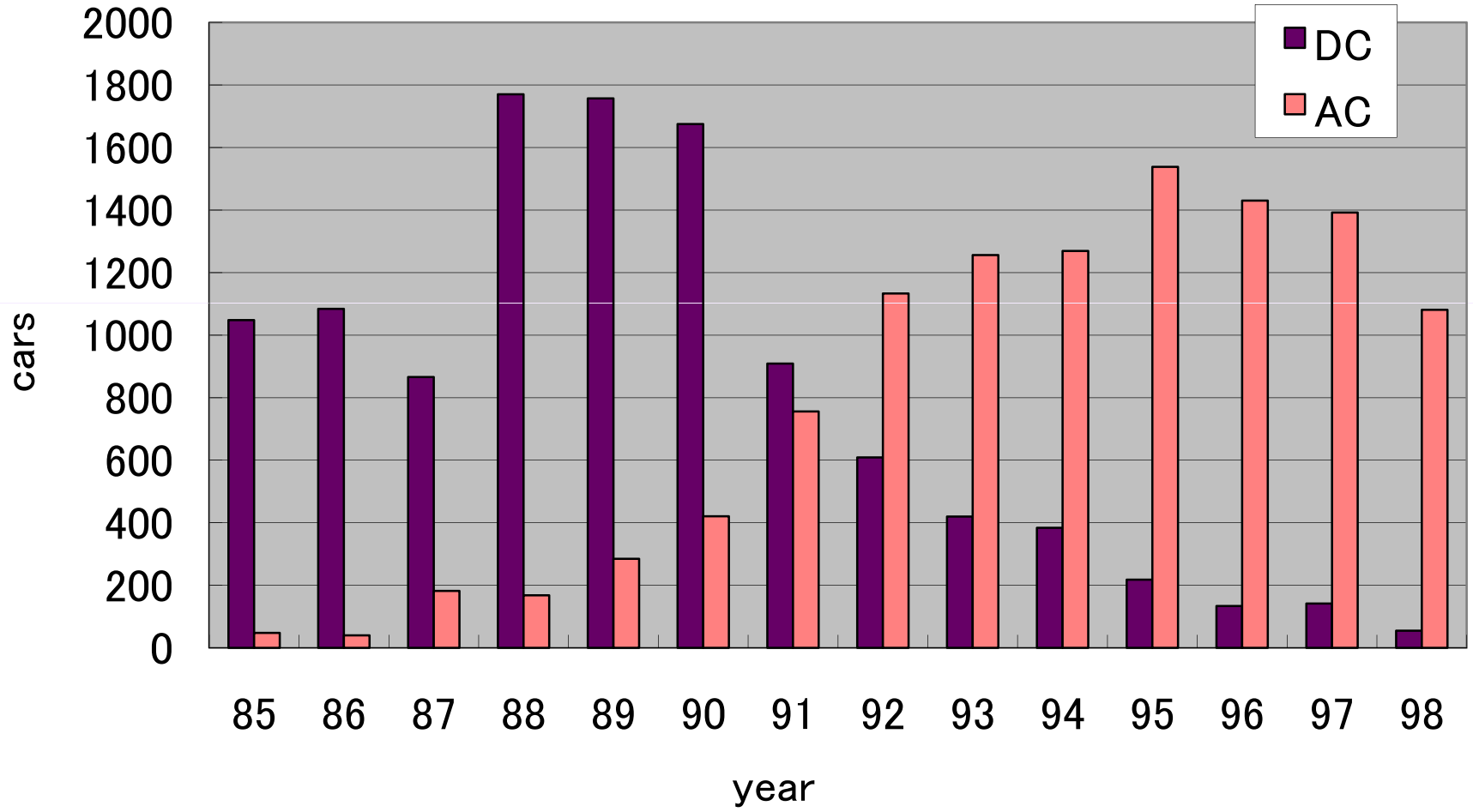
Type 8200 in Kumamoto tram in 1982 (600V catenary)

