"THE CHALLENGES OF SUSTAINABLE DEVELOPMENT, WHICH RAILWAYS FOR TOMORROW?"
Collaboration for Sustainable Mobility

Rod BARBER
Heidi HOPPER
Charlie YOON
Carole ESCOLAN
Sydney Trains Sustainability and Emissions Reduction Strategy

Rod BARBER
Sydney Trains Sustainability & Emissions Reduction Strategy
• Strategic Direction
• Emissions Profile
• Energy Efficiency
• Renewable Energy
• Biodiversity
• Waste & Recycling
Transport for NSW Future Transport Strategy 2056, which outlines the NSW Government’s vision of integrated, connected and liveable cities.

Transport for NSW Future Energy Strategy – Headline Actions include:
- Net Zero Emissions from heavy rail, light rail and metro electricity consumption by 2025
- Sydney Trains target for a 10% reduction in the rate of energy consumption (kWh/train km) over five years.
**NSW Climate Change Policy Framework and Net Zero Plan**

**Future Transport**

Net zero emissions by 2050. Net Zero Plan forecast to deliver 35% reduction by 2030 including transport related initiatives:

- Transition public bus fleet to zero emission buses
- Corporate fleet EV program
- Charging stations
- 30% of new NSW Gov passenger fleet electric or hybrid by 2023, at least 10% fully electric
- Yearly fuel costs and fuel economy star rating at point of sale and registration.
- Option to offset carbon emissions at registration.

Future directions to investigate that form the basis of Future Energy.

**Future Energy**

**Scope**
- Direct emissions from on-road transport, rail transport and ferries
- Indirect emissions from electricity used for on-road transport, rail transport and ferries

**Objectives**
- Implement financially sustainable actions to maximise value and position the sector to take advantage of rapidly developing technology
- Secure our transport energy needs and manage energy supply climate risk
- Support the transition of the transport sector to net zero emissions by 2050

**Focus Areas**
- Improve operational energy efficiency
- Increased uptake of zero and low emission vehicles.
- Identify and promote opportunities to shift to more efficient transport modes.
- Transition to a secure, cost-effective, low emission energy supply
- Embed low carbon considerations as part of decision making across the cluster
Our bulk electricity consumption is measured in GWh (FY19 - 869GWh), primarily driven by rolling stock and its associated movements (77%) followed by Stations (8%) and Rail Infrastructure (4%).

Our bulk consumption is demand driven and has increased year on year due to the introduction of:
- new rolling stock (traction, HVAC)
- additional running lines
- additional services (timetable updates)

Our emissions profile for FY19 was 545,750 t/CO2-e

98% of our emissions are Scope 2 - *indirect emissions from the creation of electricity*

2% of our emissions are Scope 1 due to *direct emissions from diesel powered plant and equipment*

Sydney Trains makes up 1.3% of the total use of electricity in NSW.
In Progress
i. HVAC software enhancements for A and B sets:
   – Optimising duct heater set points
   – Introducing new efficiency mode (HVAC setback) when sets are stabled
ii. HVAC hardware upgrades for A sets – reducing condenser coil size and converting fans to EC motors
iii. LED lighting upgrades – over 120 stations complete, LED trials in tunnels (e.g. City Underground), and continually exploring for more opportunities for LED deployment.
iv. Energy Data Management System EDMS – see following slide for overview

Under Investigation
i. Using inverter technology to replace energy dissipating resistors at select substations and recover braking energy
Energy Data Management System – Envizi

Inputs
- Electricity contract
- Interval data
- Monthly Electricity invoices

Energy Data Management System

Outputs
- Validated bills
- Energy performance & carbon emissions tracking
- Greenhouse emissions reports
- One source of truth
- Consumption data insights
- Identified savings
- Cost tracking
• Sydney Trains now has 860kW of PV installed across 27 locations

• Business case development is underway for the installation of large PV systems at:
  – Mortdale Train Maintenance Centre – 1MW
  – Clyde Warehouse and Clyde Hub Office – 451kW

• TfNSW and Sydney Trains have been working collaboratively to assess and deliver PV systems across TAP and car-park projects.

• A recent example is the new PV system with battery storage installed at Rooty Hill station commuter car park.
• Grey-Headed Flying-Fox (GHFF) are listed threatened species both in NSW and Nationally.

