THE BOOMERANG EFFECT

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Marketing & Product

TRANSPORT

Toulouse 09/07/2012

Some History

- 1971-74 : LMD ENS
- 1974-1980 : LMD X
- 1980-84 : Professor Florida State University
- 1985-90 : LMD X
- 1990 : Deputy-Director INSU Ocean-Atmosphere

  Old good time when CNRS was operating National Programs set up and financed by several agencies! PNEDC, PNTS, PNOC, etc…
- 1996 : Directeur Relations Internationales du CNRS

  Scouting the world!
- July-2001 : ALSTOM Transport

  Another job, Another world where you are in competition and you must be leading otherwise you can be wiped out. One single strategic error and .. that's it!

Some Comments

- In the 90s, Climate Issues were mainly discussed within the Scientific Community although the world was becoming more Environment Conscious (Rio 1991!).
- Popped up in the Media : becoming Big Stuff!
- Started to turn into a thriller with a lot of politics!

THE BOOMERANG EFFECT?

WHAT IS ALSTOM BUSINESS?

Three main activities in 4 sectors

Equipment&Services for power generation

Alstom Thermal Power

Alstom Renewable Power

Equipment&Services for power transmission

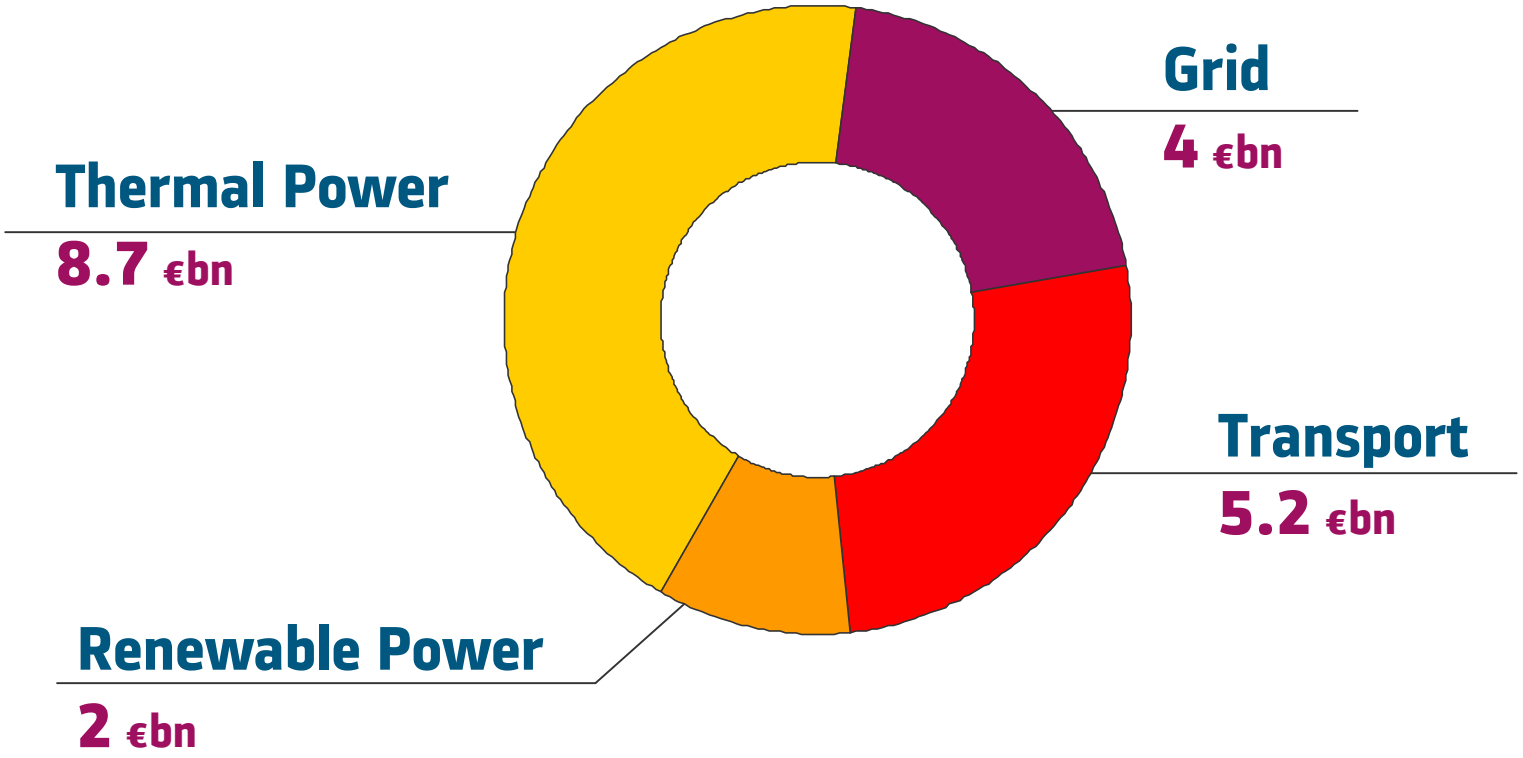
Alstom Grid

Equipment&Services for rail transport

Alstom Transport

TRANSPORT | ALSTOM

Three main activities in four sectors



Total sales 2011/12
€19.9 billion

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ALSTOM Power
Present in all markets

GAS

COAL

OIL

HYDRO

NUCLEAR (conventional island)

WIND

SOLAR

GEOTHERMAL

BIOMASS

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ALSTOM Power
World leader in power generation infrastructure

Alstom supplies major equipment for 25% of the worldwide installed power generation capacity

Global leader
in integrated
power plants

Global leader
in hydro power

Global leader
in air quality
control systems

Global leader
in services for
electricity utilities

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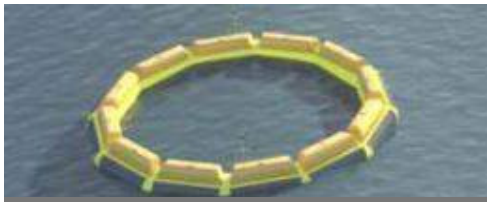
Alstom Renewable Power

WIND OFFSHORE

WIND ONSHORE

HYDRO

TIDAL



WAVE

SOLAR THERMAL

GEOTHERMAL

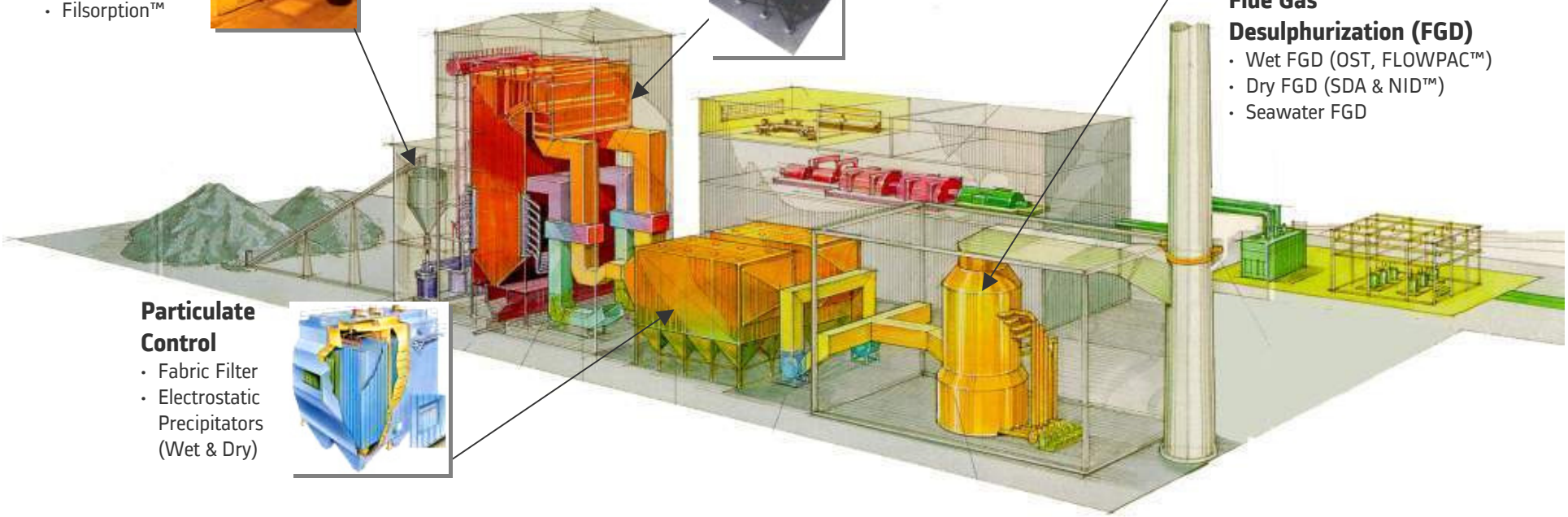
BIOMASS

Air Quality Control Systems

Mercury Control
- KNX™
- Mer-Cure™
- Filsorption™

NOx Control
- SCR Systems (Selective Catalytic Reduction)

Flue Gas Desulphurization (FGD)
- Wet FGD (OST, FLOWPAC™)
- Dry FGD (SDA & NID™)
- Seawater FGD

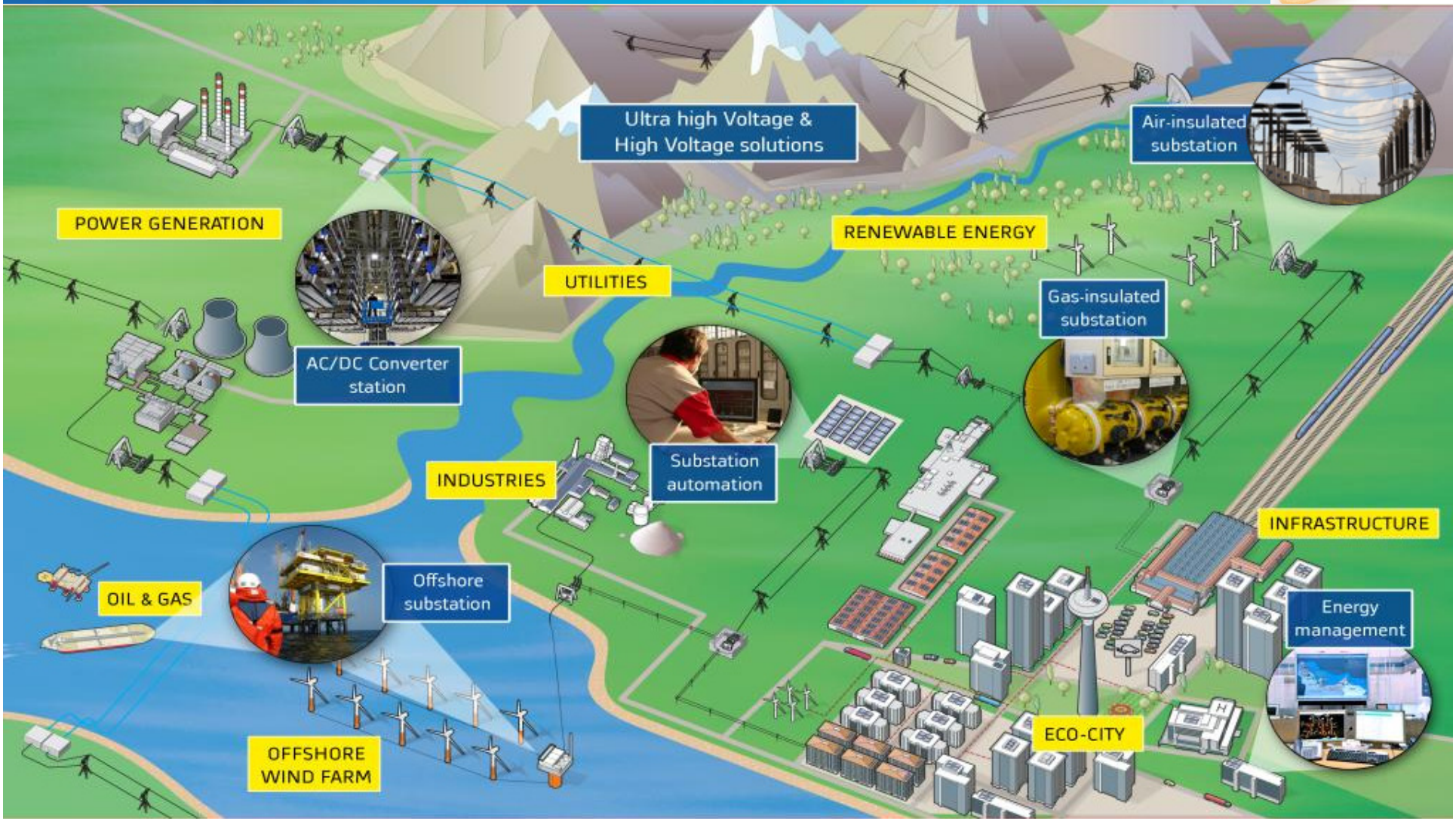


Particulate Control
- Fabric Filter
- Electrostatic Precipitators (Wet & Dry)

KNX™ (Bromine spray)
Mer-Cure™ (brominated activated carbon injection)
Filsorption™ (activated carbon injection)

OST: Open Spray Tower; SDA: Sprayer Dryer Absorber; NID: Novel Integrated Desulphurization

ALSTOM Grid
Energy landscape



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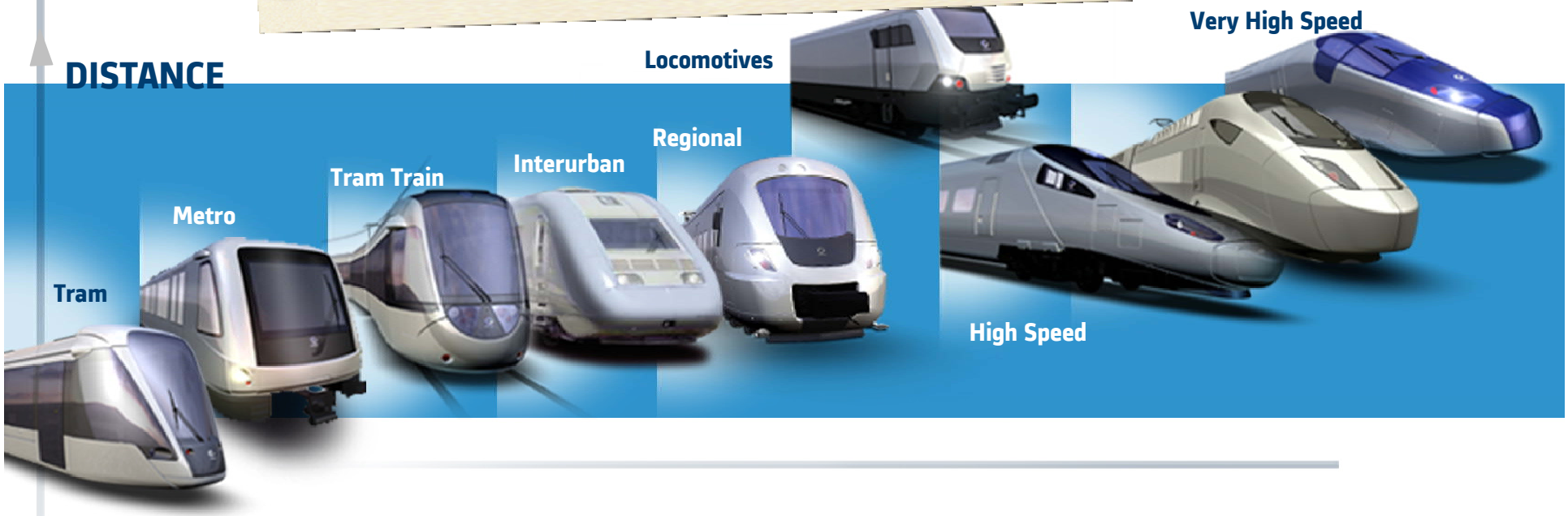
ALSTOM Transport
An extensive range of products and services

- Rolling Stock: from trams to very high speed…



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ALSTOM Transport
An extensive range of products and services

signalling, services & maintenance and infra.