The first inverter control tram in Japan

Series 300 since 1992

The first inverter control Shinkansen emu

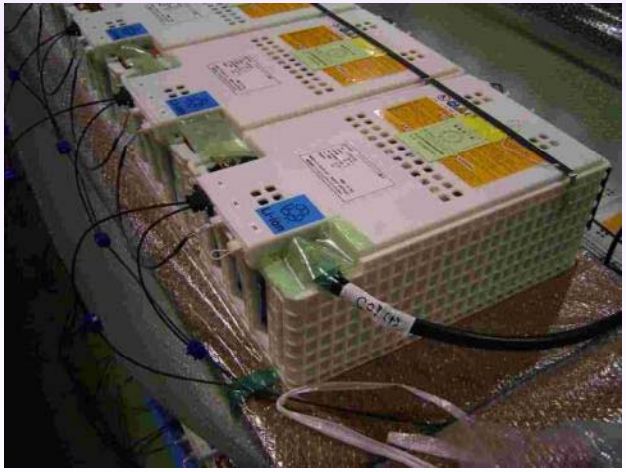
DC traction motor cars and AC cars

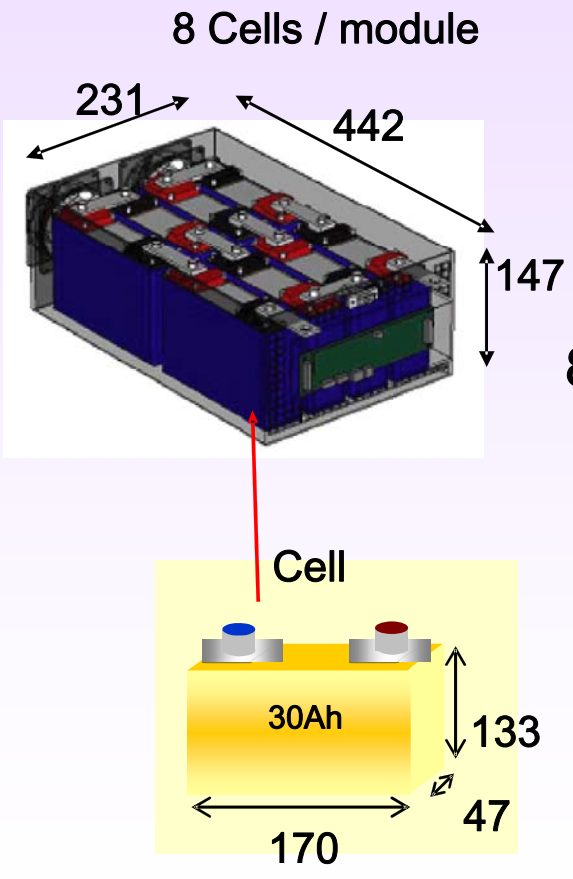


Energy storage: Lithium ion battery, Hi-tram

Gauge	1067**mm**
Capacity	44persons (20 seats)
Max. Speed	40km/h (LRV) 80km/h (Heavy Rail)
Accel.	4.0km/h/s
Catenary	DC 600,1500V

Energy storage　Lithium ion battery





Voltage: 605V
Capacity: 120Ah
(72kWh)
Max. Current: 1kA
Weight: 2.0t

84 Modules on board

New energy: Fuel cell train

First Object: Replace Diesel Motor

- aving Energy
- Saving Pollution with Exhaust
- Saving noise
  and vibration of motors
- Enhance the
  performance