• Two Camps occur on land adjacent to the rail corridor, the camps support up to 10,000 GHFF at Clyde and 20,000 Wolli Creek (which is a nationally significant camp).

• Flying fox camps are becoming more common in populated areas due to habitat loss and this regularly results in conflicts with residents, Wolli Creek and Clyde do not suffer with this issue making them important camps to maintain.

• Regular vegetation management is required to maintain these camps to prevent habitat loss and the subsequent shift of GHFF closer to residents.

• Vegetation management must be undertaken sensitively to avoid disrupting the bats breeding cycle.
Chullora Ballast Recycling Centre

• The BRC’s core function is the cost effective management of spoil and spent ballast that has been generated by Sydney Trains' trackwork programme.

• This is achieved through recycling to meet the requirements of EPA Resource Recovery Orders and Exemptions into reusable products for rail-related infrastructure projects.

• The BRC processes approximately 100,000 tonnes per annum, with a rate diversion from landfill of over 90%.
Overview: Emissions Reductions & Energy Procurement Strategy

**Ongoing Management**
Continuous management of electricity category to ensure a never ending cycle of continuous improvement and taking opportunities as the market presents them. Moving away from contract end date driving procurement.

**Electricity Hedging Program**
Providing the ability to hedge in the market up to 3 years out when the physical electricity contract is in its latter stages.

**Develop internal capability**
Develop internal capability in terms of analysis, reporting, strategy implementation and governance to allow the ongoing management of more complex models to be effective and deliver best overall value for money.

**Category Management**

**Best Overall value for money**
Providing energy solutions that provide the optimum mix that balances risk versus reward.

**Carrying offsets**
A strategy to assist the business with ascertaining the to understand the costs and the best pathway associated with achieving the offsetting of 100% of electricity related carbon emissions.

**React to changing market and internal drivers**
Providing a framework both contractually and from a governance and capability perspective to allow ST to react to an ever changing market and internal drivers to manage energy price risk.

**Electricity data**
Implement the EDMS system to create a platform where all electricity related data is stored, validated, analysed and utilised by all stakeholders. Creating a single source of truth.

**Electricity Embedded Customer Network**
Efficient embedded network, operating on a fully outsourced basis with a program to upgrade metering to automated meter reading.

**Reduce Consumption**
Ongoing initiatives to reduce energy consumption across the network, heavily focussed on train traction operations (HVAC, lighting, stabling mode).

**Flexibility In Procurement models**
Ability to change the mix of commercial models throughout contract term to suit market conditions, including optional extensions and increasing renewables percentages if required.
Sustainability Initiatives in Irish Rail

Heidi HOPPER
Sustainability Initiatives

Heidi Hopper Duffy
Railway Undertaking
Environmental Officer

larnrón Éireann
Irish Rail
Agenda

• IE Sustainability Policy & Strategy
• Fleet Modifications – Electrification and Hybridization
• Train Maintenance – Hazardous Waste Minimisation
• Packaging Waste Upcycling – Wood Waste Upcycling Projects
• Centralised Contracts - Single Use Plastics Project
• Health & Wellbeing & Environment Initiatives
• Swap Shops – Reuse within Industry
• Track Infrastructure – Reuse within Industry
• Sustainability Integration – Challenges for Initiatives
Strategy Document issued by IÉ Board in 2020

**Economic:** Provide a high-quality transport service that stimulates economic activity, tackles congestion and connects communities, businesses and organisations.

**Social:** Foster a diverse and inclusive society by ensuring access and opportunity for all.

**Environment:** Work with partners to lead the transition to a low emissions transport network; ensure the protection of natural capital and infrastructure at risk of climate-related disruption; and minimise our impact to the environment through circular economy initiatives.
Electrification

- Electrification is the main focus for Irish Rail
- Currently only 1 line electrified in Dublin County
- Expansion on commuter branches in Dublin planned for completion by 2028
- Future electrification of mainlines to Belfast, Sligo, Galway, Limerick, Tralee and Cork (no dates set yet)
Hybridization

- Bridging the gap - hybrid power packs
  - Stage 1 – ZF transmission on trial now
  - Stage 2 – Engine & E-machine trial to start in Aug 2021
  - Stage 3 – Hybrid drive trial (battery pack) – Aug 2022
  - Fleet Roll Out – commencing Jan 2025
    - 60 cars per year
    - 4-5 year programme
  - Savings per year:
    - 33% reduction in fuel consumption (7.6 million litres)
    - 20,000 tonnes of CO₂
    - 860 tonnes of NOx
    - 45 tonnes of PM
    - 21 dB noise reduction
### Coolant Recycling
- Waste coolant shipped overseas for disposal (large carbon footprint).
- 90% of the time, coolant is ok for reuse, might need water top-up
- **Initiative**: collect coolant into mobile units, test and put back into engine.