- Infrastructure
- Signalling
- Services and Maintenance




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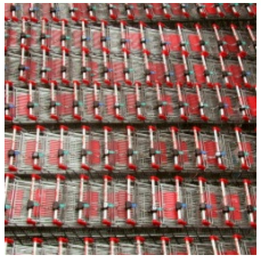
WHAT ARE THE CHALLENGES?

Our world is facing global challenges

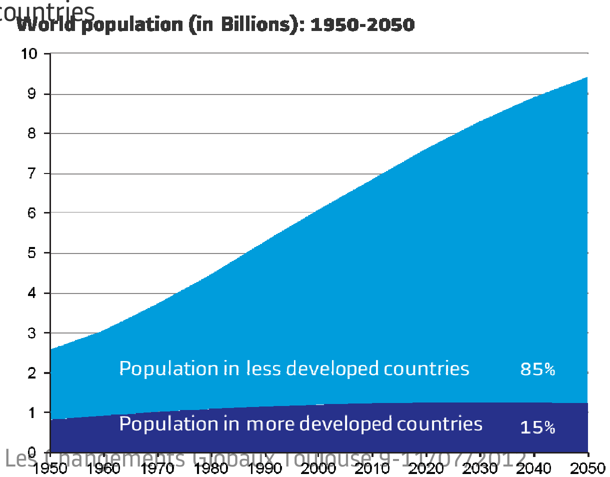


Consumption

Consumption is growing faster than population

Population Growth

Over last century, population has multiplied by 6 and it will increase by 50% more by 2050, 85% of this growth will take place in emerging countries



Energy prices

About 50% of known oil resources have been consumed

Transportation

In 30 years, road traffic has multiplied by 12 and air traffic by 17

Urbanization

Urban population will increase from 50% to 70% between 2010 and 2050

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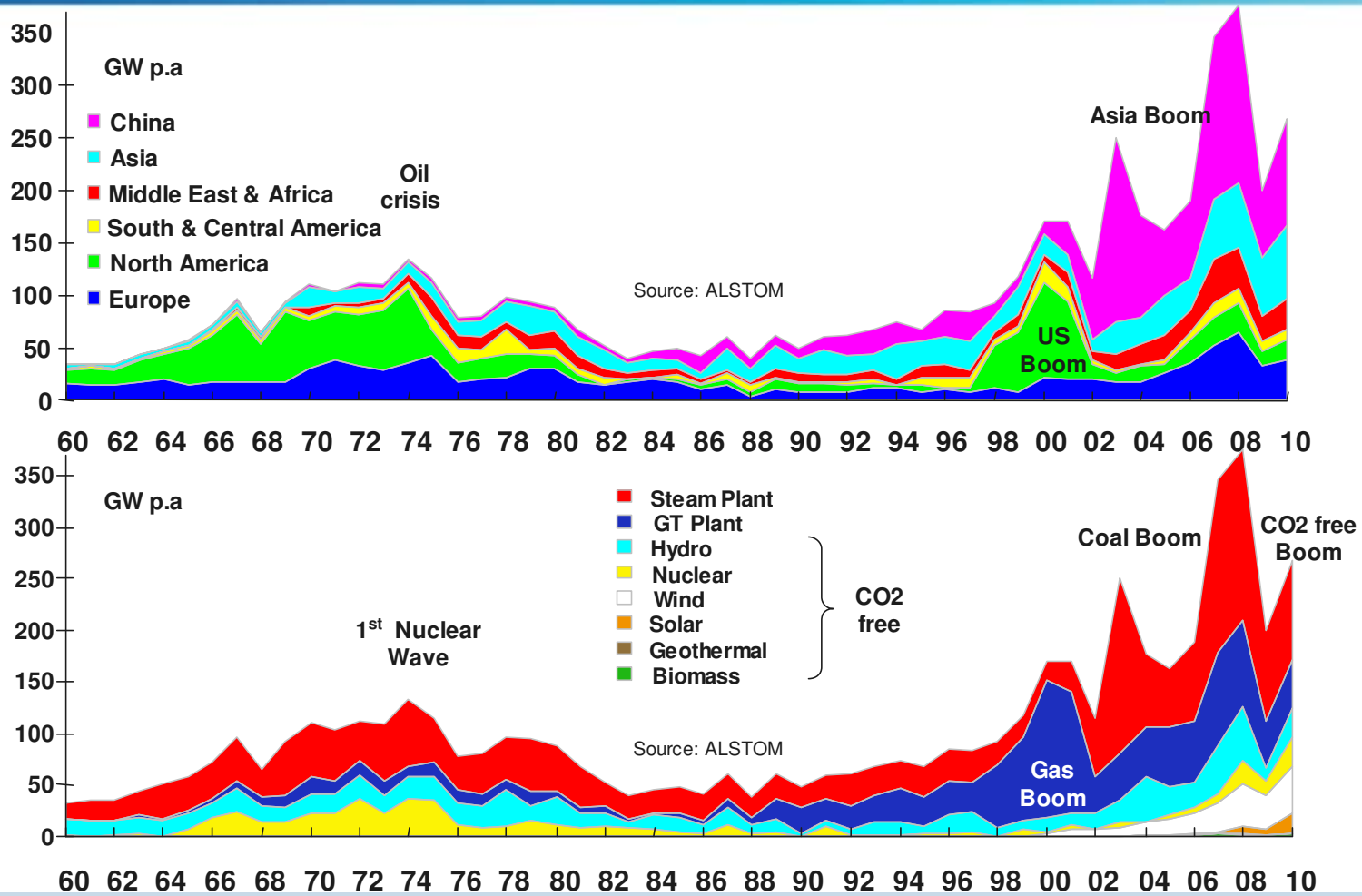
Past 50 years market development
Order for new Power Plants in GW p.a



R.E.R Wave

Replacement

Emerging

Renewable

Drivers leading to the "triple" invest. wave - **R.E.R** – are still valid ahead: **R**eplacement in old countries + Invest. in fast growing **E**merging countries + **R**enewable

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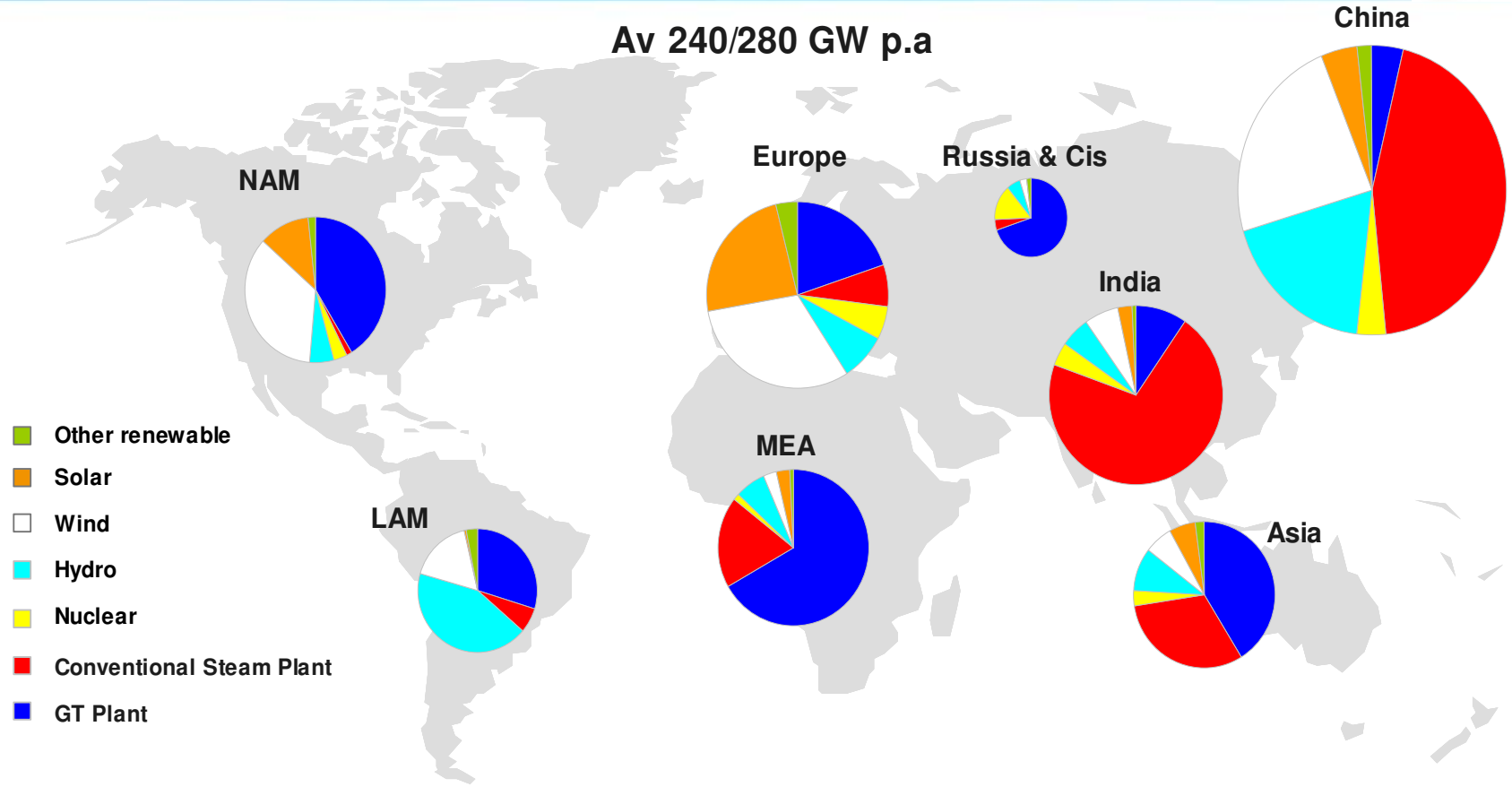
Global power market forecast – medium term
New Power Plant Orders in GW p.a



Source: ALSTOM MACA 2011

Diversified mix with growing share of Renewable all across the globe

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HOW ARE ALSTOM POWER and ALSTOM GRID PARTICIPATING TO EFFORTS TO REDUCE CO_2 EMISSION?

Alstom Power positioning since 2004

Clean Power Today®

Stabilising Power Emissions is possible ……

With solutions that are available today

1. Technology Mix

Balancing the generation portfolio by significantly increasing the share of Renewable and CO2 free technology

2. Production Efficiency and Flexibility

Efficiency is a key to emissions reduction and Flexibility to integrate renewable power.

3. Carbon Capture and Storage

With 60% of the installed base in 2030 being fossil fuels, CCS is a must.