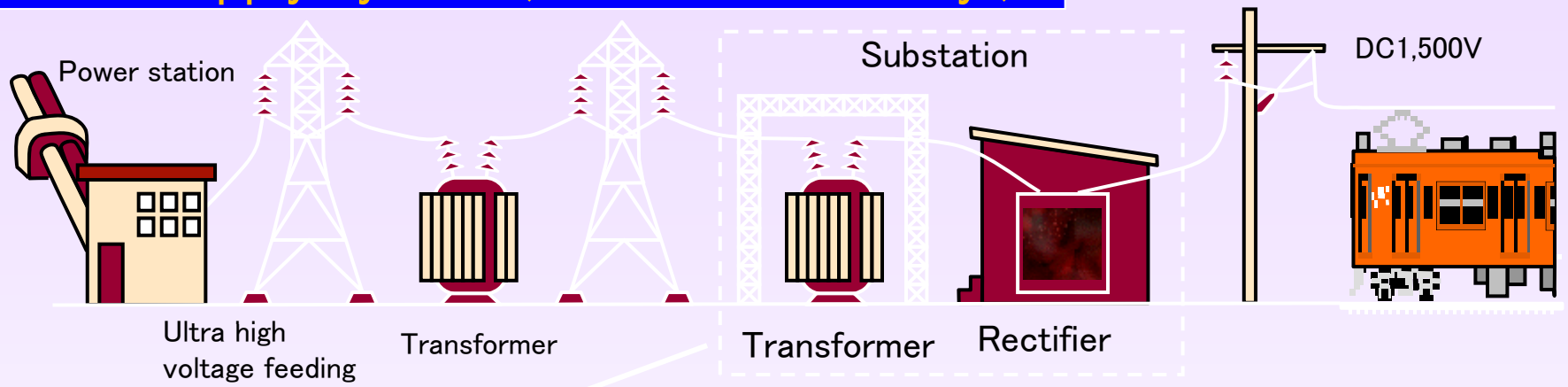
Fuel cell train

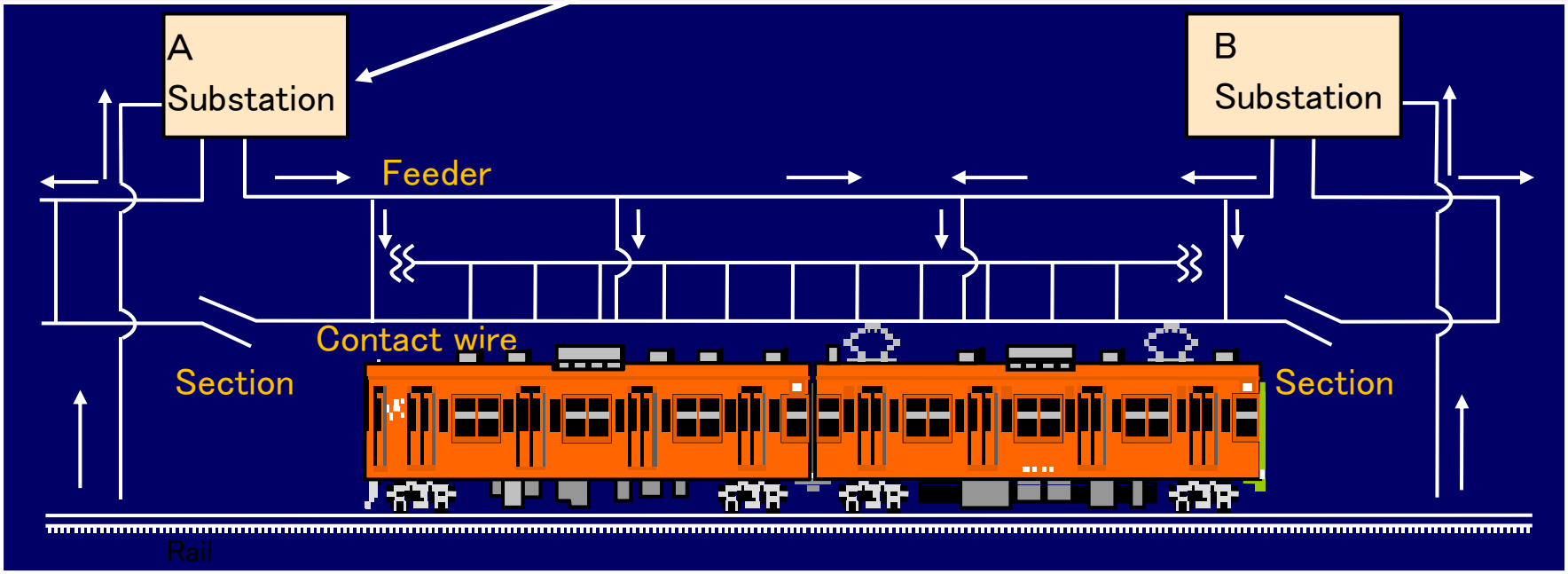
100kW class fuel cell

Output	150kW (gross) 120kW (net)
Current	250A(gross) 200A(net)
Voltage	850V (no load) 600V(rated load)
Size and weight	1650(L)× 1250(W) ×1500(H)mm 1650kg
