



Alstom Transport @ MIIT
Nov. 11, 2014

МИИТ
МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ПУТЕЙ СООБЩЕНИЯ (МИИТ)

Locomotives and Regional Trains

Marc van Damme

ALSTOM

Agenda: Mainline Rolling Stock – 11.11.2014
Alstom Session 2 – Academic year 2014/2015

1. ALSTOM Locomotive product range

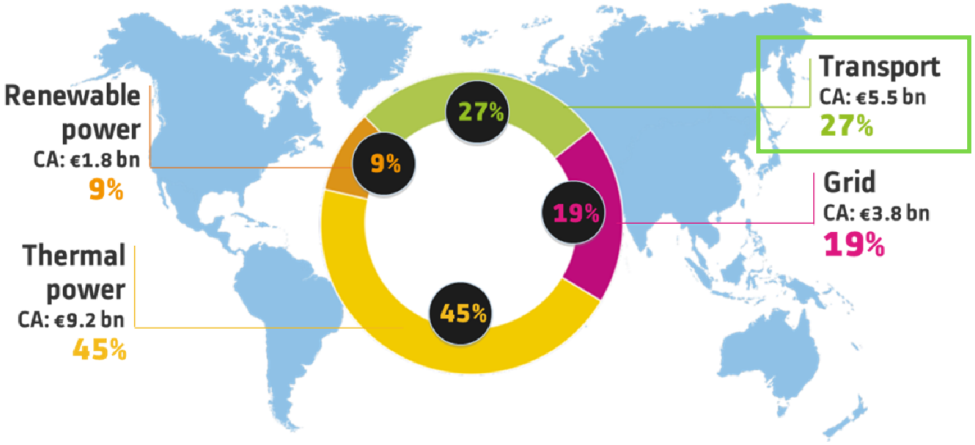
2. Power Electronic

3. Services

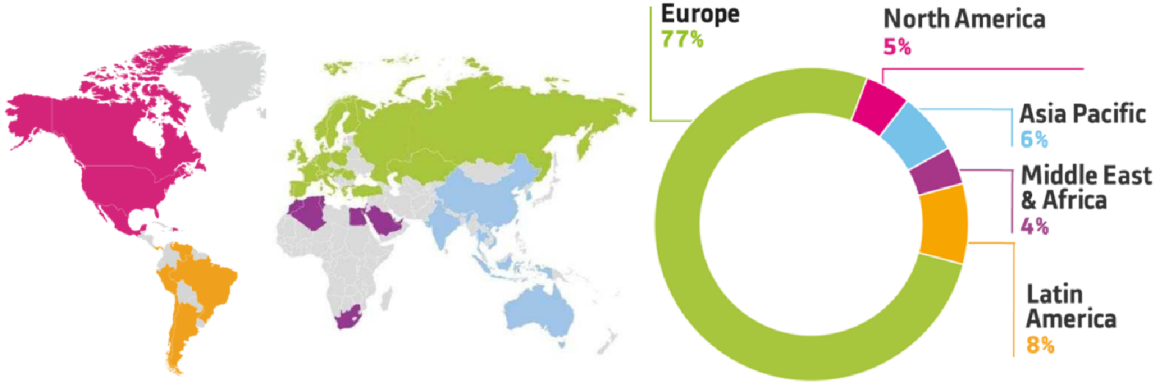
4. Regional trains: EMU / DMU

Alstom Transport in a nutshell

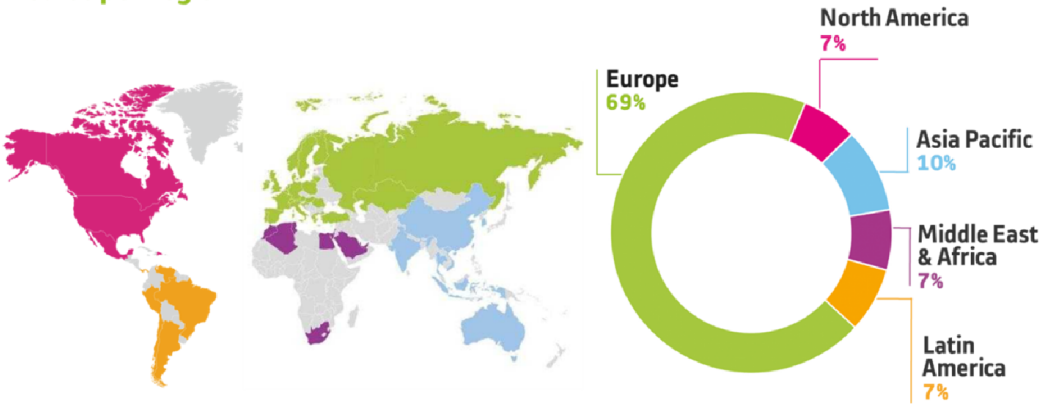
Total Alstom sales 2012/13 **€20.3 bn**



26,700 employees involved and in constant motion at about 90 Alstom sites in 60 countries

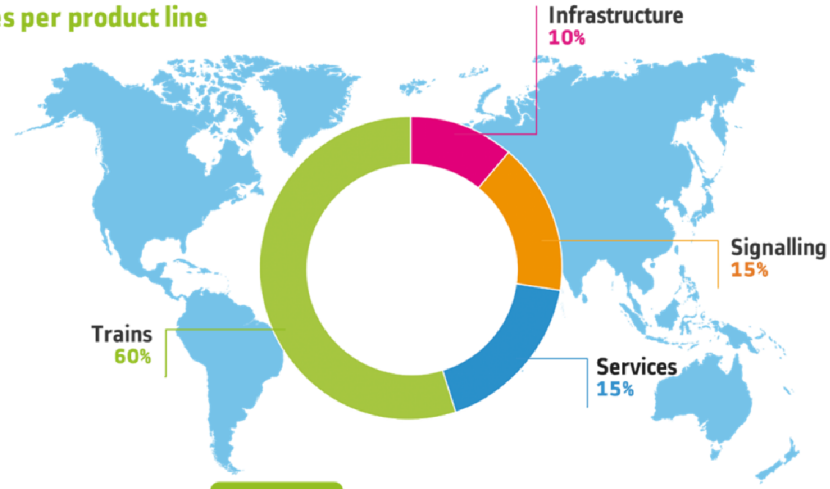


Sales per region



2012/13 total sales **€5.5 bn**

Sales per product line



2012/13 total sales **€5.5 bn**

TRANSPORT ALSTOM

State-of-the-art solutions created for public authorities, transport operators and individual passengers

The largest range of the market: from tramway to very high-speed train…

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1. ALSTOM Locomotive product range

2. Power Electronic

3. Services

4. Regional trains: EMU / DMU

The Prima range : built on proven technologies

More than 2400 locomotives delivered around the world

Electric

Diesel

200km/h

Prima II – Passengers – 6 400 kW

140km/h

Prima II – Freight – 6 400 kW

Prima – 3U15 – 4 200 kW

120km/h

Prima DJ4 – 10 000 kW

Prima CoCo - 9600 kW

100km/h

Prima DE30AC - 2 à 2 400kW

Prima DE1000AC – 1 000 kW

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Double BoBo Electric Locomotive (DJ4)

8000 tons at 120 kph

10000 tons at 80 kph

Technology transfer to China

Commercial data	
Network Homologation	China
First Delivery	2006
Number of units	180
Designation	PRIMA DJ4
Service type	Freight
Basic technical data	
Arrangement	Double Bo'Bo'
Gauge	1435 mm
Axle load	23 to 25 t
Loading gauge	Chinese gauge
Curve inscription	125 m
Nominal power	
25 kV AC overhead	2 x 5,000 kW
Traction performances	
Starting effort	700 to 760 kN
Maximum speed	120 km/h
Electric brake performances	
Regenerative. power at wheel rim	2 x 5,000 kW
Maximum effort	168 kN
Multi Unit control	2

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Double BoBo Electric Locomotive (DJ4)