Biomass co-firing energy: significant potential to reduce CO_2 emissions

POTENTIAL OF THE BIOMASS

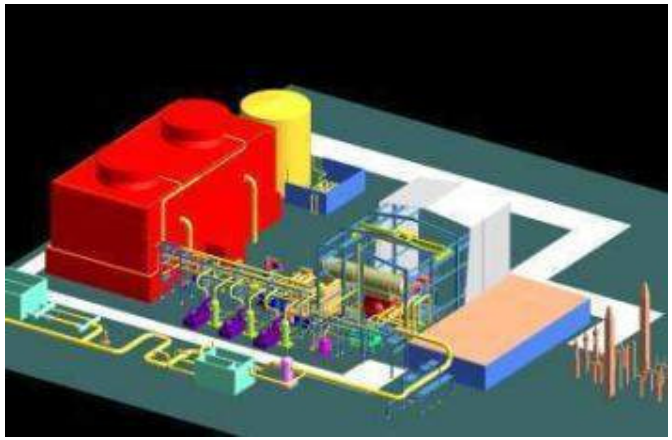
- **Up to 20 % CO_2 avoided**
- **Retrofitable** to existing coal plants
- Flexibility – **low incremental cost**
- Biomass combusted in highly efficient boilers
- DRAX- UK's largest coal fired plant – **4GW**
- 1.5 million tons/year biomass co-firing at 10% heat input
- **400 MWe of green power**
- **2 million tons/year CO_2 reduction**

Solar Thermal Technology

Geothermal energy: low in cost, low in GHG

Potential of the geothermal energy

- **Low in greenhouse gases**
- Provides a **steady, continuous**, 24/7 source of energy
- **Immune to fuel prices** fluctuations
- **Low cost** electricity generation
- Los Humeros II, Mexico, geothermal project will **reduce country's CO_2** emissions by **230,000 tonnes per year**



Ocean Energy: a clean and natural source of energy

- **Potential to 100TWh** of electricity worldwide (consumption equiv. 20 Million westerns)
- **Clean, natural, invisible**
- **No greenhouse gases**
- **100% predictable** and inexhaustible

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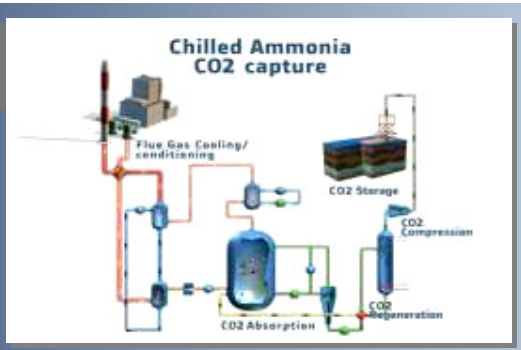
Carbon Capture & Storage (CCS) technologies range

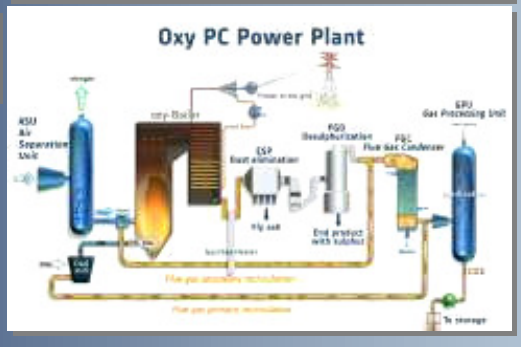
Post-combustion

- Advanced Amine
- Chilled Ammonia



Oxy-combustion

- Oxy combustion
- Chemical Looping Combustion



Integrated solutions

- **New plants**
- **Retrofit**
- **CCS ready plants**
  (storage covered with partners)

ALSTOM FOCUS

Pre-combustion

Alstom is developing several CO_2 capture technologies
to address new plants and existing installed base

CO2 Capturing Project

Over the last few years, successful pilot (5MW) and demonstration plant (54MW) operation of the chilled ammonia process : TIME TO GO TO FULL SCALE EXPERIMENT!

After a feasibility study, May 7th, 2012 Alstom entered demonstration phase at CO2 capture project (Full Scale) in Mongstad, Norway at Technology Centre Mongstad (TCM), the joint venture between Gassnova, Statoil, Shell and Sasol.

HOW IS ALSTOM TRANSPORT PARTICIPATING TO EFFORTS TO REDUCE CO_2 EMISSION?

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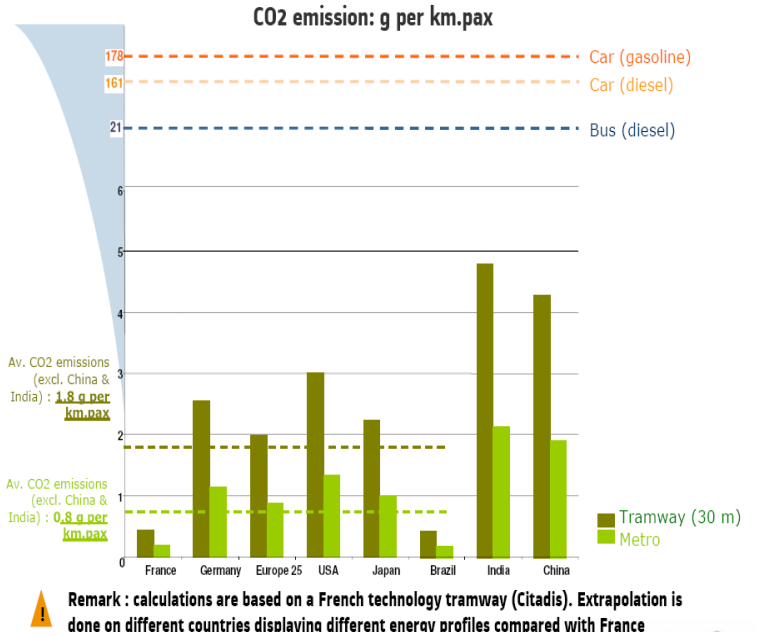
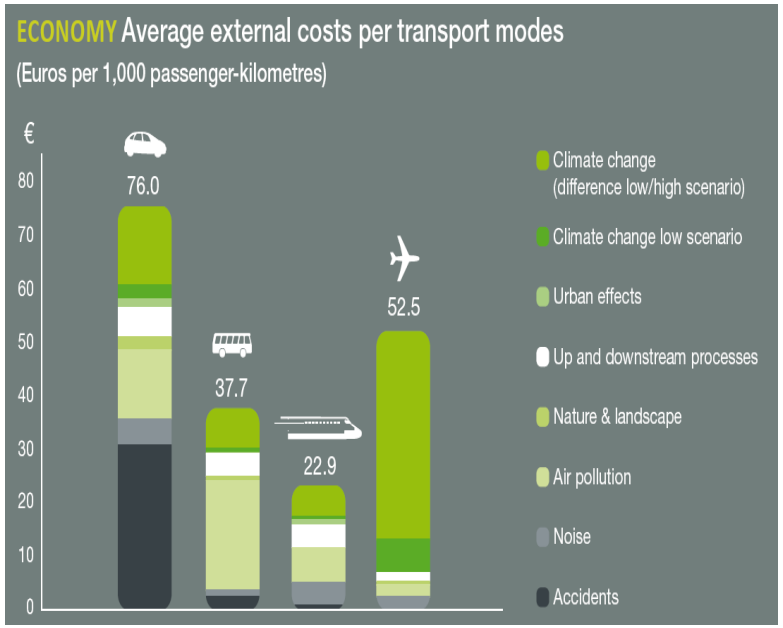
Rail advantages go beyond CO2 emissions

- **Travelling by rail is on average 3-10 times less CO2 intensive than road or air transport (depending on local electricity mix)**
- **Rail environmental benefits also include limited land use, reduction of congestion and greater safety.**



Source : Alstom – Urban trains



Source : UIC - Fast track to Sustainable Mobility

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Designed with environmental concerns in mind

AGV Automotrice Grande Vitesse

CO_2 EMISSIONS per passenger per kilometre

2,2 gr CO_2

30 gr CO_2

115 gr CO_2

153 gr CO_2

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La performance environnementale du rail : recyclabilité

- ✓ **Prise en compte de la recyclabilité des véhicules dès leur conception** :
  - Matériaux recyclables
  - Méthode d'assemblage

- ✓ **Recyclabilité théorique supérieure à 95% (tramway)**

- ✓ **Un système de tramway génère 2 fois moins de matériaux non-recyclables qu'un système bus**

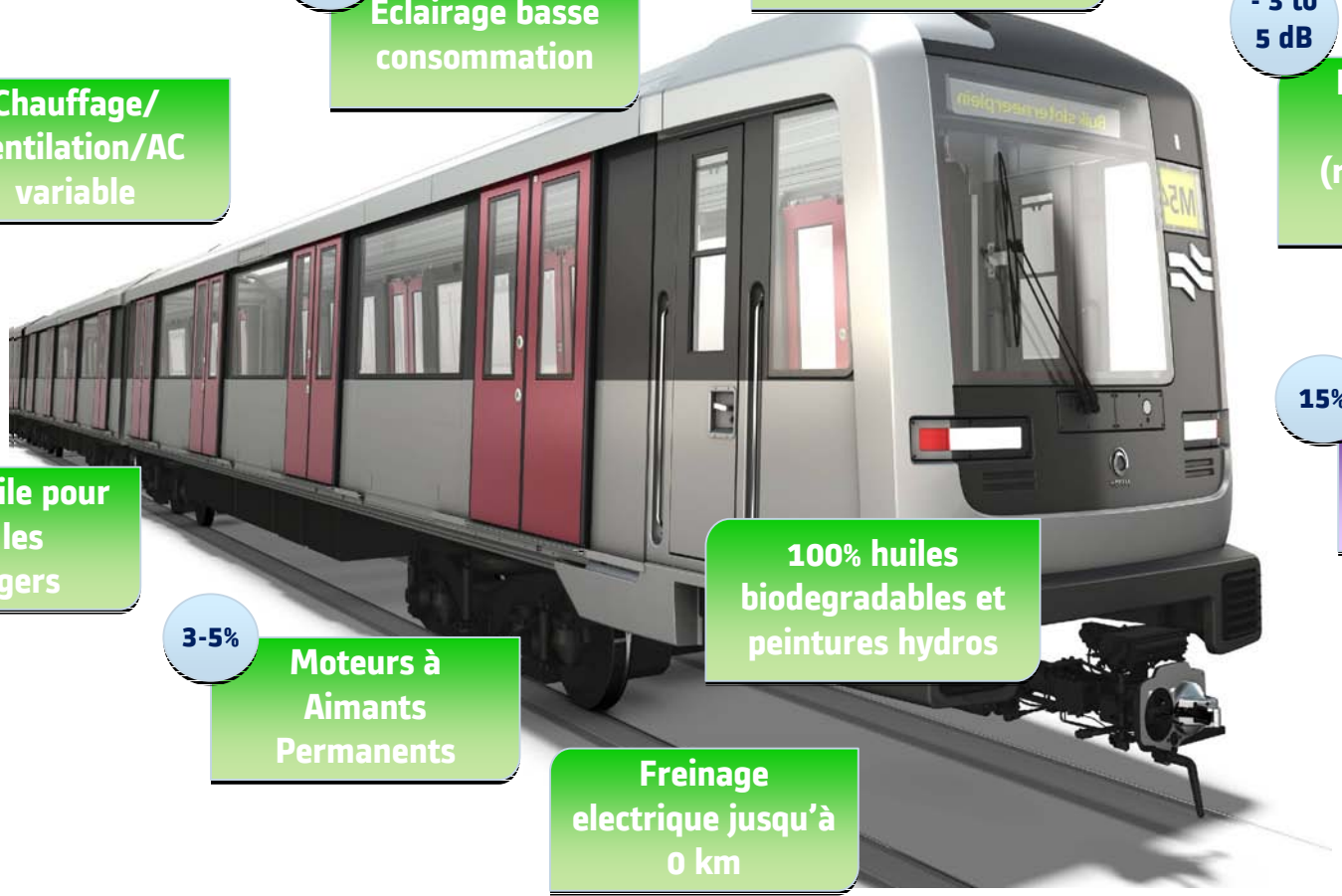
Transport urbain fer = excellente recyclabilité

La performance environnementale du rail : intégration urbaine

- ✓ **Décongestion des villes**
- ✓ **Embellissement des centres urbains**
  - Bruit
  - Design
  - Solutions sans caténaire

Transport urbain fer = la meilleure intégration urbaine

Des solutions innovantes pour le matériel roulant



10%
Recuperation de l'energie de freinage en supercapas

2%
Eclairage basse consommation

10%
Chauffage/ Ventilation/AC variable

- 3 to 5 dB
Bruit interieur et exterieur reduit (redesign moteur + HVAC)

15%
Compteurs et Outils d'Eco-Driving

Accès facile pour tous les passagers

100% huiles biodegradables et peintures hydros

3-5%
Moteurs à Aimants Permanents

Freinage electrique jusqu'à 0 km

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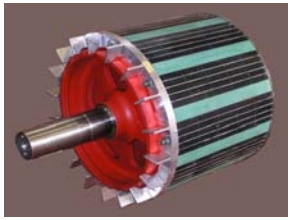
R&D and Innovation

- ✓ **Optimisation de la consommation énergétique**
  - Refroidissement naturel nouveaux équipements électriques
  - Généralisation des Moteurs à Aimants permanents
  - Optimisation des supercaps (autonomie, compatible APS, …)



- ✓ **Optimisation de la masse**
  - Utilisation de composites (métro)
  - Optimisation des composants (équipements électriques, moteurs rapides, …)

- ✓ **Emissions de bruit**
  - Refroidissement naturel nouveaux équipements électriques

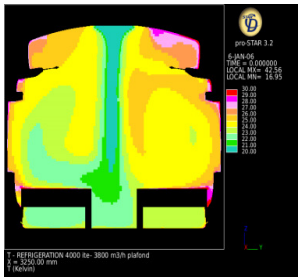
- ✓ **Synergies du système de transport avec d'autres systèmes pour réduire les impacts environnementaux : intermodalité, smart grid, eco-cities**

Optimizing energy consumption in Rolling-Stock
Focus on Energy efficient Auxiliaries

Up to 15 % saving

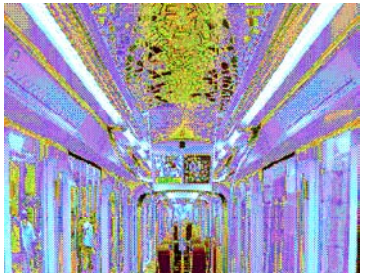
- **Variable Ventilation/Air-Conditioning (Regiolis, MI09, Singapore Metro)**

  Using information on train weight or CO2 concentration, HVAC is regulated when there are less passengers.



- **Energy-efficient lighting (Ref. Amsterdam Metro)**

  LED have a much longer life-span than traditional lighting. Sensors also allow to implement “dimming” so a constant lighting level is maintained for an optimized energy consumption.