Configuration	18.75kW×8

Energy Storage System for DC Electric Railway

Power supply system (DC electric railway)

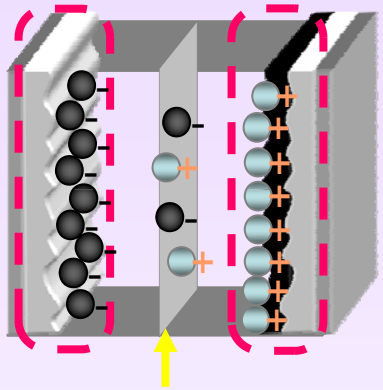




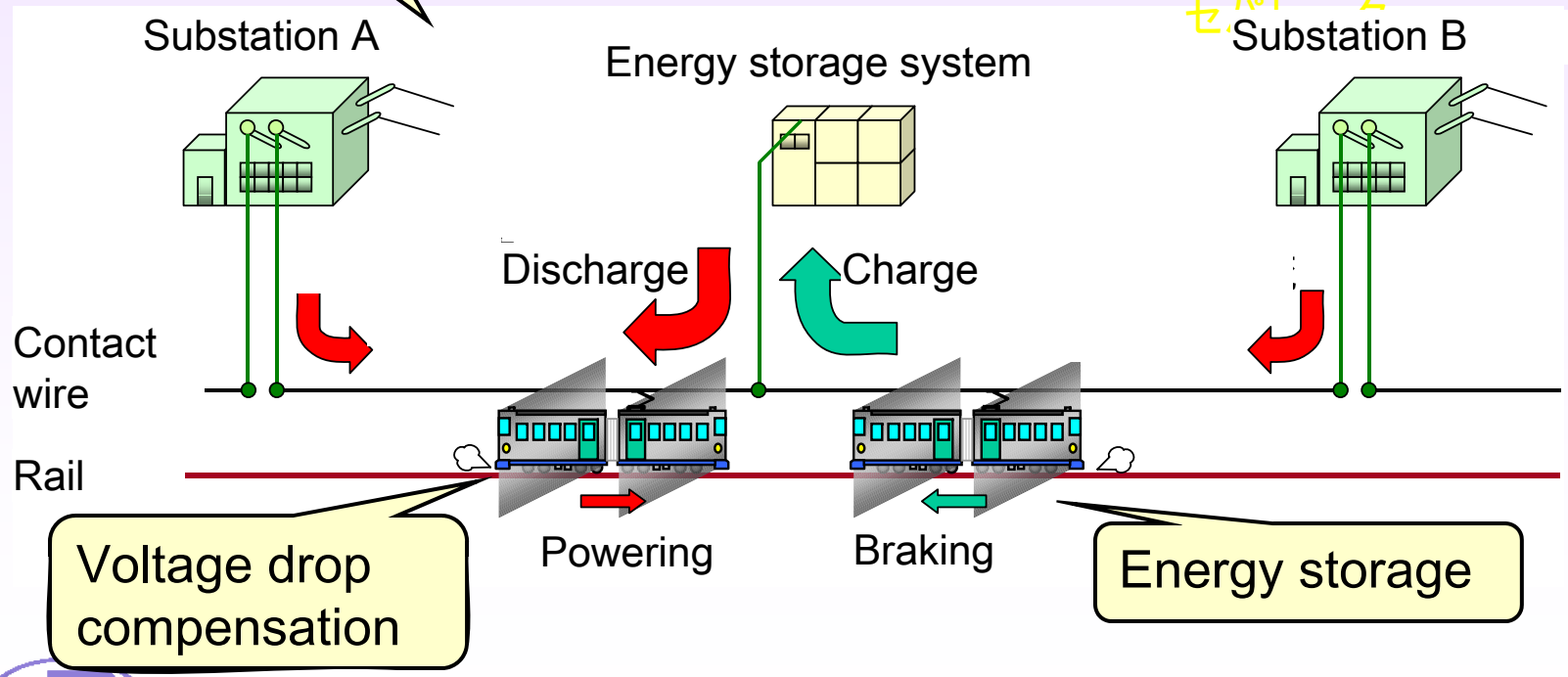
Energy Storage System for DC Electric Railway