Living area

Washroom

Beds, microwave, fridge

PRIMA DE 43 C AC F - IIRR

2500 tons at 90 kph

Technology transfer to Iran

Commercial data	
Operator	IIRR
Network	Iran
First Delivery	2002
Number of units	10+60
Designation	N°230 - 299
Service type	Freight
Basic technical data	
Arrangement	Co'Co'
Gauge	1,435 mm
Axle load	23 t
Loading gauge	UIC 505
Curve negotation	80 m
Fuel tank capacity	9,200 l
Diesel engine power	
UIC power	3160 kW (4300 HP)
Traction performances	
Starting effort	543 kN
Continuous effort	422 kN
Continuous speed	18 km/h
Power at wheel rim	2,150 kW
Maximum speed	110 km/h
Dynamic brake performances	
Power at wheel rim	3,270 kW
Maximum effort	217 kN
Multiple Unit control	3

PRIMA DE 1000 AC - SNCF

Commercial data	
Operator	SNCF
Network	France
First Delivery	2006
Number of units	175
Service type	Shunting
Basic technical data	
Arrangement	Bo'Bo'
Gauge	1,435 mm
Axle load	18;25 t
Loading gauge	UIC 505
Curve negotation	100 m
Fuel tank capacity	3000 l
Diesel engine power	
UIC power	1000 kW (1360 HP)
Traction performances	
Starting effort	170 kN
Continuous effort	141 kN
Continuous speed	18 km/h
Power at wheel rim	720 kW
Maximum speed	100 km/h
Multiple Unit control	2

CoCo Electric Locomotive – China market

5000 tons at 120 kph - 7000 tons at 80 kph

Technology transfer to China

Commercial data	
Network Homologation	China
First Delivery	2009
Number of units	500
Designation	PRIMA EL C HF
Service type	Freight
Basic technical data	
Arrangement	Co'Co'
Gauge	1435 mm
Axle load	25 t
Loading gauge	Chinese gauge
Curve inscription	125 m
Nominal power	
25 kV AC overhead	9,600 kW
Traction performances	
Starting effort	584 kN
Maximum speed	120 km/h
Electric brake performances	
Regenerative. power at wheelrim	7,200 kW
Maximum effort	368 to 400kN
Multi Unit control	2

The most powerful Locomotive in the world

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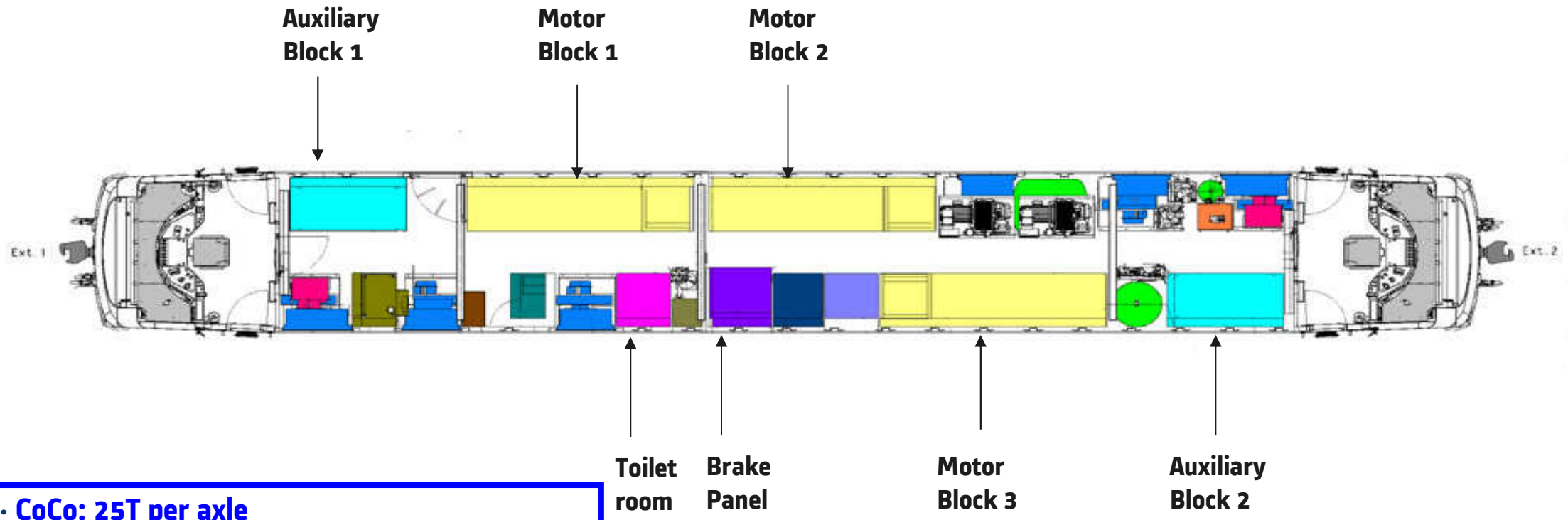
CoCo Electric Locomotive – China market



- **CoCo: 25T per axle**
- **Max speed: 120 km/h**
- **Catenary tensions: 25 kV 50Hz,**
- **Power under catenary tension : 9600 KW**
- **Starting effort: 584 kN**
- **Environment conditions : -40°C/+40°C**

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EP 20 Electric Locomotive – Russia

ТРАНСМАШХОЛДИНГ

Commercial data	
Network Homologation	Russia
First Delivery	2011
Number of units	200
Designation	EP 20
Service type	Passenger
Basic technical data	
Arrangement	Bo'Bo'Bo'
Gauge	1520 mm
Axle load	25 t
Loading gauge	Russian gauge
Curve inscription	125 m
Nominal power	
25 kV AC overhead	6,600 kW
Traction performances	
Starting effort	350 kN
Maximum speed	200 km/h
Electric brake performances	
Regenerative. power at wheelrim	6,000 kW
Multi Unit control	2

Compliant with

- GOST norms
- Low temperature operation up to –50°C

Alstom is the supplier of traction drives and traction control

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2ES5 Electric Locomotive – Russia

ТРАНСМАШХОЛДИНГ

Commercial data	
Network Homologation	Russia
First Delivery	2013
Number of units	200
Designation	2ES5
Service type	Freight
Basic technical data	
Arrangement	2*Bo'Bo'
Gauge	1520 mm
Axle load	25 t
Loading gauge	Russian gauge
Curve inscription	125 m
Nominal power	
25 kV AC overhead	8,400 kW
Traction performances	
Starting effort	833 kN
Maximum speed	120 km/h
Electric brake performances	
Regenerative. power at wheelrim	7,600 kW
Multi Unit control	2