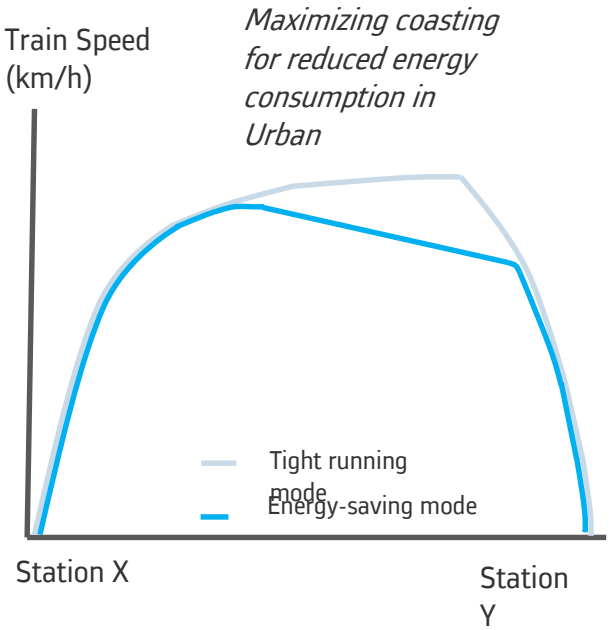
- **Energy-efficient sleeping modes**

  All efforts are made to reduce consumption of the various sleep modes. Only key equipment is kept active and consumption is minimized.

Optimizing energy consumption in Operations

- **Tracking energy consumption data**
  - Metering systems for billing (Regiolis, Prima Locos)
  - Energy tracking for traction and auxiliaries (Singapore Metro)

  => Data Analysis enables to better know key influencing factors (timetable, external temperature, occupancy rate) which allows system optimization.



10 to 20 % savings

Reduction of traction energy consumption

- Energy-saving driving modes for automatic metros (e.g.: Hong-Kong metro achieving 20% savings through system upgrade)
- Eco-driving tools for Locos and Mainlines trains

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Maximizing Braking Energy recovery
A focus on recovery and storage solutions

Video

Up to 20 % savings

- **HESOP Reversible sub-stations**
- Recover 99% braking energy that can be regenerated into the network
- Optimize infrastructure

=> Positive results with RATP on Line T1 – Pablo Picasso sub-station

- **On-board storage**
- Supercapacitors / Running without pantographs
- Best energy-saving off-peak hours

Up to 15 % savings

=> Test positive on Citadis for RATP Line 3 in operation with passenger service

Improving recyclability and integrating bio-materials

We always try to propose innovative solutions to :

- Eliminate harmful substances and materials that can be present in fluids, oils, refrigerating gases, brake pads

- Improve recyclability :
  - METROPOLIS™ and CITADIS™ trams are now at least 90% recyclable, with levels of 95% achieved in the Hamburg metro.
  - Stockholm's suburban CORADIA™ Lirex™ train holds the record for recyclability at 98%

- Maximize use of biomaterials from renewable resources such as wood, hemp and wool as thermal and/or sound insulation in trains.

Metropolis Aluminium , a show case of our smart solutions : Amsterdam

Lower energy consumption :

- 12 t/axle for a wide gauge (116.2 x 3 m)
- Open Motor
- Full electrical braking up to standstill
- 100% LED technology: saloon, cabin, head/tail lights

Passenger comfort improvement :

- Easier access and getting around on board : large doors, continuous low floors, wide gangways
- Noise reducing equipment
- 2.3 m ceiling height

Multi specialist proposal :

- Full signalling, rolling-stock, life-services proposal

AGV technology to reduce customer footprint : NTV for Italy

Lower energy consumption :

- 60t lighter than competitors' trains(200 m)
- only distributed power traction VHST with articulated architecture
- Permanent Magnet Motors

⇒ 20 % less consumption than previous generation

⇒ 10 % less consumption than other market solutions

Lower maintenance costs :

- 25 % fewer bogies than competition (bogie is 40% of maintenance cost)
- feed back of 30 years of operation
- maintenance optimization considered at design stage

⇒ 10 % cost saving for the maintenance

And further development :

- Composites (structural part of the carbody & bogie) under test on the Pegase prototype train

Modernisation of existing fleet to improve energy efficiency : MEXICO STC – MP82

Full Traction modernisation & maintenance

- 25 trains
- Plug and play concept : Traction fully refurbished and braking energy recovery function implemented

Lower energy consumption :

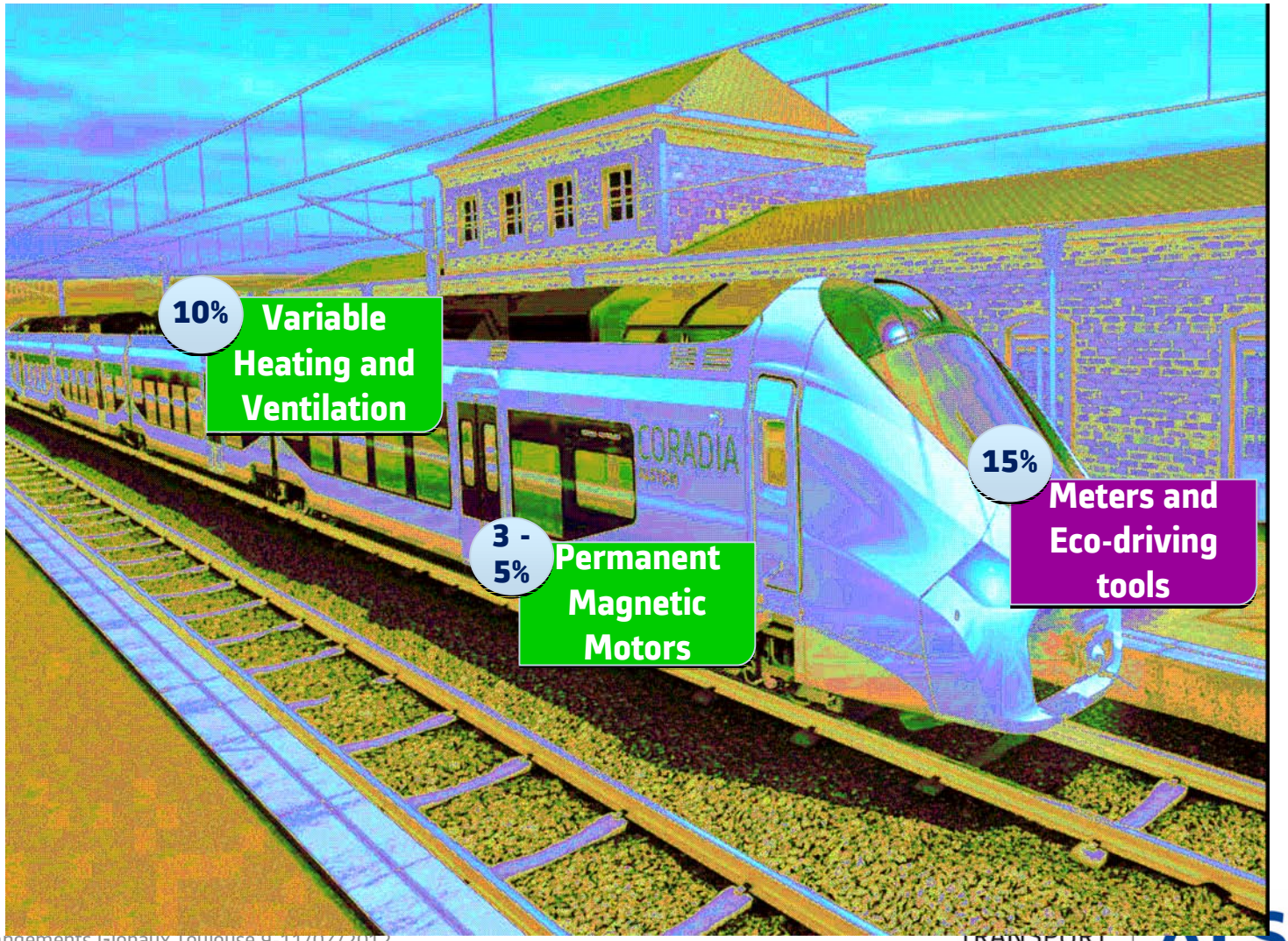
- 40% energy saving for upgraded traction drive

Additional benefits :

- Increased Availability (-10 times Service-Affecting –Failures per month)
- Reduced Maintenance Costs (90% braking consumables wheel & tires consumption

Regiolis, Sustainable Mobility for French Regions

Performance improvement



PRODUCING CLEAN ENERGY
TRANSPORTING EFFICIENTLY PEOPLE AND GOODS
IS THAT ALL?

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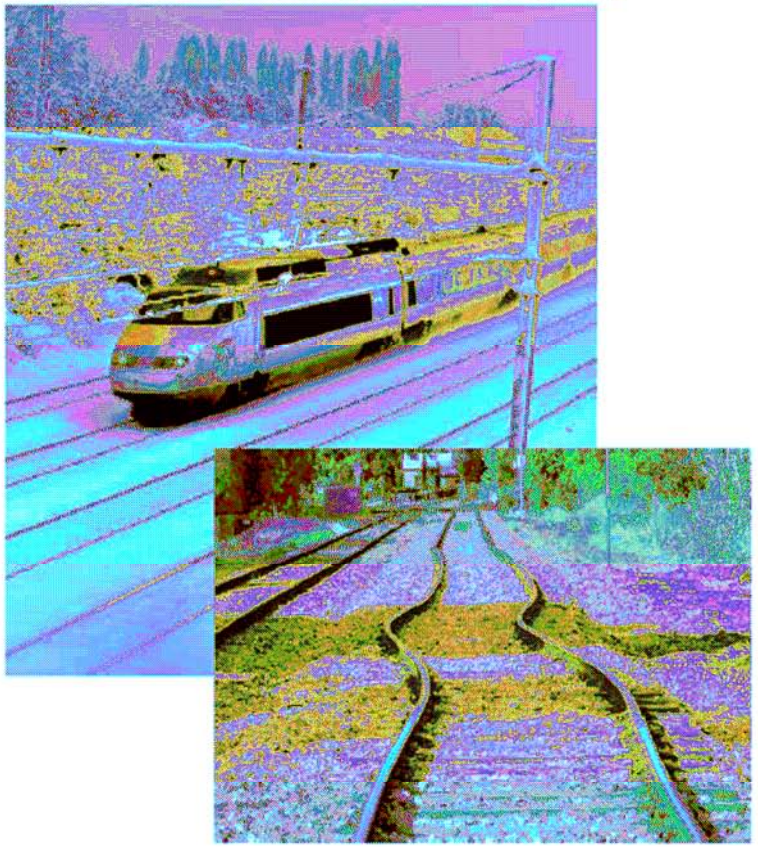
From Crisis to Climate Change Management

1910 NATURAL HAZARDS

21st c. EXTREME EVENTS



Take into account Climate Change

Heatwaves	Rain	Snow	Coldest days
Rails: overheating & torsion	Tracks, Stations, Tunnels: Flood (drainage systems)	Switchpoint: Accumulation of snow and disruption	Track: High temperatures for workers
Catenaries: overheating & distortion	Bridge: increase of stream flow, fretting wear	Trains : doors and harness equipment disruption	Embrittlement of rails
Tracks &Trains: electric and electronic equipments disruption	Landslides	Tracks &Trains: electric and electronic equipments disruption	Stations: Black ice, slippery platforms
Station & Trains: global comfort (temperature, humidity)	Tracks: Erosion, excavation	Impracticable roads: modal transfer to the train	Trains : doors and harness equipment disruption
Track: High temperatures for workers	Tracks: signals equipments disruption		Trains : broken windows
Track: Fire	Impracticable roads: modal transfer to the train		Blocked switchpoint
			Difficulties of starting up of the driving machines
			Ice-cold rails > Loss of efficiency of the braking
			Icing of catenaries

Solutions to tackle the issue

EXAMPLE: ADAPTATION TO THE RISK OF HEATWAVE

Rolling stock | Infrastructure | Station | Journey condition

RISK	IMPACTS ON SNCF	POSSIBLE ADAPTATION MEASURES
Overheating of the temperature in the passenger car	Discomfort or even uneasiness of personnel and passengers	> Having longer preparation of trains > Higher specification of the air conditioning > Improvement of ventilation (modelled on the VMC turbofan) > For vehicles travelling st moderate speed (eg. Trams), installing ventilation without air conditioning (eg. Tram in La Réunion)
Alteration or premature waring of on-board electronic systems or signalling systems along the tracks	Loss of reliability	> More frequent maintenance > Tougher specifications
Engine overheat	Loss of power of traction units	> Slow down of traffic
Vegetation drought	Fires along the tracks	> Choice of less flammable plant species > Preventive coordination with Civil security
	Presence of animals along the tracks, seaching for pasture	> Fences along the tracks > « Cow-catcher » at the front of the locomotives
Migration of certain insects to the North, due to global warming	Infestation of insects in the passenger cars (ventilation systems, sleeper trains,...)	

The Time Scale

Rolling stock | Infrastructure | Station | Journey condition

INFRASTRUCTURE	years
Creation and production of an infrastructure work	150
Electrification	80
Production and setting-up of tracks	50
Revegetation along the tracks and slopes	15

MARKETING SYSTEMS	years
Management software	15
Ticketing	10
Pricing	5
Communication campaign	0,5

TRAIN STATION	years
Creation and operation of the new station	100
Creation of platforms	50
Design of a train station	30
Reorganisation of public areas	20
Air conditioning/heating systems	15
Setting up of common services (toilets, water access)	15
Setting-up of a waiting room	10
New organisation of reception centre	5
Setting-up of Passenger information systems	2

ROLLING STOCK	years
Investment for new rolling stock (full set of coaches)	40
New traction unit	20
Comfort elements	20
Fitting of toilets	20
Repairing of existing rolling stock	15
Air conditioning/heating systems	15
Purchasing of driver assistance and consumption optimisation systems	10
Leasing operation	10

SNCF Winter Plan

SNCF WINTER PLAN

ROADMAP

- **Investments 2011: 90 M€**
  - Rolling stock: 40 M€
  - Infrastructures: 28 M€ and Additional funds
  - Information network and travellers assistance: 22 M€
- **Modernization and preparation**
  - Special winter preparation of 234 locomotives
  - 69 Snow-plows located in strategic places.
- **Switchpoint heaters:**
  - 100 heaters modernized in 2011.
  - 360 will be settled in 2011 and 2012.
- **Reduction of the speed :**
  - For TGV: 220/230 kph and may be down to 160/170 kph (instead of 300 or 320 kph).
  - For IC trains and Regional Trains (TER): 120 kph (instead of 160 and sometimes of 200 kph).