![Image](image1.png)

**23 Tonnes** of waste coolant saved annually  
Significant reduction in life cycle impact.  
€26,000 saved annually

### Used Oil Filters
- Filters shipped overseas for disposal (large carbon footprint).
- **Initiative**: crush filters, collect oil for reuse as heating oil, recycle metal, dispose of residual paper as hazardous waste (far less weight)

![Image](image2.png)

**13 tonnes** of waste filters saved annually  
Significant reduction in life cycle impact.  
€9,000 saved annually
Wood Waste Upcycling Projects
Local Community Network

Swords Educate Together Sensory Garden for Autism

New Train-themed Library in Hansfield National School
Centralised Contracts: Single Use Plastics Project

- Single Use Plastics Ban implemented in March 2019
- Contacted all central vendors – positive responses
- Big wins:
  - Cleaning products sachets – *91% reduction in plastic*, 204kg CO$_2$e saved annually, better cleaning
  - Paper only tickets – *54% reduction in cost*, 430kg of plastic, 5,315 CO$_2$e saved annually, no validation issues (eventual move toward mobile devices)

Bin Liners ➔ Biodegradable option

Water Dispensers ➔ switch to mains fed

Non reusable cleaning product containers ➔ Sachet system with reusable bottles

Trilaminated Tickets ➔ Paper only
Health & Wellbeing & Environment Initiatives

• Cycling/Walking Promotions
  • Cycle to Work Scheme – deduction from gross pay cheque (before tax) approx. 50% savings
  • Reviewing the provision of support facilities provisions (lockers, showers, etc.)

• Promoting Gardening
  • Promotion of healthy eating, and lower carbon footprint
  • Station vegetable gardens – partnering with local support groups, pride in stations
  • Gardening Webinar – home gardens

• Men’s Sheds
  • Materials provided (wood, metal) - upcycling
  • Mental health of retirees
Swap Shops – Reuse within Industry
Reuse within Industry – Track Infrastructure

• Approximately 20% of redundant concrete sleepers are reused on branch lines
• 18,000 sleepers reused as access roads in 2020
• 7,000 Tonnes of Metal Waste recovered for recycling in 2020
Challenges for Initiatives

Pushing an open door - if the cost savings justify the change!

Reluctant to change if payback is long-term – hybrids and electrification just around the corner... but still a decade to go!

Environmental Management Team limited (2 people for 5,000 staff nationwide) – still seen as secondary support. An integrated management system with a focus on sustainability is needed.
Thank you!
Korail’s Sustainability management to connect People, World, Future
Connecting the People, World, and the Future

Railroad of the Republic of Korea

KORAIL
**Facilities and Transportation Performance (As of December 31, 2019)**

<table>
<thead>
<tr>
<th>Trains</th>
<th>Length of Railway Lines</th>
<th>Average Transported Volume per Day</th>
<th>Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>16,180 cars</td>
<td>- KTX 1,530 cars</td>
<td>- Railway length 4,087.1 km (99 lines in total)</td>
<td>698 stations</td>
</tr>
<tr>
<td>- Locomotive 429 cars</td>
<td>- Double-track railway 2,573.7 km (63.1%)</td>
<td>- Passengers 3,604 million</td>
<td>- 346 local stations</td>
</tr>
<tr>
<td>- Passenger car 821 cars</td>
<td>- Electrified track length 2,990.1 km (72.1%)</td>
<td>- Freight 80,000 tons</td>
<td>- 306 whistle stop stations</td>
</tr>
<tr>
<td>- Diesel car 2913 cars</td>
<td></td>
<td></td>
<td>- 2 yards</td>
</tr>
<tr>
<td>- Freight car 10,359 cars</td>
<td></td>
<td></td>
<td>- 44 signal stations and signal stations</td>
</tr>
<tr>
<td>- Generator car 113 cars</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How to fight against COVID19