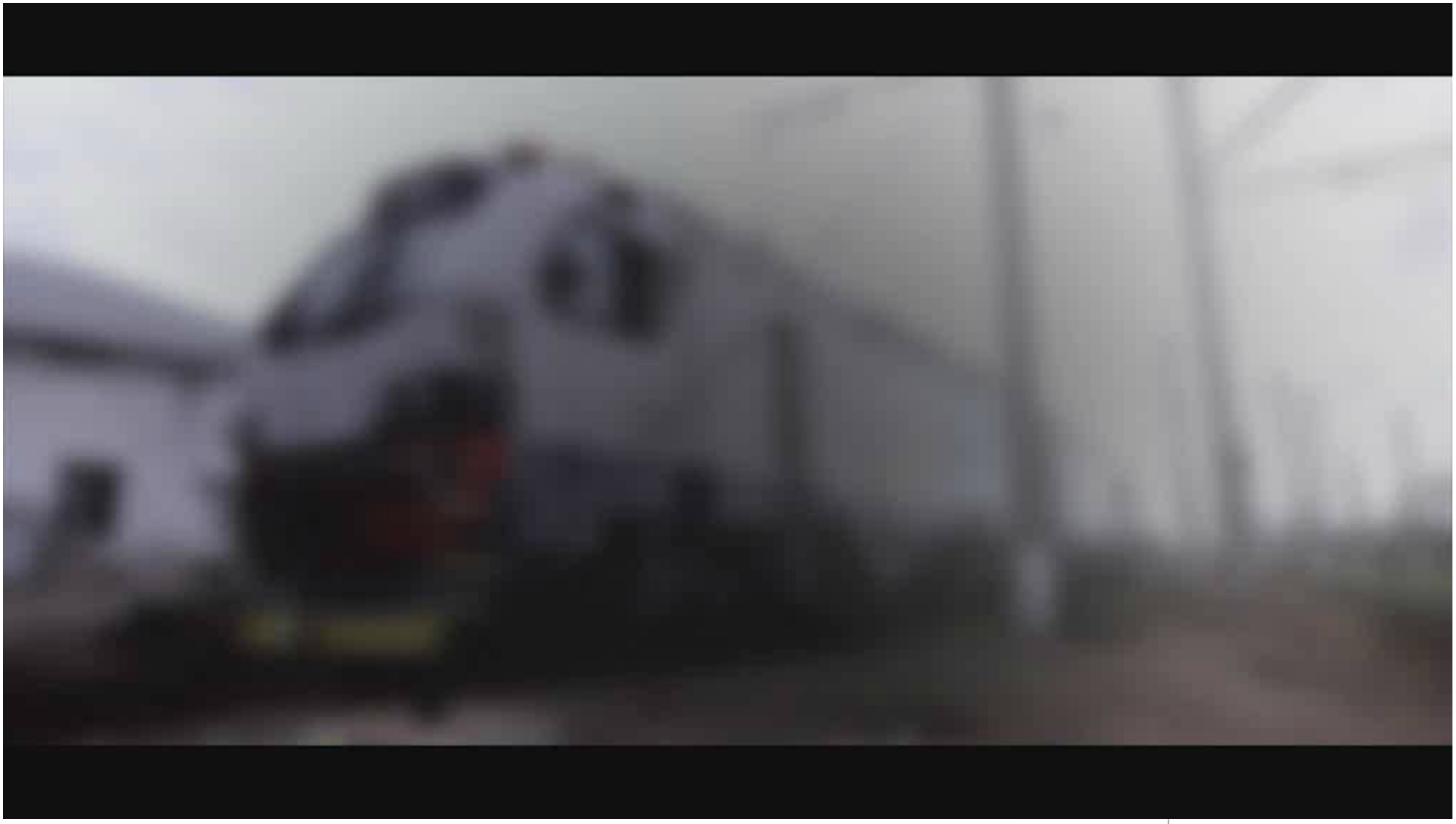
Compliant with

- GOST norms
- Low temperature operation up to –50°C

Alstom is the supplier of traction drives traction control and bogie

МИИТ TRANSPORT ALSTOM

Video 1: KZ8A Ready to run in all conditions



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KZ8A Electric Locomotive – Kazakhstan and CIS markets

Compliant with
- GOST norms
- Low temperature operation up to –50°C

Commercial data	
Network Homologation	Kazakstan
First Delivery	2014
Number of units	200
Designation	KZ8A
Service type	Freight
Basic technical data	
Arrangement	2*Bo'Bo'
Gauge	1520 mm
Axle load	25 t
Loading gauge	Russian gauge
Curve inscription	125 m
Nominal power	
25 kV AC overhead	8,800 kW
Traction performances	
Starting effort	833 kN
Maximum speed	120 km/h
Electric brake performances	
Regenerative. power at wheelrim	7,600 kW
Multi Unit control	2

Alstom is responsible for the design, validation and certification

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KZ4A Electric Locomotive – Kazakhstan and CIS markets

Compliant with

- GOST norms
- Low temperature operation up to –50°C

Commercial data	
Network Homologation	Kazakhstan
First Delivery	2014
Number of units	95
Designation	KZ4A
Service type	Passenger
Basic technical data	
Arrangement	Bo'Bo'
Gauge	1520 mm
Axle load	21.5 t
Loading gauge	Russian gauge
Curve inscription	100 m
Nominal power	
25 kV AC overhead	4,800 kW
Traction performances	
Starting effort	264 kN
Maximum speed	200 km/h
Electric brake performances	
Regenerative. power at wheelrim	4,400 kW
Multi Unit control	2

Alstom is responsible for the design, validation and certification

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PRIMA II - UIC market

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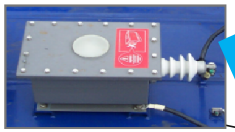
Product Overview – PRIMA II (4 Voltage BoBo)