ADAPTATION STRATEGIES SHOULD BENEFIT THE MANAGEMENT OF TODAY'S EXTREME WEATHER

Climate Change is not only a technical matter

- RESEARCH & INNOVATION
- NEW MOBILITY BEHAVIOUR
- GOVERNANCE & STRATEGY
- RESILIENCE & ADAPTATION

Conclusions

ENERGY GENERATING and TRANSPORT INDUSTRIES DO HAVE SOLUTIONS TO REDUCE CO2 FOOTPRINT.

IMPORTANT R&D EFFORTS TO FURTHER REDUCE THE CO2 FOOTPRINT.

Morale

WHATEVER YOU DO, THE PAST WILL CATCH YOU UP!

www.alstom.com

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  Scouting the world!
- July-2001 : ALSTOM Transport

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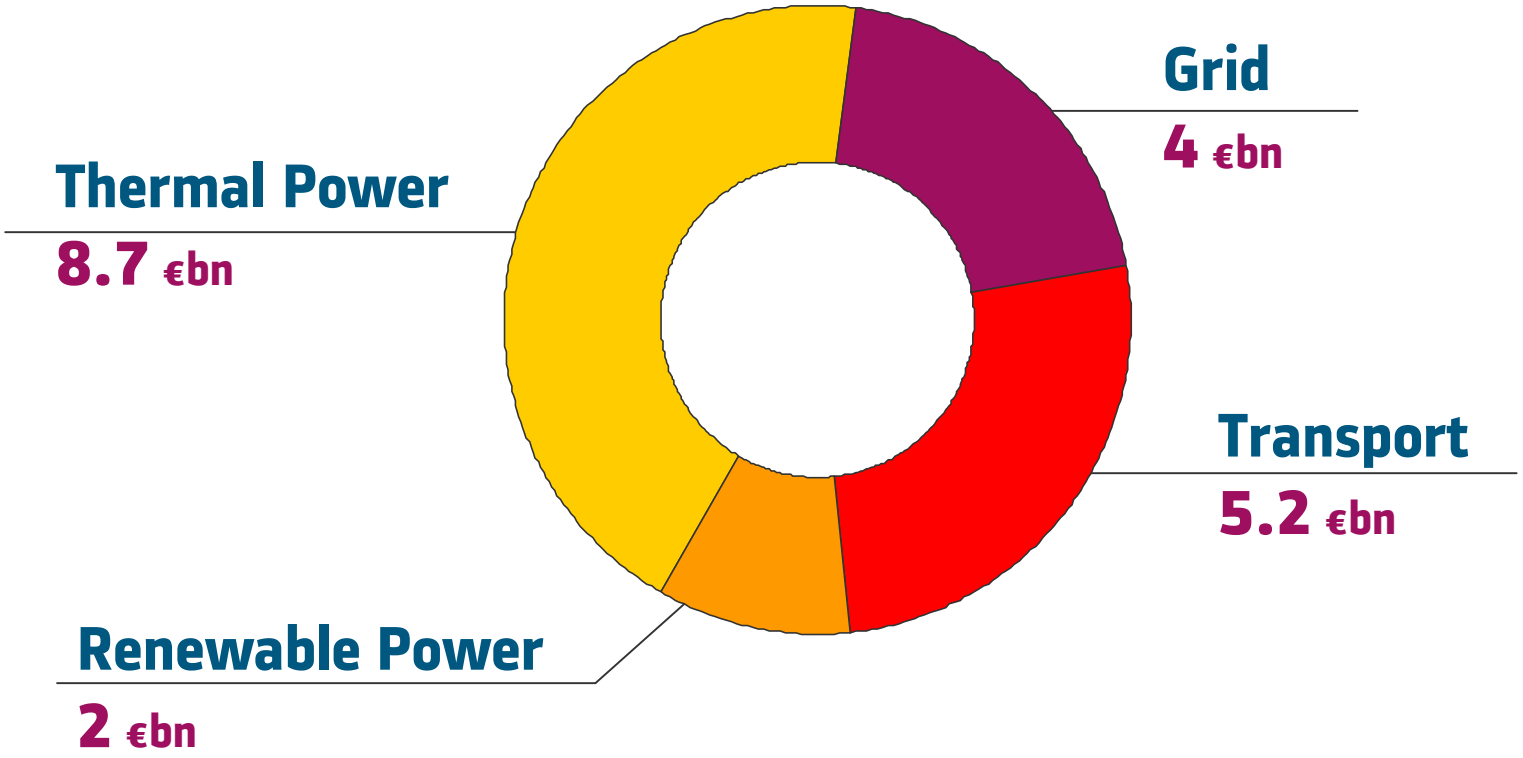
Three main activities in four sectors



Total sales 2011/12
€19.9 billion

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ALSTOM Power
Present in all markets

GAS

COAL

OIL

HYDRO

NUCLEAR (conventional island)

WIND

SOLAR

GEOTHERMAL

BIOMASS

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ALSTOM Power
World leader in power generation infrastructure

Alstom supplies major equipment for 25% of the worldwide installed power generation capacity

Global leader
in integrated
power plants

Global leader
in hydro power

Global leader
in air quality
control systems

Global leader
in services for
electricity utilities

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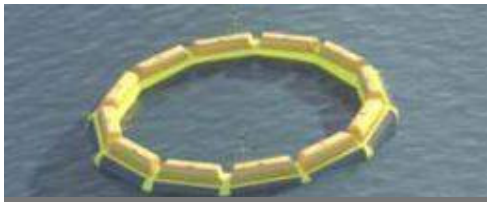
Alstom Renewable Power

WIND OFFSHORE

WIND ONSHORE

HYDRO

TIDAL



WAVE

SOLAR THERMAL

GEOTHERMAL

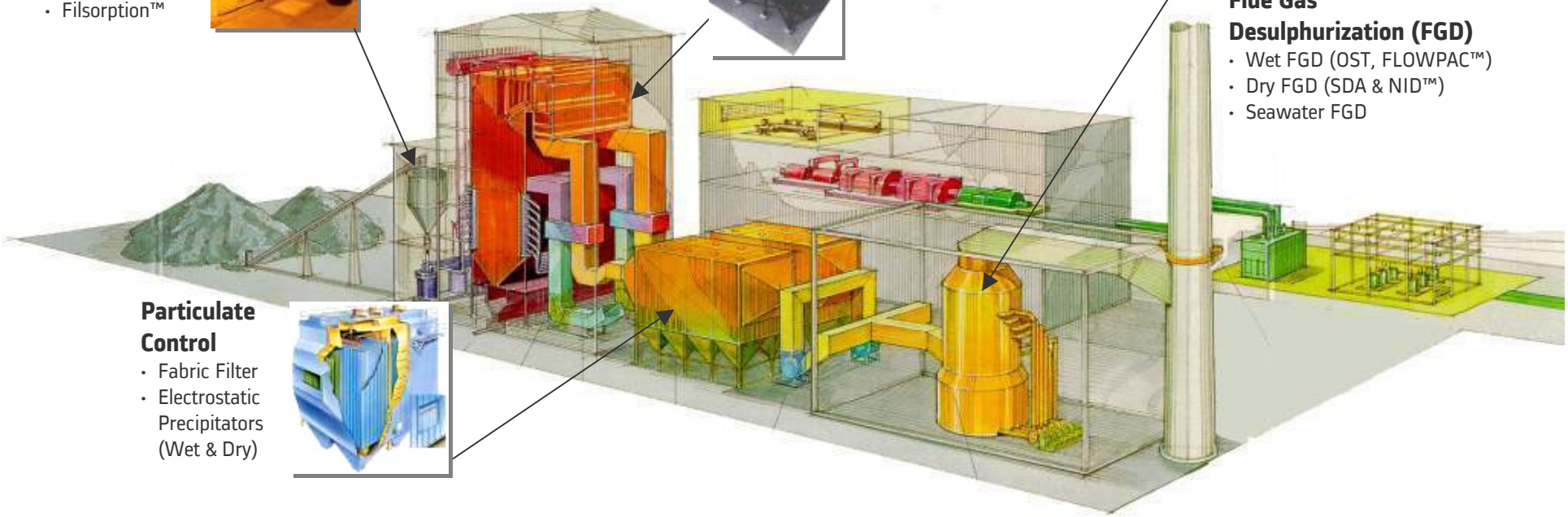
BIOMASS

Air Quality Control Systems

Mercury Control
- KNX™
- Mer-Cure™
- Filsorption™

NOx Control
- SCR Systems (Selective Catalytic Reduction)

Flue Gas Desulphurization (FGD)
- Wet FGD (OST, FLOWPAC™)
- Dry FGD (SDA & NID™)
- Seawater FGD

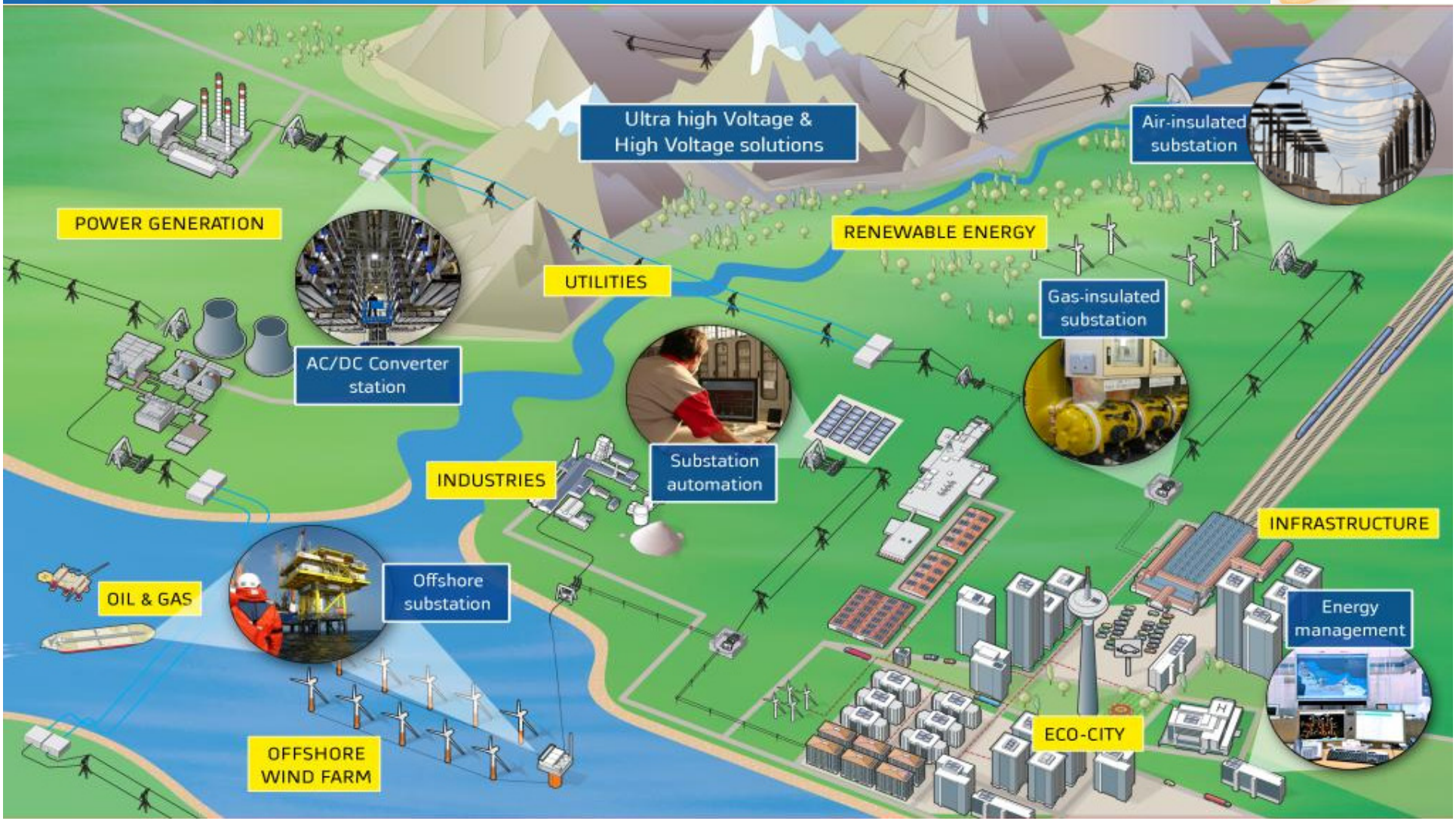


Particulate Control
- Fabric Filter
- Electrostatic Precipitators (Wet & Dry)

KNX™ (Bromine spray)
Mer-Cure™ (brominated activated carbon injection)
Filsorption™ (activated carbon injection)

OST: Open Spray Tower; SDA: Sprayer Dryer Absorber; NID: Novel Integrated Desulphurization

ALSTOM Grid
Energy landscape



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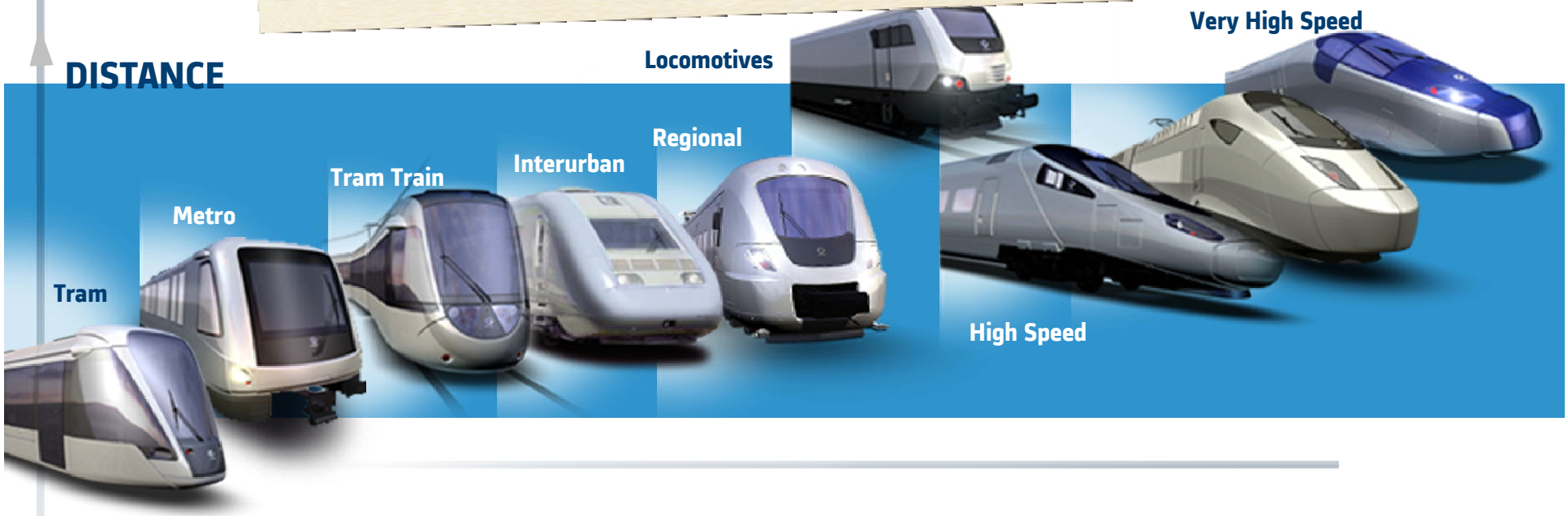
ALSTOM Transport
An extensive range of products and services

- Rolling Stock: from trams to very high speed…



TRANSPORT | ALSTOM

ALSTOM Transport
An extensive range of products and services

signalling, services & maintenance and infra.