<table>
<thead>
<tr>
<th>Establishing thorough quarantine system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disinfecting railway stations</td>
</tr>
<tr>
<td>Two or more times daily</td>
</tr>
<tr>
<td>Quarantine Train</td>
</tr>
<tr>
<td>4.5 times per day</td>
</tr>
<tr>
<td>Thermal Imaging Camera</td>
</tr>
<tr>
<td>Placing Hand sanitizers, Antibacterial film</td>
</tr>
<tr>
<td>Separating traffic lines for passengers boarding and arriving</td>
</tr>
</tbody>
</table>
K-Quarantine Thanks to YOU
KORAIL’s Sustainability Management

<table>
<thead>
<tr>
<th>Sustainability Vision and Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision: Korean Railway Connecting the People, the World and the Future</td>
</tr>
</tbody>
</table>

**Strategies**

<table>
<thead>
<tr>
<th>Trust</th>
<th>Responsibility</th>
<th>Ardor</th>
<th>Innovation</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growing into a reliable corporation based on its righteous management by spreading ethical culture throughout the corporation and its employees, expanding anti-corruption and integrity culture and internalizing ethics.</td>
<td>Completing its responsibility as a public institution by conducting social contribution activities specialized in the railway, making shared growth with local communities, providing technical support for SMEs and actively pursuing shared growth policies.</td>
<td>Laying the groundwork for employees to concentrate all their capabilities on the development of the corporation by achieving non-discriminatory HR policies such as an open recruitment culture and provision of equal opportunities, taking care of grievances and health care of employees to enhance their satisfaction.</td>
<td>Growing into the world’s best railway corporation by improving human and physical services and safety matters and continuously innovating various policies for customers.</td>
<td>Enhancing the status of KORAIL as a green railway by implementing eco-friendly policies, reducing greenhouse gases, realizing low-carbon green growth and preventing various kinds of environmental contamination.</td>
</tr>
</tbody>
</table>
Sustainable development GOALS
Environment Management

- Green-house Gas
- Noise & Vibration
- Air Quality Control
- Energy
Green-house Gas Reduction

(tCO2-eq, %)

Graph showing emission reduction goals and rates.
Energy Usage Results

(tCO2-eq)

- Diesel train: 3990; 13%
- Subway train: 21834; 72%
- Living: 4378; 14%
- Heating & Airconditioning: 289; 1%
- car for biz.: 83; 0%
## Air Quality

<table>
<thead>
<tr>
<th>Stations</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under</td>
<td>Ground</td>
<td>Under</td>
</tr>
<tr>
<td>Fine dust</td>
<td>150mg/m²</td>
<td>69</td>
<td>61</td>
</tr>
<tr>
<td>CO₂</td>
<td>1000ppm</td>
<td>523</td>
<td>488</td>
</tr>
<tr>
<td>CO</td>
<td>10ppm</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>100mg/m²</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trains</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine dust</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subway</td>
<td>200mg/m²</td>
<td>66</td>
<td>87</td>
</tr>
<tr>
<td>train</td>
<td>150mg/m²</td>
<td>55</td>
<td>59</td>
</tr>
<tr>
<td>CO₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subway</td>
<td>2000ppm</td>
<td>1048</td>
<td>1231</td>
</tr>
<tr>
<td>train</td>
<td>2000ppm</td>
<td>1225</td>
<td>1170</td>
</tr>
</tbody>
</table>
# Noise and Vibration

<table>
<thead>
<tr>
<th>Noise</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>70</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Night</td>
<td>60</td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td><strong>Manufacturing Area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>75</td>
<td>54</td>
<td>56</td>
</tr>
<tr>
<td>Night</td>
<td>65</td>
<td>54</td>
<td>56</td>
</tr>
</tbody>
</table>

dB(A) average
# Investment for Environment

(Million KRW)

<table>
<thead>
<tr>
<th>Investment amount</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>278</td>
<td>270</td>
<td>177</td>
</tr>
<tr>
<td>Air</td>
<td>23</td>
<td>114</td>
<td>82</td>
</tr>
<tr>
<td>Soil</td>
<td>330</td>
<td>966</td>
<td>1265</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>180</td>
<td>412</td>
<td>13</td>
</tr>
<tr>
<td>Sum</td>
<td>811</td>
<td>1762</td>
<td>1537</td>
</tr>
</tbody>
</table>
For more Information