Electric double layer Capacitor (EDLC)

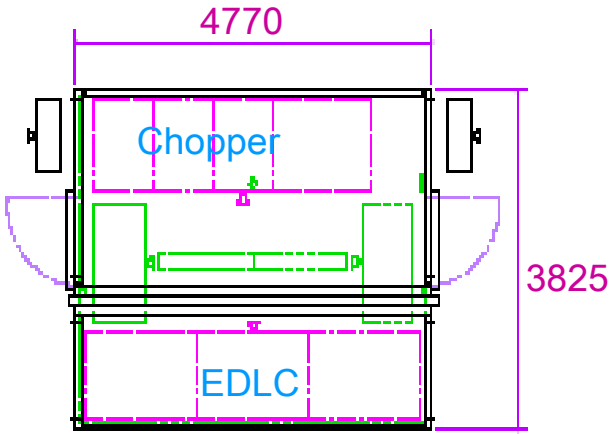
Electric double layer



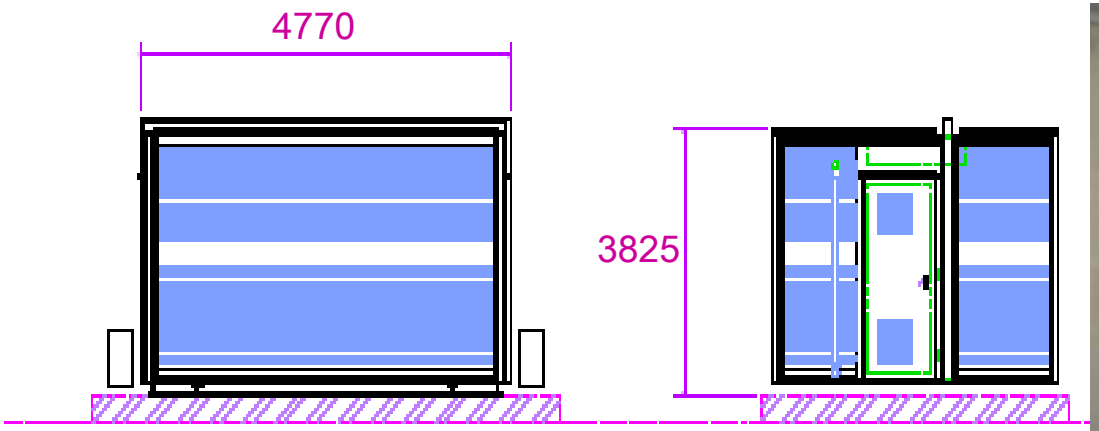
Peak cut



Overview of Energy Storage System



Panel configuration (top view)



Side view

Front view

Conclusion

Most important:

Canalize passengers / goods from cars

We have to brush up rail technology !

Using regenerative energy
Energy storage on board / wayside

New energy

Fuel sell: waiting for cost down