- Infrastructure
- Signalling
- Services and Maintenance

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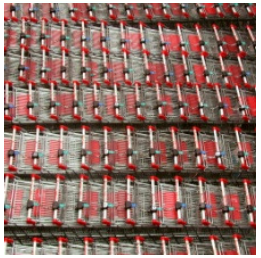
WHAT ARE THE CHALLENGES?

Our world is facing global challenges



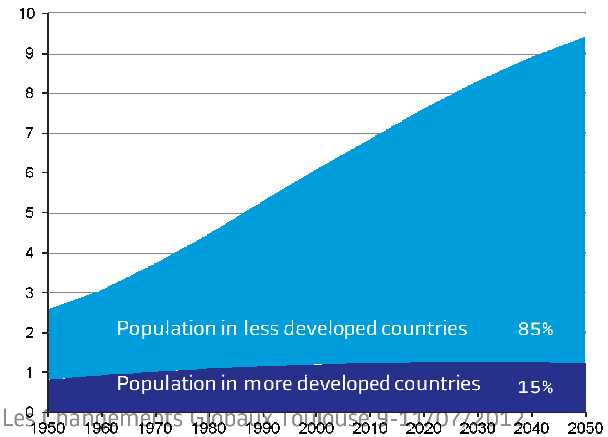
Consumption

Consumption is growing faster than population

Population Growth

Over last century, population has multiplied by 6 and it will increase by 50% more by 2050, 85% of this growth will take place in emerging countries

World population (in Billions): 1950-2050



Energy prices

About 50% of known oil resources have been consumed

Transportation

In 30 years, road traffic has multiplied by 12 and air traffic by 17

Urbanization

Urban population will increase from 50% to 70% between 2010 and 2050

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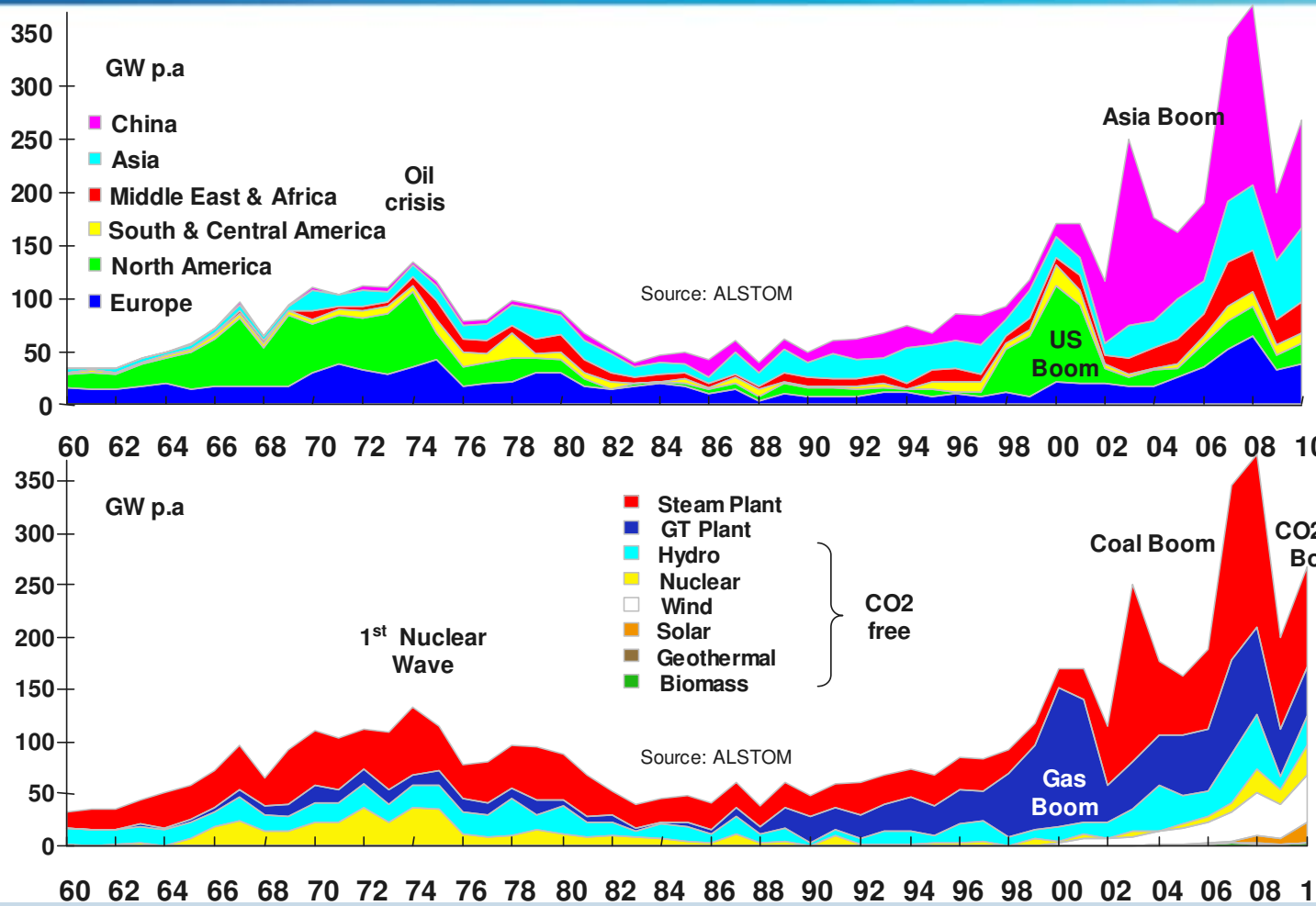
Past 50 years market development
Order for new Power Plants in GW p.a



R.E.R Wave

Replacement

Emerging

Renewable

Drivers leading to the "triple" invest. wave - **R.E.R** – are still valid ahead: **R**eplacement in old countries + Invest. in fast growing **E**merging countries + **R**enewable

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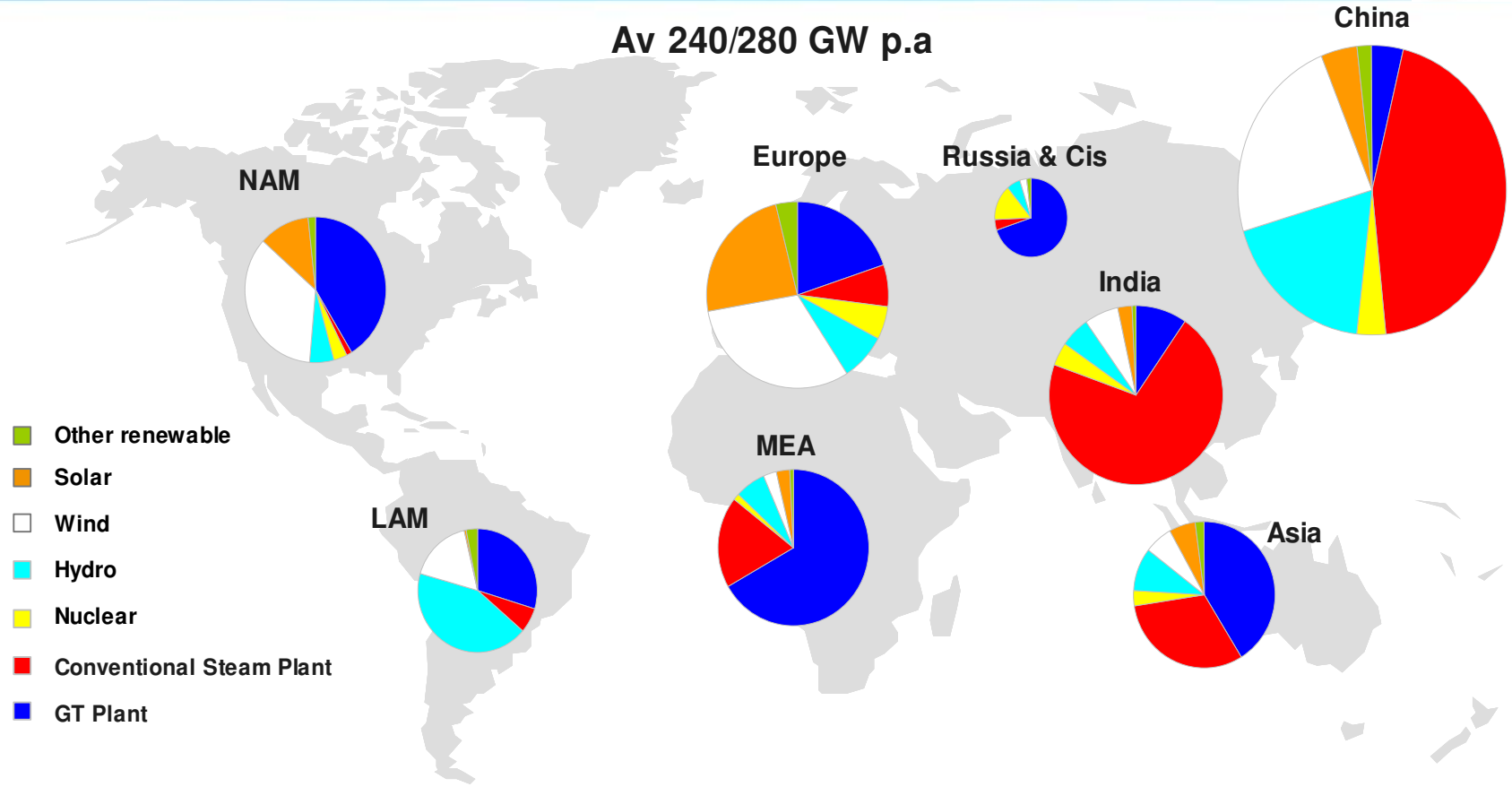
Global power market forecast – medium term
New Power Plant Orders in GW p.a



Source: ALSTOM MACA 2011

Diversified mix with growing share of Renewable all across the globe

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HOW ARE ALSTOM POWER and ALSTOM GRID PARTICIPATING TO EFFORTS TO REDUCE CO_2 EMISSION?

Alstom Power positioning since 2004

Clean Power Today®

Stabilising Power Emissions is possible ……

With solutions that are available today

1. Technology Mix

Balancing the generation portfolio by significantly increasing the share of Renewable and CO2 free technology

2. Production Efficiency and Flexibility

Efficiency is a key to emissions reduction and Flexibility to integrate renewable power.

3. Carbon Capture and Storage

With 60% of the installed base in 2030 being fossil fuels, CCS is a must.

Biomass co-firing energy: significant potential to reduce CO_2 emissions

POTENTIAL OF THE BIOMASS

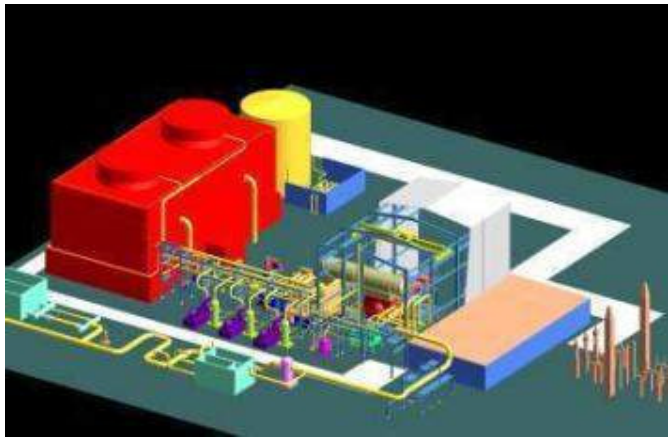
- **Up to 20 % CO_2 avoided**
- **Retrofitable** to existing coal plants
- Flexibility – **low incremental cost**
- Biomass combusted in highly efficient boilers
- DRAX- UK's largest coal fired plant – **4GW**
- 1.5 million tons/year biomass co-firing at 10% heat input
- **400 MWe of green power**
- **2 million tons/year CO_2 reduction**

Solar Thermal Technology

Geothermal energy: low in cost, low in GHG

Potential of the geothermal energy

- **Low in greenhouse gases**
- Provides a **steady, continuous**, 24/7 source of energy
- **Immune to fuel prices** fluctuations
- **Low cost** electricity generation
- Los Humeros II, Mexico, geothermal project will **reduce country's CO_2** emissions by **230,000 tonnes per year**



Ocean Energy: a clean and natural source of energy

- **Potential to 100TWh** of electricity worldwide (consumption equiv. 20 Million westerns)
- **Clean, natural, invisible**
- **No greenhouse gases**
- **100% predictable** and inexhaustible

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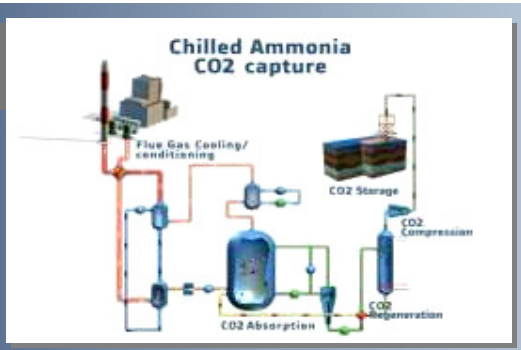
Carbon Capture & Storage (CCS) technologies range

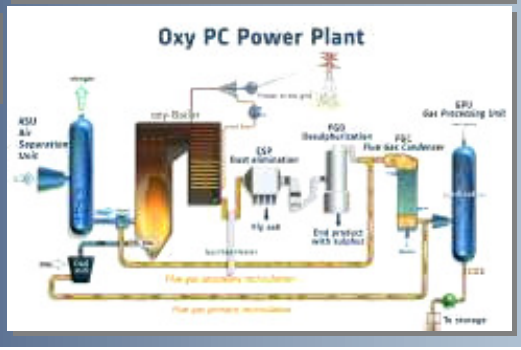
Post-combustion

- Advanced Amine
- Chilled Ammonia



Oxy-combustion

- Oxy combustion
- Chemical Looping Combustion



Integrated solutions

- **New plants**
- **Retrofit**
- **CCS ready plants**
  (storage covered with partners)

ALSTOM FOCUS

Pre-combustion

Alstom is developing several CO_2 capture technologies
to address new plants and existing installed base

CO2 Capturing Project

Over the last few years, successful pilot (5MW) and demonstration plant (54MW) operation of the chilled ammonia process : TIME TO GO TO FULL SCALE EXPERIMENT!