• KORAIL Sustainability Management Annual Report

• KORAIL Environment Management Annual Report

• Charlie Yoon
  • [Byongchulyoon@gmail.com](mailto:Byongchulyoon@gmail.com)
Sustainable energy policy at SNCF Voyageurs

Carole ESCOLAN
SUSTAINABLE ENERGY & CARBON POLICY AT SNCF VOYAGEURS

« The first leverage for environmental impact is to gain market share on the most polluting modes »
SNCF ORGANISATIONAL CHART

ÉTAT FRANÇAIS

100 %
Actions incesibles

SNCF SA
(Holding)

100 %
incesibles

RÉSEAU SA
Gestion du réseau ferroviaire

100 %
incesibles

VOYAGEURS SA
Transport de voyageurs

70 %

gois

KEOIS
Leader mondial du mass transit

100 %

GEOLOGI
Fret multimodal et fret forwarding

100 %

FRET FERROVIAIRE
Activités de fret ferroviaire dont SNCF Fret

100 %

GARES &
CONNEXIONS SA
Gestion des gares

62 %

62%

FILIALE

55 %

55%

FILIALE

LES AUTRES FILIALES DU GROUPE NE SONT PAS MENTIONNÉES DANS CET ORGANIGRAMME
ENERGY IS A MAJOR ISSUE FOR SNCF GROUP

<table>
<thead>
<tr>
<th>Energy Consumption</th>
<th>Energy Bill</th>
<th>Fuel Consumption</th>
<th>Real Estate (GPF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17,9 TWh</td>
<td>1,4 Bn €</td>
<td>620 M litres</td>
<td>12,5 M m²</td>
</tr>
<tr>
<td>Energy bill (34% rail, 62% road vehicles) 4% service vehicles;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Energies**
  - 53% Electricity
  - 34% Gasoil
  - 10% Gas

- **Usages**
  - 59% rail (trains, metros, tramways, etc)
  - 24% road (passengers, freight, vehicles in service)
  - 17% buildings (stations, industrial, offices)

- **Emissions SNCF Group**
  - 3,1 M t CO₂eq

- **SNCF Group**
  - 1st industrial consumer of electricity in France
  - 2246 thermal Engines (GPF) (dont 43% autorails / automoteurs bi-mode, 36% locomotives gazole, 21% locotracteurs)

- **SNCF Group**
  - 100 000 ICF Habitat housing

- **Emissions**
  - 620 M litres fuel consumption
  - 3,1 M t CO₂eq emissions

- **SNCF Group**
  - 16 500 km Electrified lines
  - 21 650 Buses & cars Keolis

- **SNCF Group**
  - 100 000 Real estate (GPF)

- **SNCF Group**
  - 17,9 TWh Energy consumption
SNCF VOYAGEURS: EMISSIONS MAINLY COMING FROM DIESEL TRACTION, THOUGH ACCOUNTING FOR A MODERATE SHARE OF COSTS AND TRAFFIC

Diesel accounts for 16% of trains.km, 22% of expenditures but 55% of Co2eq emissions

<table>
<thead>
<tr>
<th>CO2eq Emissions SNCF Voyageurs</th>
<th>Répartition des trains.km</th>
<th>368 M train.km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traction électrique</td>
<td>84% du trafic</td>
</tr>
<tr>
<td></td>
<td>Traction diesel</td>
<td>16% du trafic</td>
</tr>
<tr>
<td>Répartition des coûts énergétiques</td>
<td>425 M€</td>
<td></td>
</tr>
<tr>
<td>Traction électrique</td>
<td>76% des €</td>
<td></td>
</tr>
<tr>
<td>Traction diesel</td>
<td>22% des €</td>
<td></td>
</tr>
<tr>
<td>Répartition des émissions de tCO2eq</td>
<td>646 tCO2eq</td>
<td></td>
</tr>
<tr>
<td>Traction électrique</td>
<td>45% des tCO2eq</td>
<td></td>
</tr>
<tr>
<td>Traction diesel</td>
<td>55% des tCO2eq</td>
<td></td>
</tr>
</tbody>
</table>