Selector Switch



Surge Arrester

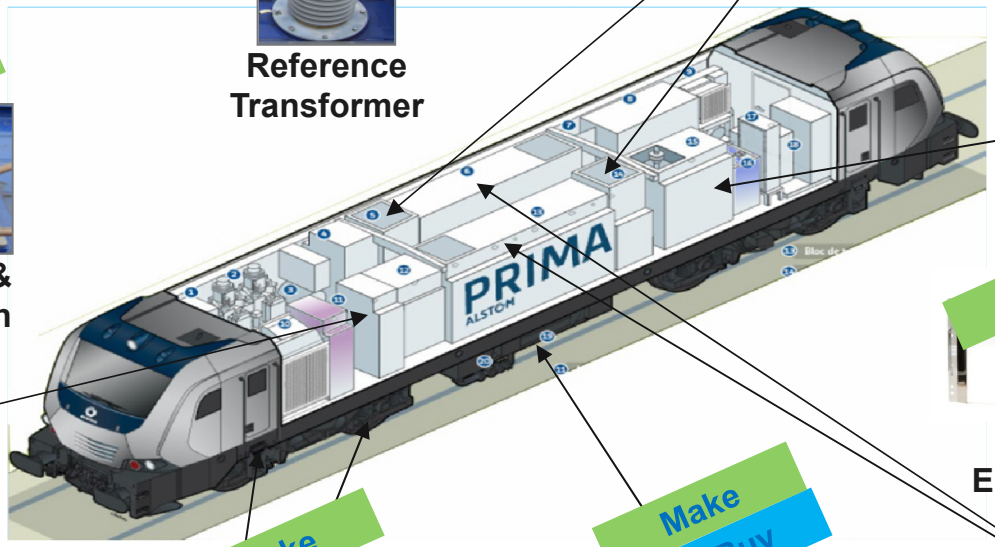
Reference Transformer

Vacuum Circuit Breaker & Earthing Switch

Brake Resistor Blocks x 2

High Speed Circuit Breaker

DC Block

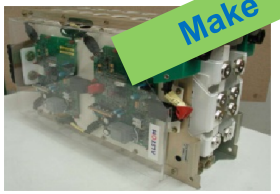


Auxiliary Block

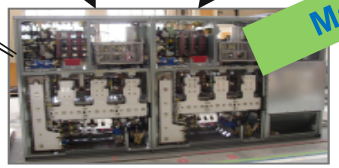
Traction Motors x 4

Main Transformer

Control Electronics



Power Modules



Motor Blocks x 2

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PRIMA II - UIC market

First contract : Morocco

20 electric locomotives

Freight and Passenger 160 kph

3kV

Possibility to upgrade for 25 kV

Delivery : August 09

PRIMA II – Test under the Channel

Tests achieved on

September 29th

2012

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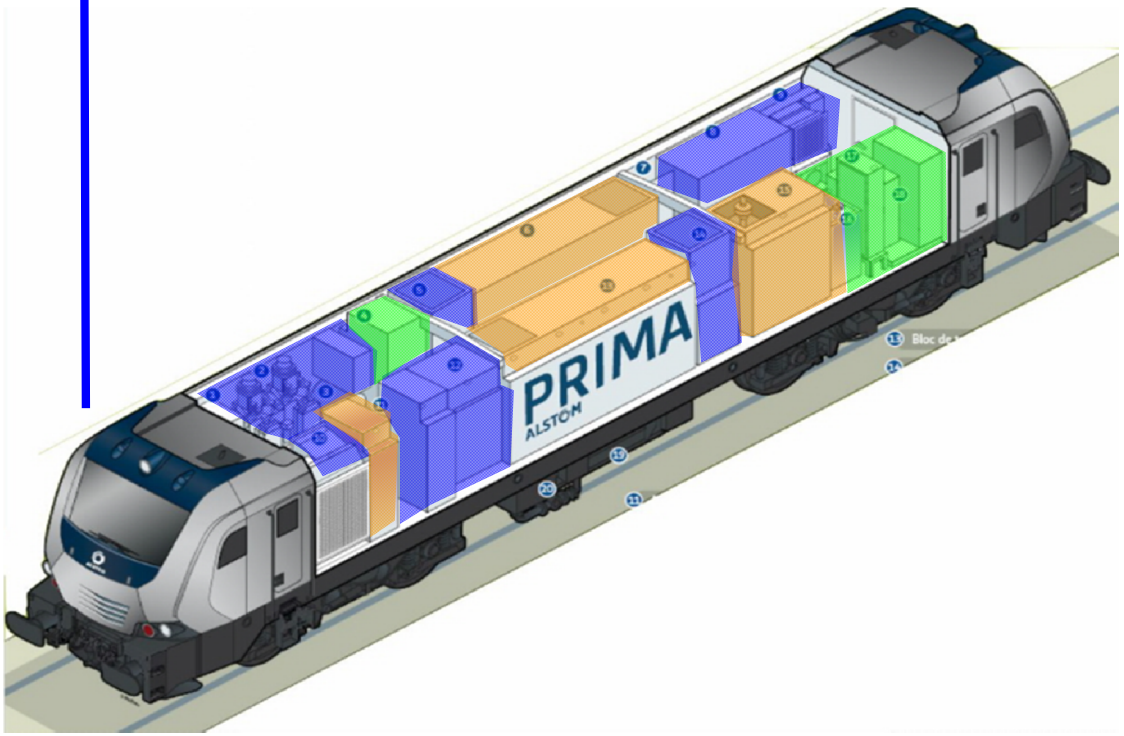
PRIMA II : Optimal modularity and flexibility

Prima II: a reference solution…

Reference solution



- **BoBo: 22 t. per axle**
- **Max speed: 140 km/h (freight version)**
- **Catenary tensions: 25 kV 50Hz, 15 kV 16Hz $^{2}/_{3}$, 3 kV, 1,5 kV**
- **Power under catenary tension : 6 400 KW**
- **Starting effort: 320 kN**
- **Driver desk : UIC612 type**
- **ERTMS systems integrated**
- **Remote maintenance**
- **Safety**

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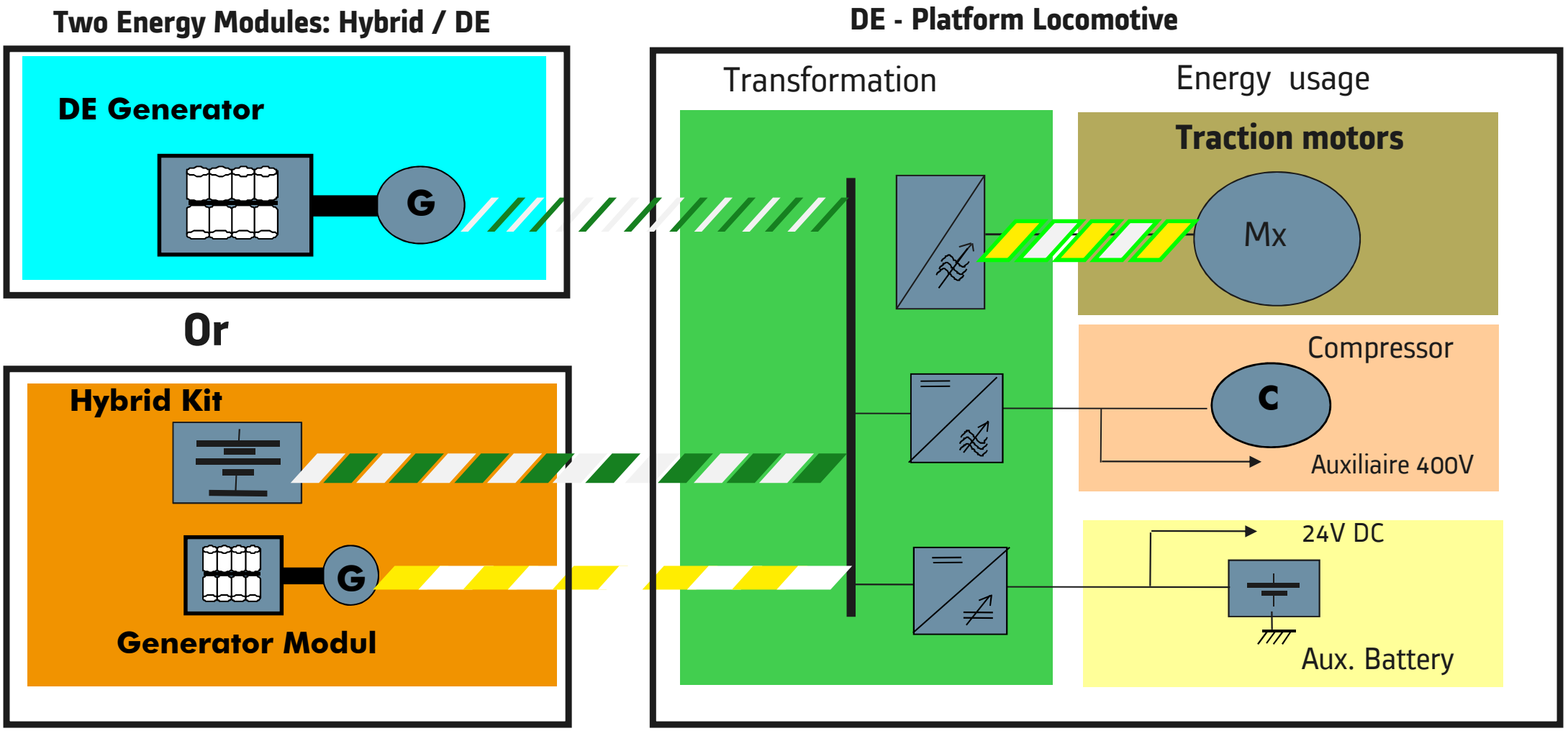
Shunting Locomotives DE and Hybrid – One platform!



DE: Generator with power of locomotive
or Hybrid: Dieselelectric shunter plus Batterie Booster for Peak Power!

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Alstom's Shunting Locomotives

Volkswagen AG
H3 Hybrid, 3 units, end of 2014
AT V100 Hybrid already in operation

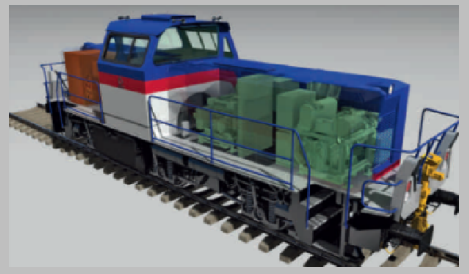
DB Regio Bayern
H3 Hybrid, 5 units, 2015

Shunting locomotives

- **Suitable for all shunting missions**
- **100 km/h max speed for all versions**
- **50% less diesel consumption, 15% less maintenance cost**
- **50% less emissions, low noise level**

Batteries
700 kW
0 emission
Sensitive areas

Hybrid
700 kW
30-50% fuel saving
Large industry area
Medium/large ports
Track works



Dual engine
700 kW
15% of fuel saving
Intense duty cycles
Steep slopes
Mine, ports, track works, line…

Single engine
1000 kW
High power
Logistics operators
Steel plants
Ports, track works