After a feasibility study, May 7th, 2012 Alstom entered demonstration phase at CO2 capture project (Full Scale) in Mongstad, Norway at Technology Centre Mongstad (TCM), the joint venture between Gassnova, Statoil, Shell and Sasol.

HOW IS ALSTOM TRANSPORT PARTICIPATING TO EFFORTS TO REDUCE CO_2 EMISSION?

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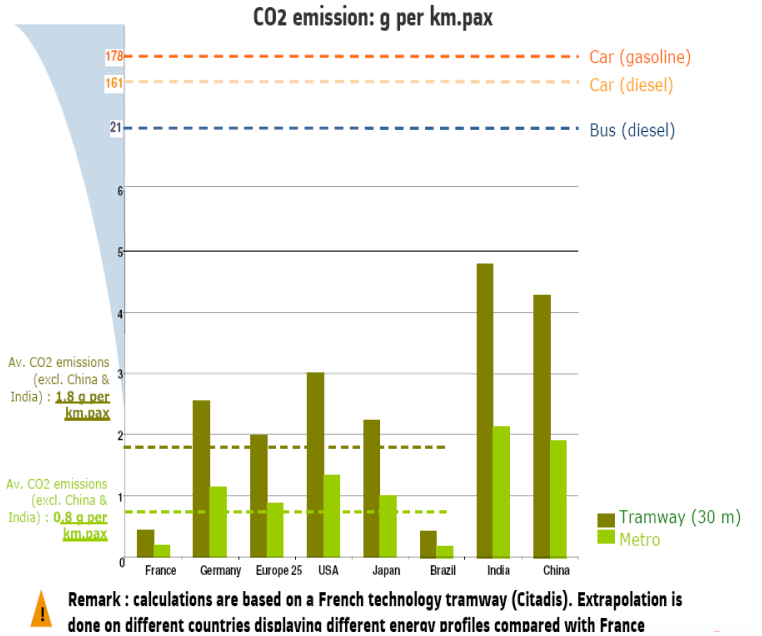
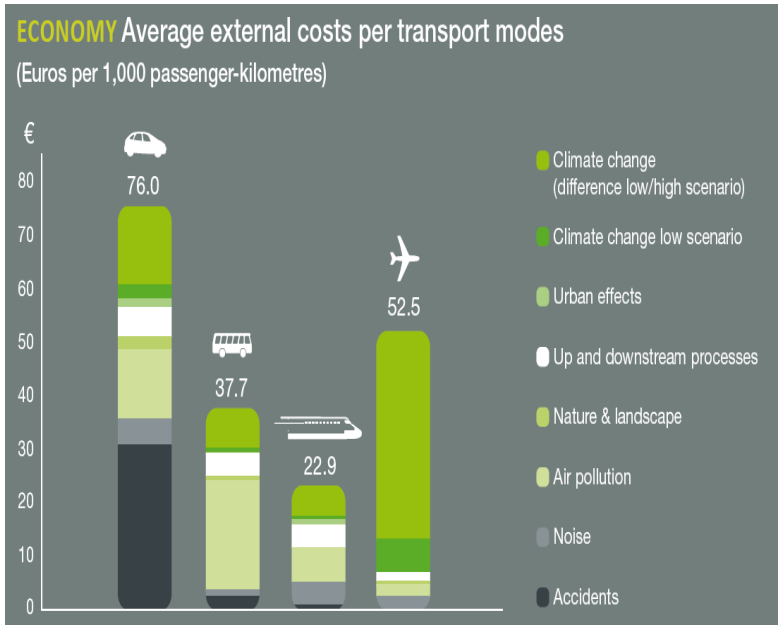
Rail advantages go beyond CO2 emissions

- **Travelling by rail is on average 3-10 times less CO2 intensive than road or air transport (depending on local electricity mix)**
- **Rail environmental benefits also include limited land use, reduction of congestion and greater safety.**



Source : Alstom – Urban trains



Source : UIC - Fast track to Sustainable Mobility

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Designed with environmental concerns in mind

AGV Automotrice Grande Vitesse

CO_2 EMISSIONS per passenger per kilometre

2,2 gr CO_2

30 gr CO_2

115 gr CO_2

153 gr CO_2

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La performance environnementale du rail : recyclabilité

- ✓ **Prise en compte de la recyclabilité des véhicules dès leur conception** :
  - Matériaux recyclables
  - Méthode d'assemblage

- ✓ **Recyclabilité théorique supérieure à 95% (tramway)**

- ✓ **Un système de tramway génère 2 fois moins de matériaux non-recyclables qu'un système bus**

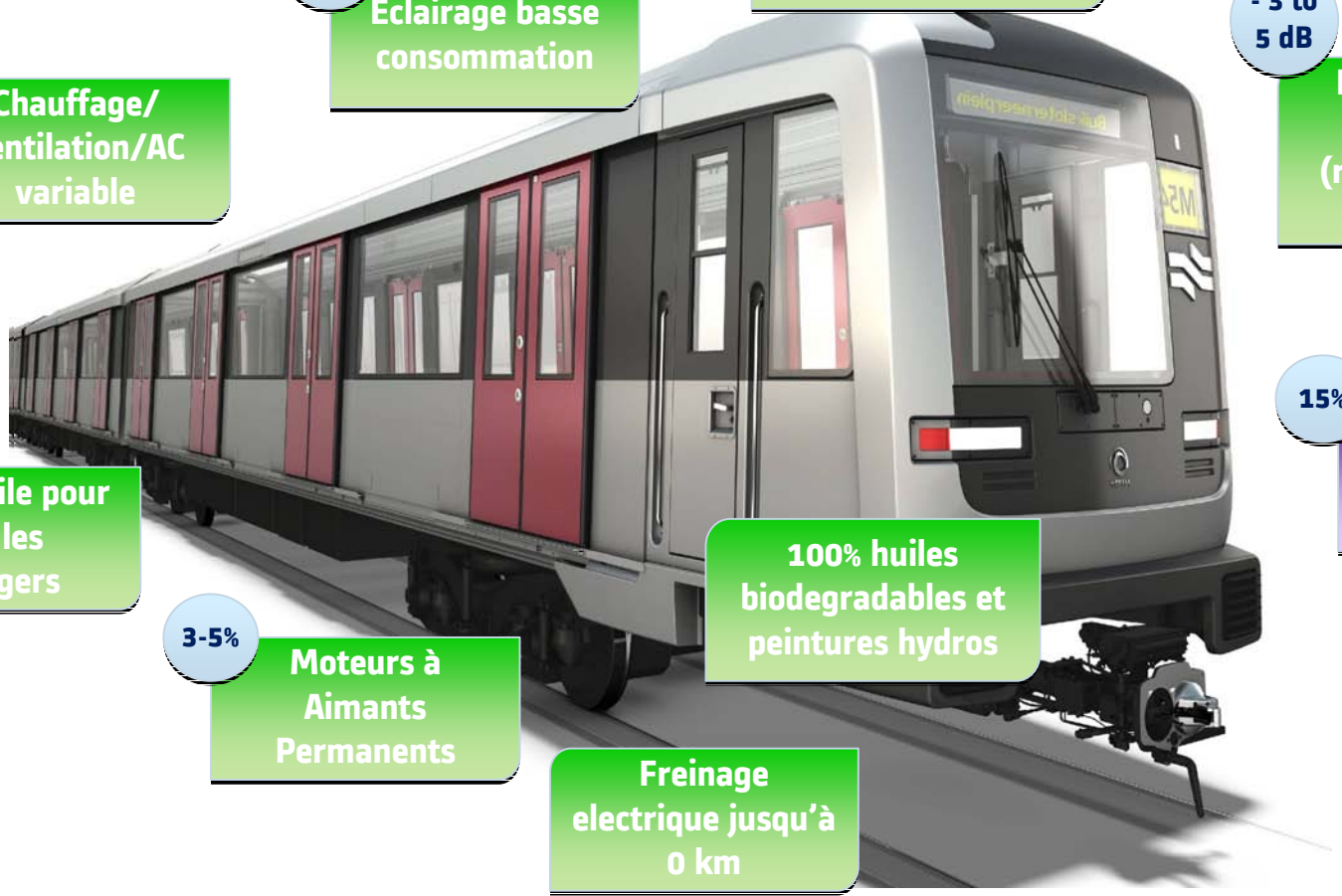
Transport urbain fer = excellente recyclabilité

La performance environnementale du rail : intégration urbaine

- ✓ **Décongestion des villes**
- ✓ **Embellissement des centres urbains**
  - Bruit
  - Design
  - Solutions sans caténaire

Transport urbain fer = la meilleure intégration urbaine

Des solutions innovantes pour le matériel roulant



10%
Recuperation de l'energie de freinage en supercapas

2%
Eclairage basse consommation

10%
Chauffage/ Ventilation/AC variable

- 3 to 5 dB
Bruit interieur et exterieur reduit (redesign moteur + HVAC)

15%
Compteurs et Outils d'Eco-Driving

Accès facile pour tous les passagers

100% huiles biodegradables et peintures hydros

3-5%
Moteurs à Aimants Permanents

Freinage electrique jusqu'à 0 km

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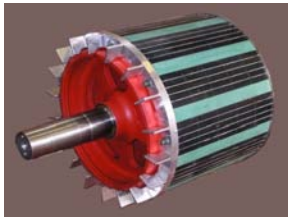
R&D and Innovation

- ✓ **Optimisation de la consommation énergétique**
  - Refroidissement naturel nouveaux équipements électriques
  - Généralisation des Moteurs à Aimants permanents
  - Optimisation des supercaps (autonomie, compatible APS, …)



- ✓ **Optimisation de la masse**
  - Utilisation de composites (métro)
  - Optimisation des composants (équipements électriques, moteurs rapides, …)

- ✓ **Emissions de bruit**
  - Refroidissement naturel nouveaux équipements électriques

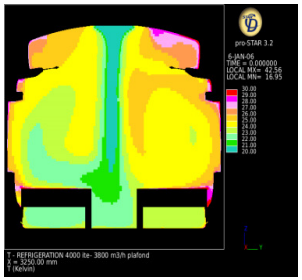
- ✓ **Synergies du système de transport avec d'autres systèmes pour réduire les impacts environnementaux : intermodalité, smart grid, eco-cities**

Optimizing energy consumption in Rolling-Stock
Focus on Energy efficient Auxiliaries

Up to 15 % saving

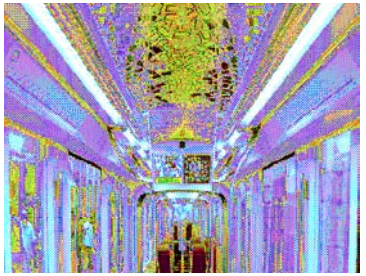
- **Variable Ventilation/Air-Conditioning (Regiolis, MI09, Singapore Metro)**

  Using information on train weight or CO2 concentration, HVAC is regulated when there are less passengers.



- **Energy-efficient lighting (Ref. Amsterdam Metro)**

  LED have a much longer life-span than traditional lighting. Sensors also allow to implement “dimming” so a constant lighting level is maintained for an optimized energy consumption.



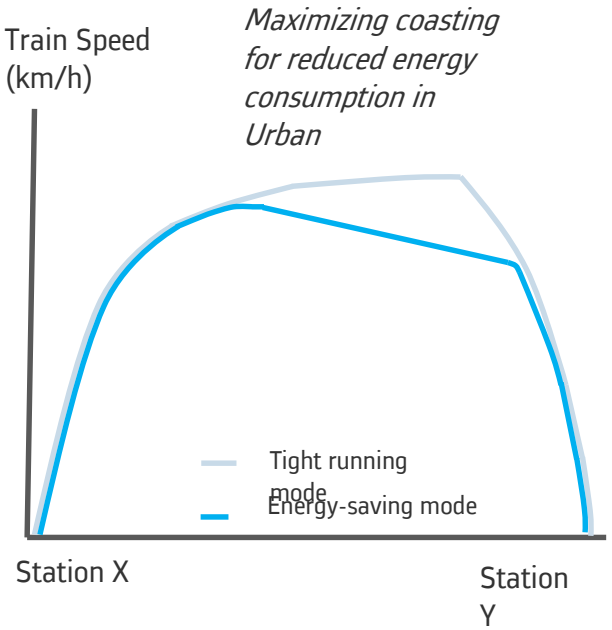
- **Energy-efficient sleeping modes**

  All efforts are made to reduce consumption of the various sleep modes. Only key equipment is kept active and consumption is minimized.