Figures: 2019
## DIFFERENT SITUATIONS BETWEEN ACTIVITIES

<table>
<thead>
<tr>
<th>ENERGYMIX</th>
<th>CO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix 100% electricity based</td>
<td>1.7 grCO2/p.km</td>
</tr>
<tr>
<td>High passenger traffic</td>
<td>4.1 grCO2/p.km</td>
</tr>
<tr>
<td>Excellent environment performance</td>
<td></td>
</tr>
<tr>
<td>Energy mix including diesel:</td>
<td></td>
</tr>
<tr>
<td>➢ TER (~50%)</td>
<td>24.8 grCO2/p.km</td>
</tr>
<tr>
<td>➢ IC (~14%)</td>
<td>5.3 grCO2/p.km</td>
</tr>
<tr>
<td>Rather low average occupation rate</td>
<td></td>
</tr>
<tr>
<td>Rather good environmental performance compared to other means of transport but less excellent</td>
<td></td>
</tr>
</tbody>
</table>
TARGETS FOR 2030

Modal share
- Between 13 and 15% of modal share for passenger transport;
- 18% of modal share for freight transport;

CO2eq emissions
- Carbon neutrality by 2050
- 30% reduction on transport activities by 2030 (vs. 2015 – scopes 1 & 2);
- 50% reduction on buildings emissions by 2030 (vs. 2015 – scopes 1 & 2);
- 3.7 million tons of CO2eq avoided per billion€ of investment;

Energy targets
- Renewable Energies: increased share of renewables in the energy mix from 3% in 2022 to 20% in 2026;
- Phasing out of Fossil fuels by 2035 (TER)
AN ENERGY-CARBON STRATEGY LAUNCHED IN 2016 AT SNCF VOYAGEURS

Our Responsible Energy strategy, reflects SNCF VOYAGEURS ‘desire to be proactive and exemplary on the sustainable mobility market, in a logic of economic performance and differentiation from its competitors.

3 AXES

**Axe 1 - Controlling our energy bill** (purchasing, counting, energy savings)

**Axe 2 - Decarbonising our assets**
Get out of fossil fuels

**Axe 3 - Greening our electricity**
Through the development of electricity based on renewables

3 TARGETS FOR 2015-2025

- **Energy efficiency and frugality**: decrease by 20% of our energy intensity per passenger.km
- **Innovation in favour of decarbonation by reducing the use of fossil fuels**
- **Greening half of the electricity used for traction**
<table>
<thead>
<tr>
<th>ECO-DRIVING</th>
<th>ELECTRICITY METERING SYSTEMS</th>
<th>ROLLING STOCK</th>
</tr>
</thead>
</table>
| Economic / ecological driving assistance on the drivers’ iPad  
  - Major challenge: average gain of 10% in consumption when circulating + improvement of trains’ regularity  
  - Target: 100% drivers equipped in 2022 | Generalization of on-board electricity meters by the end of 2025 as well as dedicated information systems  
  - 27% of the electric fleet to date | Less energy consuming rolling stock  
  - Energy saving actions on:  
    - resistance to movement,  
    - traction / comfort auxiliaries (air conditioning / heating management, LED lighting, etc.)  
  - Opportunities:  
    - TGV-M,  
    - Chambord Project (AGC mid-life operation, etc.),  
    - RER NG,  
    - AMLD |

| ECO-PARKING | | |
|-------------| | |
| Energy consumption reduction during commercial stops  
  - Stationary trains can consume from 5 to 30% of their global energy consumption  
  - A change of habits is necessary  
  - 1st goal of « PLANETER » or TRANSILIEN program: reduction by 1/3rd of stationary trains’ consumption | | |

https://twitter.com/i/status/1384031507975589904
FOCUS ON TGV M

Maximise the circularity of our rolling stock

Recycling rate of TGV M*: 97%

ECO CONCEPTION IN FRANCE

MID- LIFE RENOVATION AFTER 15/20 YEARS

DISMANTLING & END OF LIFE RECYCLING IN FRANCE

• Energy consumption reduced by 20%, by integrating ultra-capacity trainsets: 740 people transported vs 556

• Energy from braking is stored on board and returned to other trains which use this energy to run => ~10% of a train’s energy is returned.