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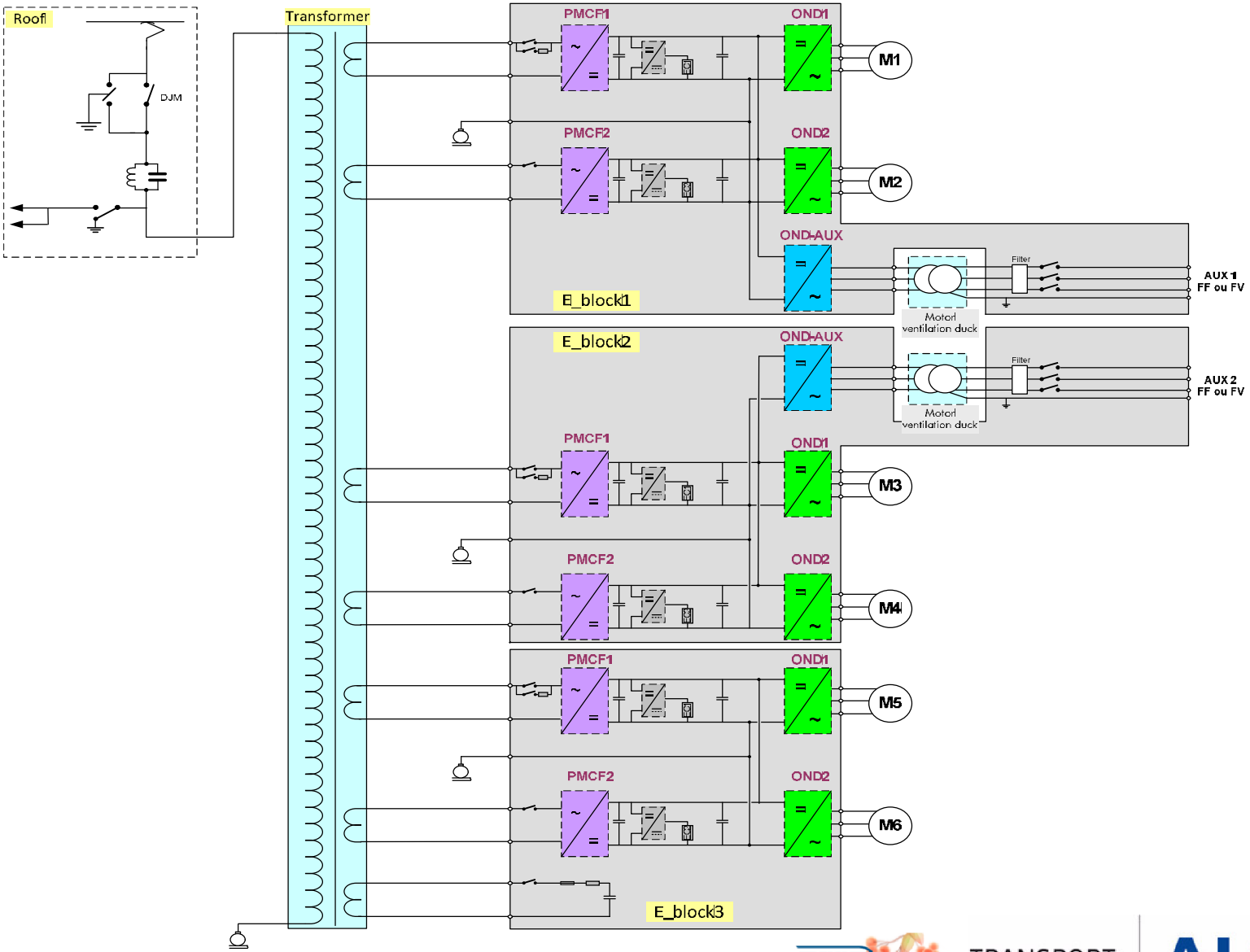
Typical Electrical scheme



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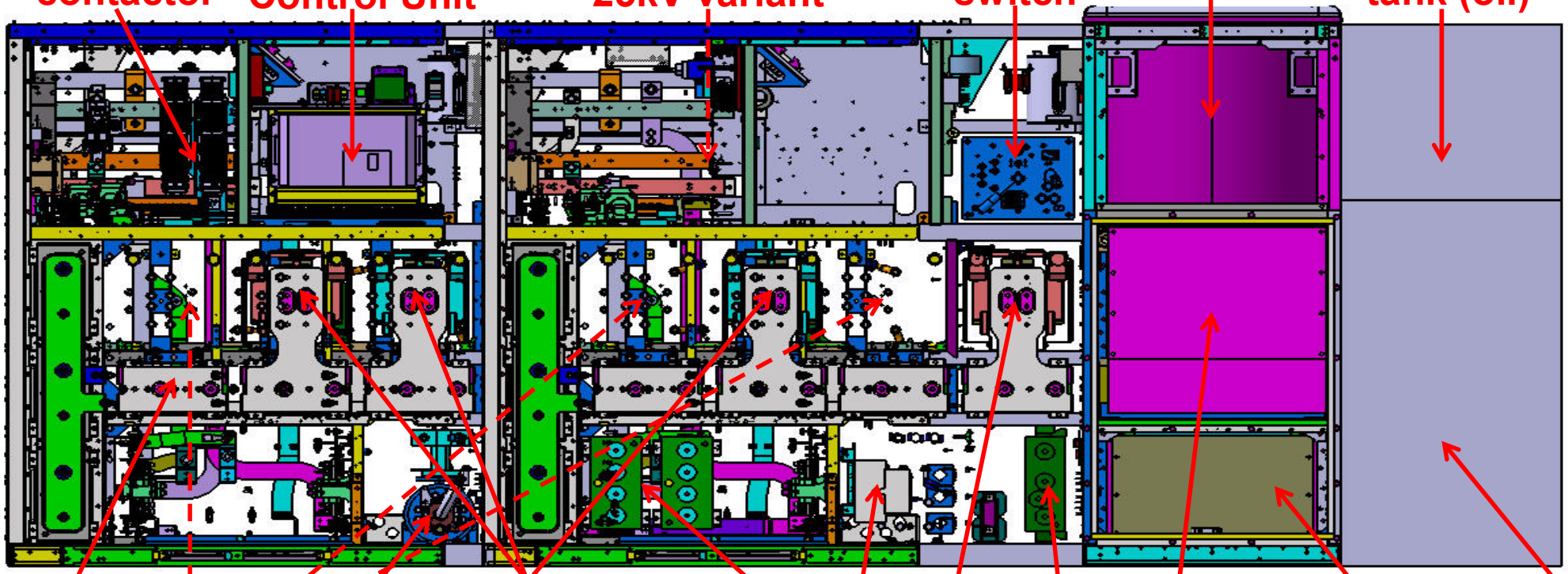
E-block layout



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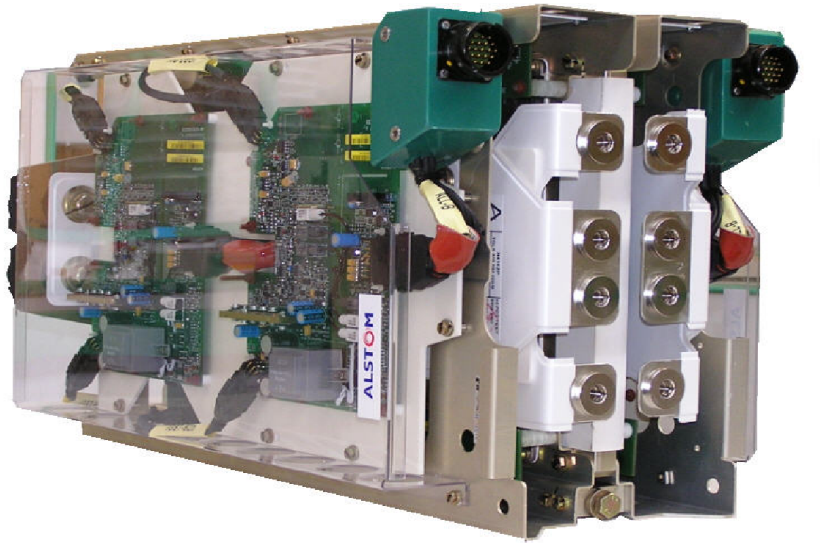
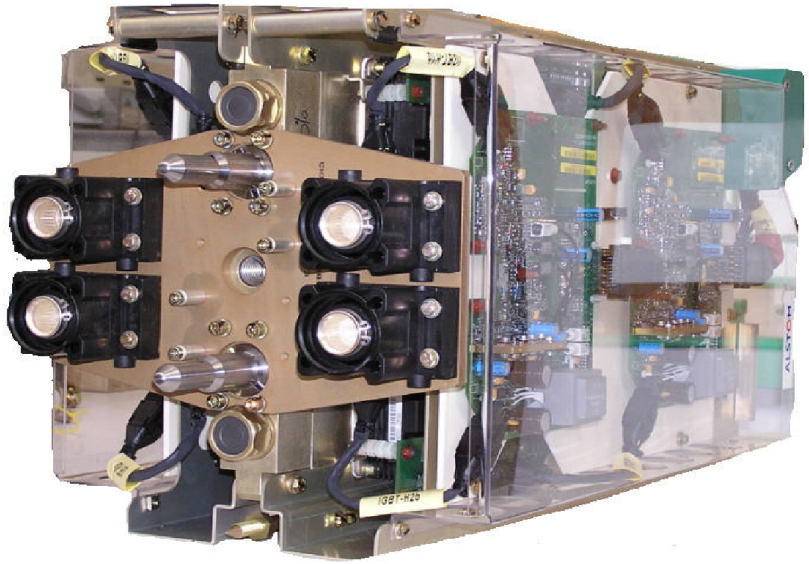
Power Module – ONIX233





