SOLUTIONS for AIR QUALITY management

1. Avoiding emissions

- 1.1. Cross-cutting/general
  - **1.1.1. Influence of efficient driving: eco-driving and Driver Advisory Systems (DAS)**
  - 1.1.2. Electrification and alternatives to combustion engines
- 1.2. Brake system wear
  - 1.2.1. Brake system pollution prevention
  - 1.2.2. Electrodynamic/electromechanical braking
- 1.3. Wheels/track wear
  - 1.3.1. Steering bogie
  - 1.3.2. Maximise track curve radius
- 1.4. Pantograph/catenary wear
  - 1.4.1. Rolling pantograph
- 1.5. Maintenance works (Grinding, ballast management)
  - 1.5.1. Work zone air flow control with vacuum cleaning

2. Reducing emissions

- 2.1. Brake system wear
  - 2.1.1. Mechanical brake system management
  - 2.1.2. Low emission brake pads
- 2.2. Wheels/track wear
  - 2.2.1. Lubrication of wheels and tracks
- 2.3. Pantograph/catenary wear
  - 2.3.1. Optimising emission-influencing factors in pantograph-overhead contact line (OCL) system
- 2.4. Exhaust
  - 2.4.1. HVO
  - 2.4.2. Electrification (see 1.1.2.)

3. Reducing concentration

- 3.1. Capture onboard trains
  - 3.1.1. Vacuum cleaner train
  - 3.1.2. At source brake dust collection system
  - 3.1.3. Filtration via the HVAC system
- 3.2. Capture inside stations
  - 3.2.1. Station/tunnel cleaning
  - 3.2.2. Plant filtration (green wall)
  - 3.2.3. Particle traps
  - 3.2.4. Liquid filtration
  - 3.2.5. Filtration by ionisation
  - 3.2.6. Passive trap filtration
  - 3.2.7. Mechanical filtration
  - 3.2.8. Filtration with the existing station HVAC system
- 3.3. Ventilation/ barriers / doors inside stations
  - 3.3.1. Ventilation
  - 3.3.2. Platform screen/edge doors (PSD/PED or automatic platform gates)

AIR QUALITY MANAGEMENT IN RAIL

PROMISING SOLUTION:

- **Driving Advisory System (DAS) & efficient driving**

Sources: Paper 1 Paper 2

Field	Driving, friction, wear, exhaust, particles
Solution	Efficient timetabling and gentle driving to reduce emissions from wear and exhaust. Brake system wear is reducing with an efficient management of the speed profile and braking phases.
Description	Efficient timetabling and gentle driving have a significant number of benefits, including punctuality and customer satisfaction, energy saving and reduced wear of all components. On the specific braking wear aspect, the idea is to optimise the speed profile to fit the timetable, and then the braking phases, from a better coasting management, are less intense on mechanical brakes, and the mechanical brake use can be delayed even more as the longer brake phase can efficiently make use of the electrodynamic/regenerative braking. The same strategy (adapted speed) will also have a beneficial influence on the wear caused by wheels and track friction, as speed and speed in curves is the most important factor in speed or G force transmission into wear. In paper 1 different driving strategies were investigated and their impact on the energy consumption, safety, timeliness, workload of the driver, environment (noise and brake wear) and cost of maintenance. It shows that the maximal coasting strategy causes the least environmental pollution, i.e. brake wear,
Objective	Adapt driving strategy to punctuality and balanced driving to reduce intense use of components, especially avoiding intense use of mechanical brakes, causing friction (but also traction system solicitation for energy saving and reduced exhaust emission for combustion powered trains).
How to	Implement DAS and/or eco-driving to increase accuracy for punctuality, enabling a comfortable margin of manoeuvre for a smooth driving profile. In the Netherlands such a method has been developed by the largest passenger operator NS. A tablet was introduced to the driver which shows the RouteLint and RolTijdAdvies. The RouteLint gives the occupancy of the track and if there are delays. The driver can use this to anticipate how to drive. RolTijdAdvies shows when the driver can turn off traction and arrive on time at the station. The main goal was to improve the punctuality and energy saving. For more information on the method, results and how the change was accepted by drivers and management can be found in paper 2
Costs and resources required	DAS implementation cost And/or Eco-driving trainings
Benefits Effects	Eco driving & DAS also prioritise balanced coasting & smooth braking over intense braking phase so it somehow makes the most of train's kinetic energy to saving traction energy & braking the optimal way (usually also favouring regenerative braking) DAS can help achieve ATO benefits earlier, hence the similar expected improvements. ATO would make it perfectly reliable but DAS can already help achieve optimal driving profiles. A harmonised data exchange protocol to be used with DAS, as generic data exchange framework for seamless cross-border activities and DAS compatibility between RUs and IMs (IRS 90940) would enable achieving these benefits, regardless of the DAS products provided they allow the use of the harmonised data structure. • Improved regenerative braking • Reduced brake system wear • Reduced particle emission • Energy saving • Reduced maintenance costs (reduced solicitation of traction components and braking system) • Improved punctuality & customer comfort and satisfaction IRS 90940
Ease of implementation	Medium It will require an implementation strategy where it is important that drivers and management will accept it. Thus, expect to spend a significant amount of time on achieving positive support to ease the introduction of DAS. It will also require a program that shows the driver what is possible during their drive (between maximal coasting or as fast as possible to keep the timetable). Development and testing of such a system can take considerable time, which can be done parallel with ensuring the acceptance in the organisation.
Constraints, challenges, or lessons learnt	To improve the adoption of the system by the driver it is very important that it must not seem that the system will be used to evaluate the driving or that it will increase workload. The method used by NS to increase acceptance can be found in paper 2,
S/M/L term	Medium term for eco-driving Medium/long term for DAS implementation
Efficiency	Medium The use of ED-braking will make this method less effective for reducing the brake wear. This is due to the fact that ED-braking does not produce a significant amount of non-exhaust. The ED-brakes will work down to a speed 5 km/h. Braking to standstill will then be accomplished by mechanical braking. Thus, coasting up to the station will not have a large effect on the non-exhaust emission when using ED-brakes.
Maturity	TRL 9
Mentioned by	NS, SBB, SNCB, SNCF
Experience	NS/ProRail/SNCF