• CO₂ sensors in coaches in order to deduce the number of passengers on board, therefore to regulate the air conditioning or the heating accordingly.

• Mid-life renovation planned to be carried out after 15/20 years of operation, to extend rolling stock’s lifetime and therefore avoid the use of new resources.

*Recycling rate of current TGVs: 92%
B100: made of 100% biofuel from the rapeseed sector:
- French production covers 1.1 M hectares cultivated in 2020.
- It provides simultaneously proteins for breeding (oil cakes), edible oil and biofuel.

- Experiments in commercial service Paris / Granville (Normandy) and Paris / Laon (Hauts de France) from April 2021
- Discussion underway with other Regions showing interest

- Compatibility with existing thermal equipment without costly modification of the engines
- Some limitations remain:
  ✓ adaptations necessary within service stations;
  ✓ partnerships to be built with biofuel producers,
  ✓ financing of additional costs

1/3rd passengers carbon footprint
Avoid 500 000 tons of CO₂ in France through modal shift from cars to trains
60% reduction in CO₂ emissions and in all air pollutants (Regiolis)

- 100 000 tons of CO₂/year by 2025

AXE 2 – DECARBONATION – PHASING OUT OF FOSSIL FUELS
IN THE SHORT-TERM: BIOFUEL
DEVELOPMENT OF NEW TECHNOLOGIES: HYDROGEN

- First order to Alstom of 12 dual-mode trainsets (+ 2 optional), using electricity from overhead lines or electricity produced from hydrogen.
- Order placed on behalf of Bourgogne-Franche-Comté, Auvergne Rhône-Alpes, Grand Est and Occitanie regions, where these trains will run on partially electrified tracks. Composed of 4 coaches, they will replace some trains running on electricity and diesel currently in use.
- Regiolis have fuel cells powered by hydrogen, stored on the roof, as well as batteries placed under the train.
- Regiolis will go up to 600km, carry 220 passengers at 160 km/h.

- For the 4 regions, hydrogen seen as part of a global ecosystem that could supply not only trains, but also buses, trucks, boats, etc.
- The total project amounts to 231 million €.
- The 1st test runs are scheduled for late 2023 - early 2024, with a first commercial run planned for late 2025.
AXE 2 – DECARBONATION – PHASING OUT OF FOSSIL FUELS

BATTERY TRAINS
- Project with Bombardier and 5 regions to transform a diesel AGC train into a battery train.
- Diesel engines are replaced by lithium batteries which recover braking energy (previously lost as heat), for the traction of the train.
- Few transformations needed: rail infrastructure remains unchanged, trains already in circulation can be modified during their mid-life operation.
- 1 TER will be transformed into hybrid in 2021 and in service in 2022/2023.
- Total investment of 38M€

HYBRID TRAINS
- Project with Alstom and 4 regions to develop a hybrid train.
- Half of diesel engines are replaced by lithium batteries which recover braking energy (previously lost as heat), for the traction of the train.
- Enables 20% reduction in the energy consumed and in greenhouse gas emissions, reduction in use and maintenance costs.

BIOGAS TRAINS
- SNCF Voyageurs is studying Biogas trains, which combines territorial and greening issues.
- A renewable gas alternative to fossil fuel resulting from anaerobic digestion, could be a new opportunity complementing TER B100, Hybrid, Batteries and hydrogen.
- Could enable at least 80% reduction in greenhouse gas emissions.
Purchase of renewable electricity via PPAs

• 3 Renewable Energy Power Purchase Agreements (PPA) with Voltalia and EDF renewables
• 20 years contracts.
• **Target:** 20% of renewable energy PPA in the traction electricity mix in 2025 - 6% contracted to date.
• Taking into account the greening of electricity purchases on the French market, the electricity consumed by SNCF Voyageurs should be 40-50% of renewable origin in 5 years.
THANK YOU FOR YOUR ATTENTION
Q&A
Finance innovative modes and mechanisms at the low-carbon mobility service in Africa

AFRICAN BANK OF DEVELOPMENT

Martha B. LAWRENCE
African Bank of Development
Rail Financing for Green Transport

Martha B. LAWRENCE
Rail Financing for Green Transport

UIC: African Railway Thursdays Sustainable Development Challenges: Railways of Tomorrow
Panel on Financing Innovative Modes and Mechanisms of Low-carbon Mobility Service in Africa