IGBT 6500V for a d.c. link voltage between 2000V and 4000V

Standard product for locomotives, high speed train, regional train, etc.

Location: in each E-Block

Integrated system for easy maintenance including:

- IGBTs mounted on a water-plate
- Plug and play connectors (water, phase)
- Gate-drives
- Water cooling
- No optic fiber to be disconnected for maintenance

Functions: 4-quadrant converter, braking chopper, VVVF inverter, auxiliary inverter

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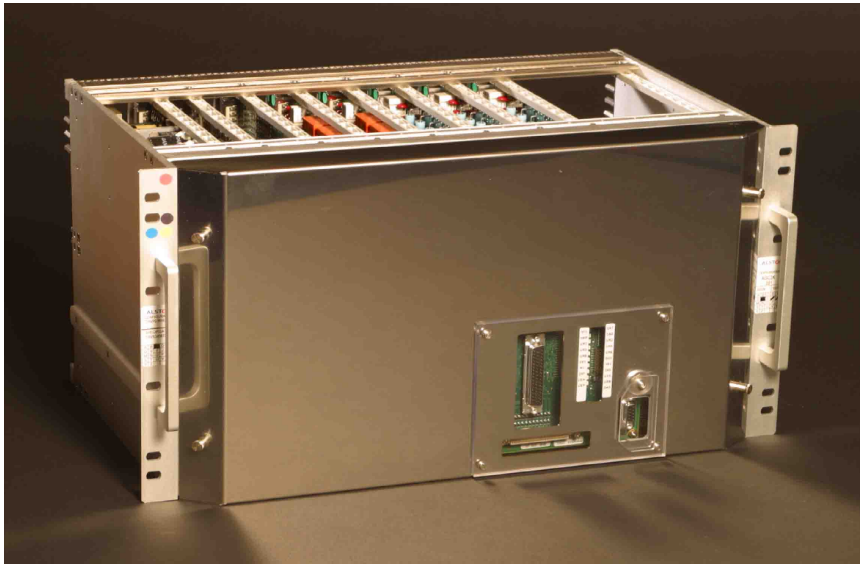
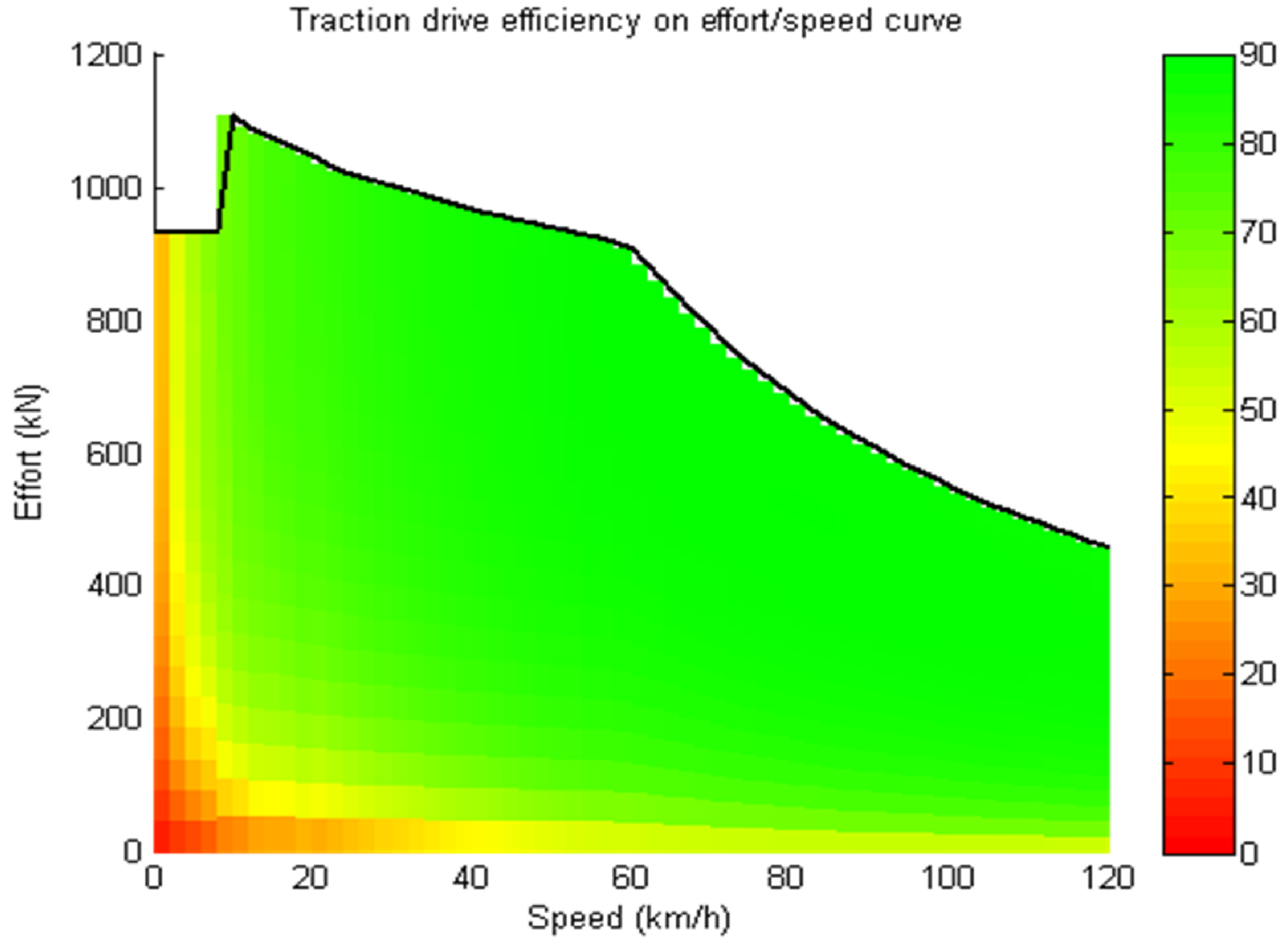
Traction Control Unit – AGATE



Functions:

- Protection and monitoring (differential protection, overload, over-current, over-voltage, short-circuit, etc)
- Control of switches and contactors
- Transducer's signals acquisition (current, voltage, temperature, speed, pressure)
- Cooling management
- PWM (pulse width modulation) control of the three inverters
- Torque control of the motor
- Regulation of the braking chopper
- Regulation of the auxiliary converter
- Fault log and maintenance functions
- Slip & slide control

Typical Traction drive efficiency (auxiliary included)



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The Alstom service references in locomotives