Optimizing energy consumption in Operations

- **Tracking energy consumption data**
  - Metering systems for billing (Regiolis, Prima Locos)
  - Energy tracking for traction and auxiliaries (Singapore Metro)

  => Data Analysis enables to better know key influencing factors (timetable, external temperature, occupancy rate) which allows system optimization.



10 to 20 % savings

Reduction of traction energy consumption

- Energy-saving driving modes for automatic metros (e.g.: Hong-Kong metro achieving 20% savings through system upgrade)
- Eco-driving tools for Locos and Mainlines trains

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Maximizing Braking Energy recovery
A focus on recovery and storage solutions

Video

Up to 20 % savings

- **HESOP Reversible sub-stations**
- Recover 99% braking energy that can be regenerated into the network
- Optimize infrastructure

=> Positive results with RATP on Line T1 – Pablo Picasso sub-station

- **On-board storage**
- Supercapacitors / Running without pantographs
- Best energy-saving off-peak hours

Up to 15 % savings

=> Test positive on Citadis for RATP Line 3 in operation with passenger service

Improving recyclability and integrating bio-materials

We always try to propose innovative solutions to :

- Eliminate harmful substances and materials that can be present in fluids, oils, refrigerating gases, brake pads

- Improve recyclability :
  - METROPOLIS™ and CITADIS™ trams are now at least 90% recyclable, with levels of 95% achieved in the Hamburg metro.
  - Stockholm's suburban CORADIA™ Lirex™ train holds the record for recyclability at 98%

- Maximize use of biomaterials from renewable resources such as wood, hemp and wool as thermal and/or sound insulation in trains.

Metropolis Aluminium , a show case of our smart solutions : Amsterdam

Lower energy consumption :

- 12 t/axle for a wide gauge (116.2 x 3 m)
- Open Motor
- Full electrical braking up to standstill
- 100% LED technology: saloon, cabin, head/tail lights

Passenger comfort improvement :

- Easier access and getting around on board : large doors, continuous low floors, wide gangways
- Noise reducing equipment
- 2.3 m ceiling height

Multi specialist proposal :

- Full signalling, rolling-stock, life-services proposal

AGV technology to reduce customer footprint : NTV for Italy

Lower energy consumption :

- 60t lighter than competitors' trains(200 m)
- only distributed power traction VHST with articulated architecture
- Permanent Magnet Motors

⇒ 20 % less consumption than previous generation

⇒ 10 % less consumption than other market solutions

Lower maintenance costs :

- 25 % fewer bogies than competition (bogie is 40% of maintenance cost)
- feed back of 30 years of operation
- maintenance optimization considered at design stage

⇒ 10 % cost saving for the maintenance

And further development :

- Composites (structural part of the carbody & bogie) under test on the Pegase prototype train

Modernisation of existing fleet to improve energy efficiency : MEXICO STC – MP82

Full Traction modernisation & maintenance

- 25 trains
- Plug and play concept : Traction fully refurbished and braking energy recovery function implemented

Lower energy consumption :

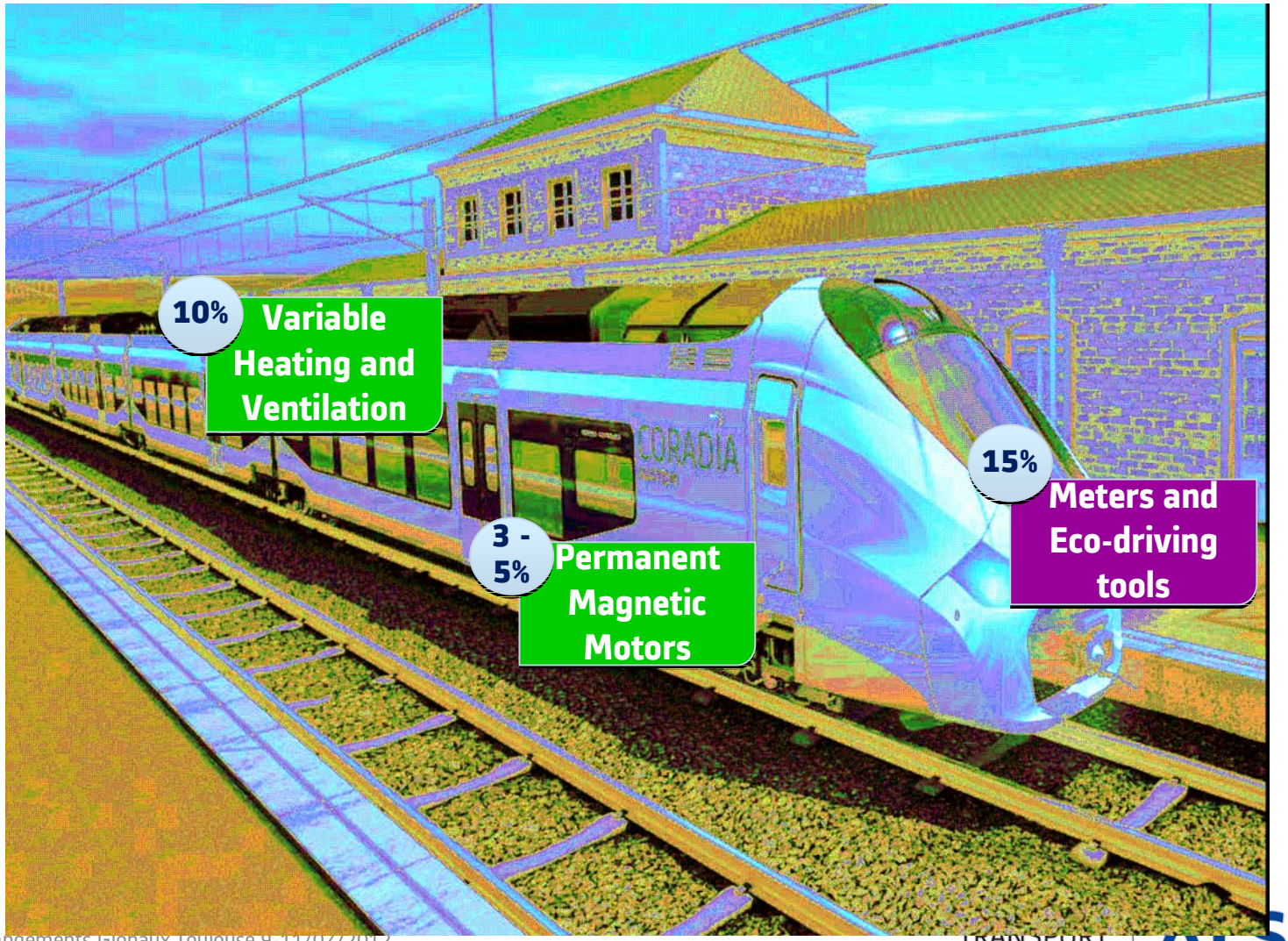
- 40% energy saving for upgraded traction drive

Additional benefits :

- Increased Availability (-10 times Service-Affecting –Failures per month)
- Reduced Maintenance Costs (90% braking consumables wheel & tires consumption

Regiolis, Sustainable Mobility for French Regions

Performance improvement



PRODUCING CLEAN ENERGY
TRANSPORTING EFFICIENTLY PEOPLE AND GOODS
IS THAT ALL?

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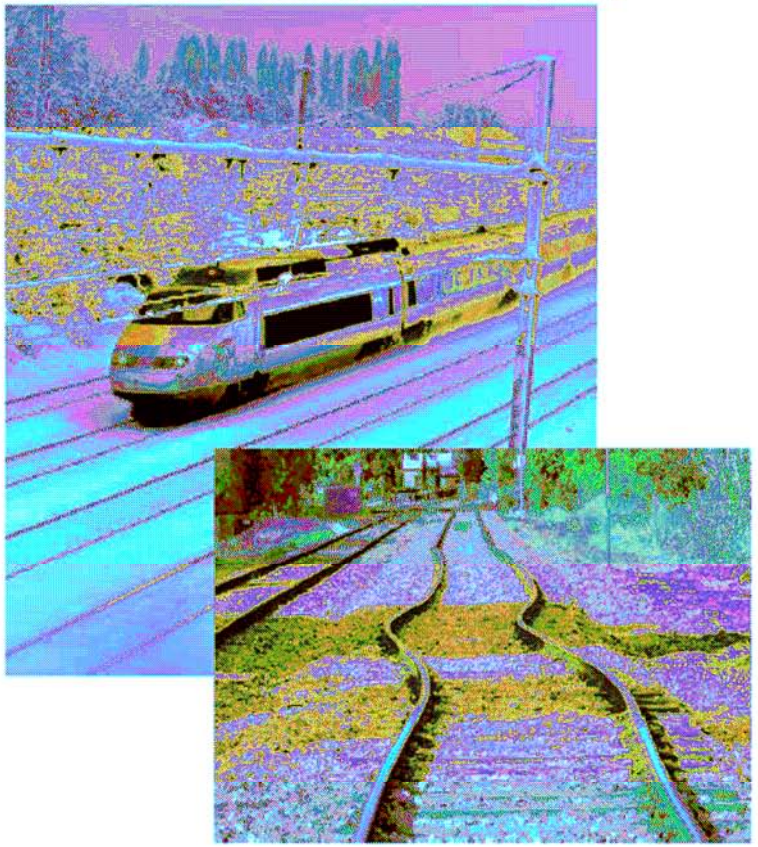
From Crisis to Climate Change Management

1910 NATURAL HAZARDS

21st c. EXTREME EVENTS



Take into account Climate Change

Heatwaves	Rain	Snow	Coldest days
Rails: overheating & torsion	Tracks, Stations, Tunnels: Flood (drainage systems)	Switchpoint: Accumulation of snow and disruption	Track: High temperatures for workers
Catenaries: overheating & distortion	Bridge: increase of stream flow, fretting wear	Trains : doors and harness equipment disruption	Embrittlement of rails
Tracks &Trains: electric and electronic equipments disruption	Landslides	Tracks &Trains: electric and electronic equipments disruption	Stations: Black ice, slippery platforms
Station & Trains: global comfort (temperature, humidity)	Tracks: Erosion, excavation	Impracticable roads: modal transfer to the train	Trains : doors and harness equipment disruption
Track: High temperatures for workers	Tracks: signals equipments disruption		Trains : broken windows
Track: Fire	Impracticable roads: modal transfer to the train		Blocked switchpoint
			Difficulties of starting up of the driving machines
			Ice-cold rails > Loss of efficiency of the braking
			Icing of catenaries

Solutions to tackle the issue

EXAMPLE: ADAPTATION TO THE RISK OF HEATWAVE

Rolling stock | Infrastructure | Station | Journey condition

RISK	IMPACTS ON SNCF	POSSIBLE ADAPTATION MEASURES
Overheating of the temperature in the passenger car	Discomfort or even uneasiness of personnel and passengers	> Having longer preparation of trains > Higher specification of the air conditioning > Improvement of ventilation (modelled on the VMC turbofan) > For vehicles travelling st moderate speed (eg. Trams), installing ventilation without air conditioning (eg. Tram in La Réunion)
Alteration or premature waring of on-board electronic systems or signalling systems along the tracks	Loss of reliability	> More frequent maintenance > Tougher specifications
Engine overheat	Loss of power of traction units	> Slow down of traffic
Vegetation drought	Fires along the tracks	> Choice of less flammable plant species > Preventive coordination with Civil security
	Presence of animals along the tracks, seaching for pasture	> Fences along the tracks > « Cow-catcher » at the front of the locomotives
Migration of certain insects to the North, due to global warming	Infestation of insects in the passenger cars (ventilation systems, sleeper trains,...)	

The Time Scale

Rolling stock | Infrastructure | Station | Journey condition

INFRASTRUCTURE	years
Creation and production of an infrastructure work	150
Electrification	80
Production and setting-up of tracks	50
Revegetation along the tracks and slopes	15

MARKETING SYSTEMS	years
Management software	15
Ticketing	10
Pricing	5
Communication campaign	0,5

TRAIN STATION	years
Creation and operation of the new station	100
Creation of platforms	50
Design of a train station	30
Reorganisation of public areas	20
Air conditioning/heating systems	15
Setting up of common services (toilets, water access)	15
Setting-up of a waiting room	10
New organisation of reception centre	5
Setting-up of Passenger information systems	2

ROLLING STOCK	years
Investment for new rolling stock (full set of coaches)	40
New traction unit	20
Comfort elements	20
Fitting of toilets	20
Repairing of existing rolling stock	15
Air conditioning/heating systems	15
Purchasing of driver assistance and consumption optimisation systems	10
Leasing operation	10

SNCF Winter Plan

SNCF WINTER PLAN

ROADMAP

- **Investments 2011: 90 M€**
  - Rolling stock: 40 M€
  - Infrastructures: 28 M€ and Additional funds
  - Information network and travellers assistance: 22 M€
- **Modernization and preparation**
  - Special winter preparation of 234 locomotives
  - 69 Snow-plows located in strategic places.
- **Switchpoint heaters:**
  - 100 heaters modernized in 2011.
  - 360 will be settled in 2011 and 2012.
- **Reduction of the speed :**
  - For TGV: 220/230 kph and may be down to 160/170 kph (instead of 300 or 320 kph).
  - For IC trains and Regional Trains (TER): 120 kph (instead of 160 and sometimes of 200 kph).

ADAPTATION STRATEGIES SHOULD BENEFIT THE MANAGEMENT OF TODAY'S EXTREME WEATHER

Climate Change is not only a technical matter

- RESEARCH & INNOVATION
- NEW MOBILITY BEHAVIOUR
- GOVERNANCE & STRATEGY
- RESILIENCE & ADAPTATION

Conclusions

ENERGY GENERATING and TRANSPORT INDUSTRIES DO HAVE SOLUTIONS TO REDUCE CO2 FOOTPRINT.

IMPORTANT R&D EFFORTS TO FURTHER REDUCE THE CO2 FOOTPRINT.

Morale

WHATEVER YOU DO, THE PAST WILL CATCH YOU UP!

www.alstom.com