Martha Lawrence, Leader, Railway Solutions, Infrastructure Vice Presidency, World Bank
29 April 2021
Opportunities to decarbonize transport through RAIL
Rail’s Contribution to Decarbonizing Transport

Source: IEA, 2018, the Future of Rail, p. 80
Shift to Rail: Urban & Commuter
Shift to Rail:
Semi-High-Speed Rail
Shift to Rail: High Speed
Shift to Rail: Bulk & Multimodal Freight
Improve Rail: Clean Energy

- Energy from a **clean** source
- **Reliable** energy supply
- Traffic **density** makes the investment economically viable

**Electric Power Supply**

- Produced in a **clean** way

**Hydrogen Power Supply**

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Rail Financing
Railway Funding Sources

- Passenger tickets
- Freight services
- Government
- Ancillary services
Railway Financing Types

- Sovereign
  - Government
- Corporate
  - Company
- Project
  - Project

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Green Bonds in Railways: Global Examples

<table>
<thead>
<tr>
<th>Company</th>
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Japanese Railways - “Lastochka” Passenger Train

NY & MTA

Bangkok Mass Transit

Paris rail network

© Climate Bonds, 2019
How the World Bank defines “green” projects:

• Support transition to low-carbon and climate resilient growth in client countries
• Climate change mitigation, i.e., greater efficiency in transport, incl. fuel switching and mass transport, and adaptation
• Selected by WB environment specialists
• Six steps following the same stages as other WB financed projects, incl. due diligence and monitoring process throughout the project cycle
• Comply to WB safeguards policies
• Eligible criteria underwent an independent review by the Center for International Climate and Environmental Research at the University of Oslo (CICERO)

Source: https://treasury.worldbank.org/en/about/unit/treasury/ibrd/ibrd-green-bonds#3
World Bank Green Bonds Financing Process

Earmarking and allocating Green Bond proceeds
World Bank railway projects using green bonds proceeds

**Brazil Greening Rio de Janeiro Urban Rail Transit:** The system is expected to especially serve the poor populations who rely on public transportation by reducing travel time, in particular when switching from inefficient bus services.

**China Hajia Railway:** The project supported the construction of a 343 km-long, electrified, mixed-use (passenger and freight) rail line between Harbin and Jiamusi.

**China Nanchang Urban Rail:** The project finances construction and equipment for urban rail Line 2 (24 km and 21 stations), as well as technical assistance to improve ridership levels, increase land value around stations.

Source: https://treasury.worldbank.org/en/about/unit/treasury/ibrd/ibrd-green-bonds#3
Rail Concessions in Africa

- Mali: Transrail (cancelled, 2015)
- Sierra Leone*: Sheralsteel Ltd (2015), SL Mining (2017)
- Côte d'Ivoire/Burkina Faso: Stareil (1994)
- Cameroon: Camrail (1999)
- Angola: BRC (expired, 2001)
- DRC: Sitareil (cancelled, 1997), JRS (2017)
- South Africa: Gautrain (2006)
- Zambia: RSZ (cancelled, 2012)
- Zimbabwe: BBR (1997)
- Uganda: RVR (cancelled, 2017)
- Tanzania: TRL (cancelled, 2011)
- Malawi: CEAR (1999), VIL (2011)

*Operations currently suspended.

Railway operated by state railway company
Private sector involved in network management or train operations
Railway now under private management

LD BANK GROUP
World Bank support for Rail
Current Railway Sector Lending

Active Railway IPFs: 11 Projects; ~$2.4 bn

Active Railway ASAs: 22 activities; ~$6.7 Mn
World Bank focus: increase Climate Co-Benefits

- Increased emphasis on Railways as low-emission mode

Example: Serbia Railway Modernization Project
Railway Lending Pipeline

Pipeline Railway IPFs: 8 Projects; ~$2.1 bn
Railway Resources

Railway Reform Toolkit
Urban Rail Handbook
China High Speed Rail Development
Railway Financing e-learning
The Rail Freight Challenge for Emerging Economies: How to Regain Modal Share
Modern Railway Services in Africa: Building Traffic – Building Value
Thank you!
Q&A
CONCLUSION

Said Chandid