1000 locomotives under service agreement today

From 1993: Full maintenance in Mexico

- Plus 300 GE locos
- extended today to 440 with private operators

From 2002: Modernization DB/ALSTOM JV in Germany

- +250 Diesel Hydraulic Locomotives modernized
- Maintenance & Parts contracts with Private operators

From 2003: Franchise maintenance in the USA (15 years)

- 474 EMD locos operated by BNSF on coal transport

From 2006: Full maintenance in France (10 years)

- 31 Locos Transnational operation (France-Germany)

TrainTracer: onboard diagnostic solution

Remote communication and diagnostic of train status

- Train events
- Train status
- Train position

Fully secured and confidential information database

Video 2: LOCLife Services

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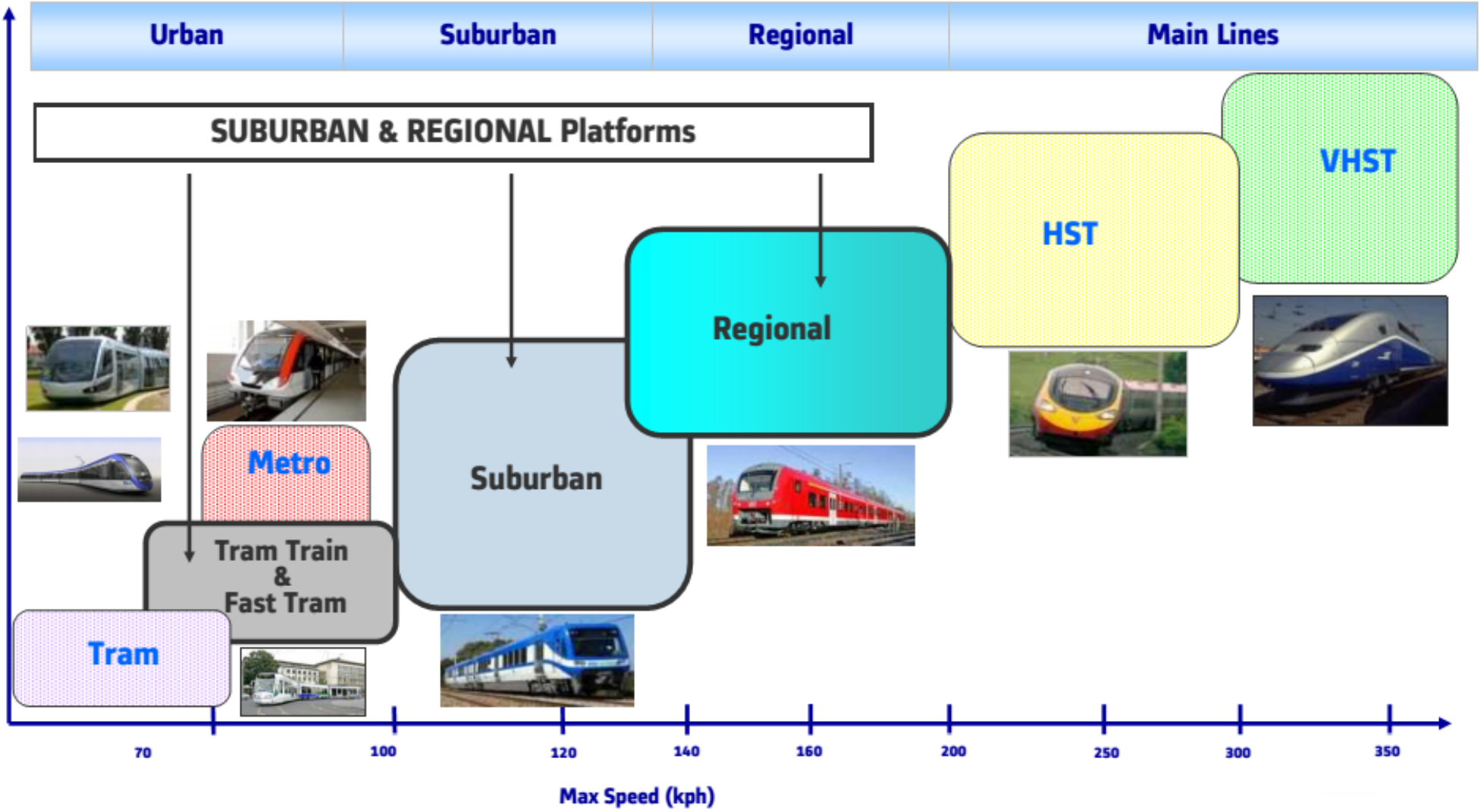
Alstom SUBURBAN & REGIONAL Platforms



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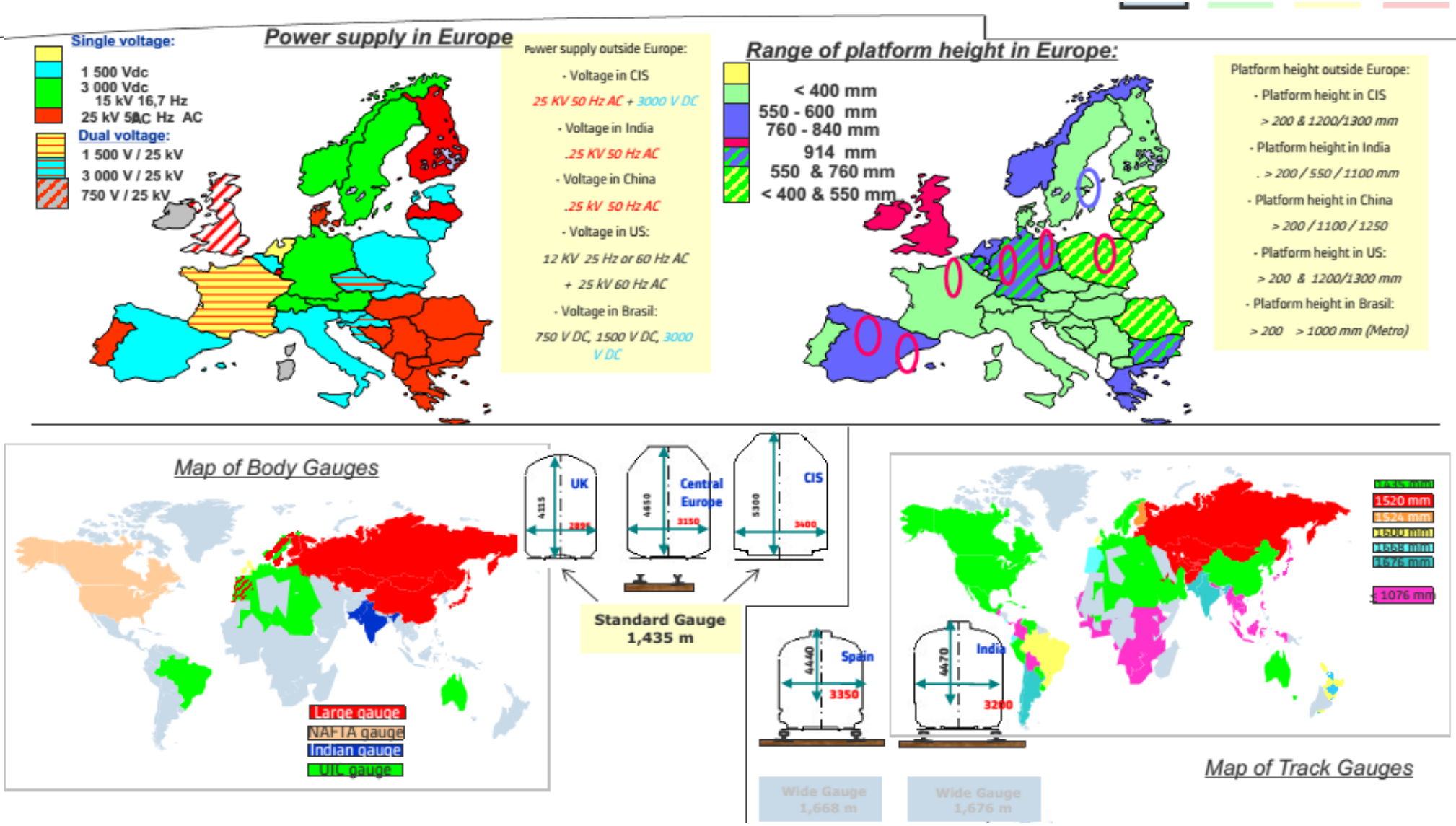
Standardization: A Key Challenge For Regional



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Video 3: Coradia

SUBURBAN & REGIONAL – Portfolio

Coradia Continental

Features

- Flexible EMU family
- Flexible train architecture
- Different train configurations (3 to 6 car)
- Wide modularity

Market

- Suburban, Regional or Regional Express applications
- Low platforms (entrance height 600 mm or 760 mm TOR)
- State-owned as well as Private operators
- 1435mm track gauge networks in Continental Europe

SUBURBAN & REGIONAL – Portfolio

Coradia Continental

Features

- Crash in line with regulation EN 15227
  - New front end design
- Fire safety in line with TSI SRT
- TSI PRM

First contracts for new solution

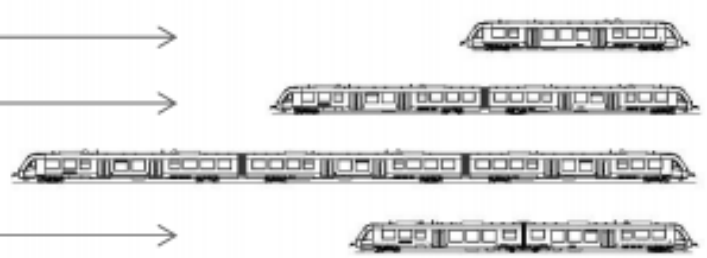
- New frame contract with DB AG
  - First call off received: 28 trains

SUBURBAN & REGIONAL – Portfolio

Coradia Lint : a best-seller

Features

- Lint 27
- Lint 54
- Lint 81
- Lint 41
- 2 type of motors: 335 / 390 KW
- Two entrance heights: 630/810mm



Market

- **Regional** trains on non-electrified lines
- Private operators
- Bestseller in Germany
  (DB AG & Private Operators)
- Mainly NE market
- To be adapted for SE

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SUBURBAN & REGIONAL – Portfolio

Coradia Lint family extended

Features

- New non-articulated architecture: Lint 54/81
- No more 3car articulated in portfolio
- Fully adapted to new norms & standards: Crash, gas emission, TSI

First contracts for new solution

- Abellio for RB 47 line (9 new Lint 41 trains)
- Dieselnetz Köln (56 Lint 54/81 trains)

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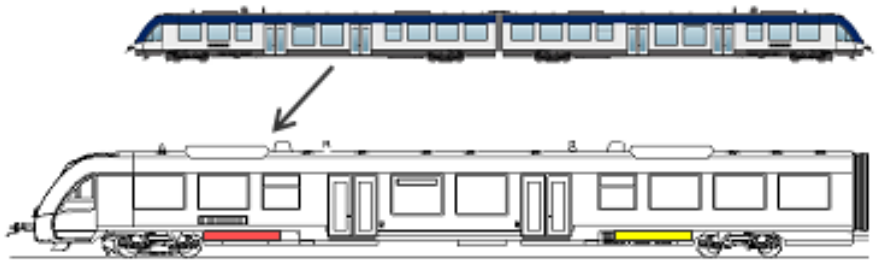
SUBURBAN & REGIONAL – Portfolio

Energy savings and emission control on Coradia Lint

- Lint 54: 3 engines
  - one engine can be switched off to save fuel



- Gas emission standard stage IIIB

	P ≥ 130 kW		Reduktion
	Stage III a	Stage III b	
Kohlenmonoxid CO	3,5	3,5	
Kohlenwasserstoff CH	4,0	0,19	~ -45%
Stickstoffoxide NOx		2,0	
Partikel PT	0,20	0,025	~ -80%
	g/kWh		

SUBURBAN & REGIONAL – Portfolio

Citadis Dualis

Features

- Tram-train vehicle
- Dual voltage or single voltage
- Full low floor train
- Modularity in length and width
- Crash acc. EN 15227 -III

Market

- Tram-Train or Fast tram market on electrified lines
- Low platforms (entrance height 360 mm TOR)
- State owned as well as Private operators
- 1435mm track gauge networks

SUBURBAN & REGIONAL – Portfolio

Coradia Polyvalent

SNCF contract

- First trains finalized and under dynamic testing

New offering

- Offering 200 kph version for Alsace Corail replacement
- Offering cross border version to Switzerland (CEVA)

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SUBURBAN & REGIONAL – Portfolio

Coradia Nordic

Features

- Product produced for Norrtag (class X62): first Coradia Nordic with max. speed 180 kph

New application

- Norrtag X62:
  Regional train upgraded for Intercity service

- 20 additional 4-car trains for Skane in Sweden (options)

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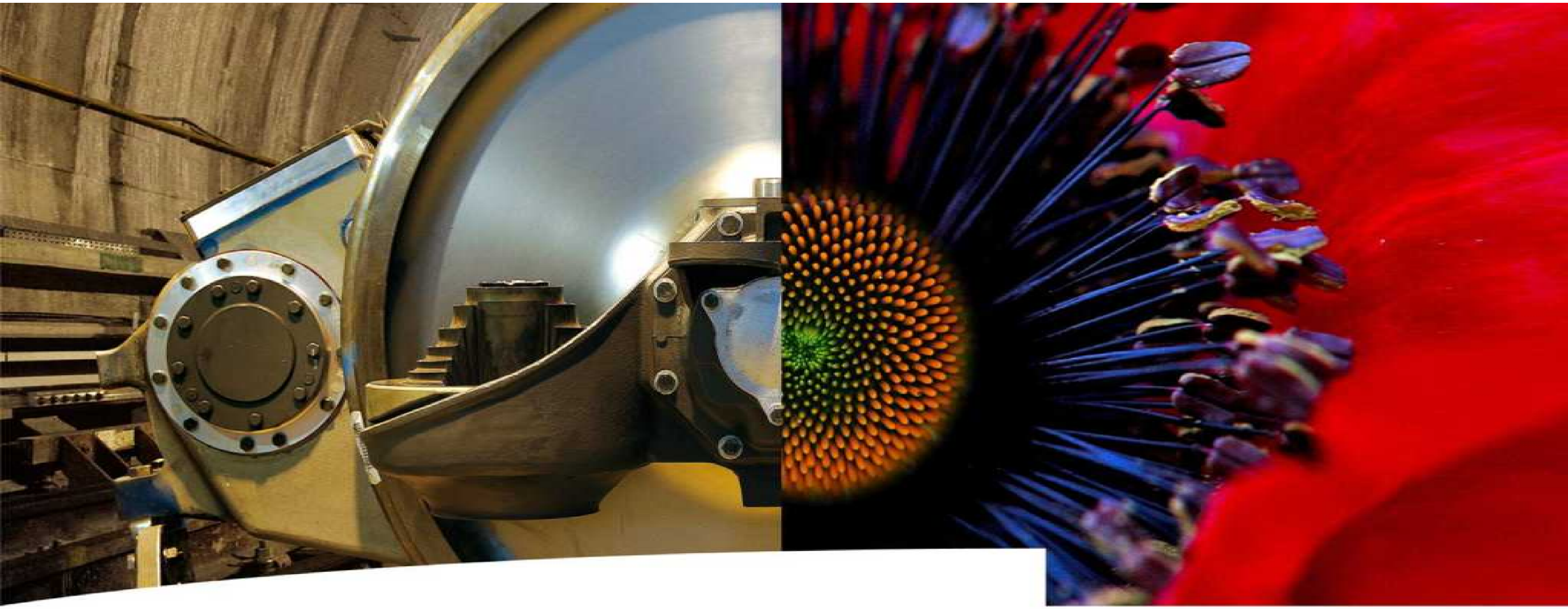

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