

POLIS

CITIES AND REGIONS FOR TRANSPORT INNOVATION

ANNUAL
CONFERENCE

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30 November
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Brussels, Belgium



#POLIS2022

Towards emission-free local rail systems in regions and cities

Laurent FRIOT

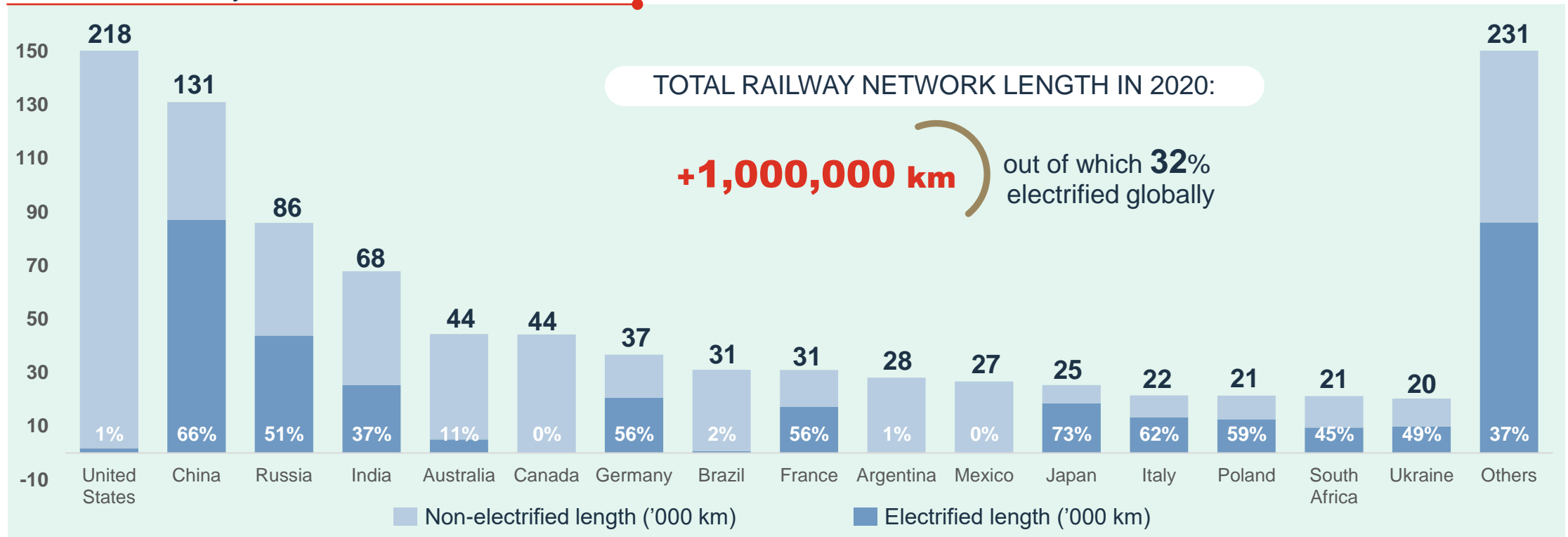
Traction Rolling stock & Components Director

ALSTOM



Rail needs to provide solutions to replace diesel for non-electrified lines

Worldwide railway networks electrification rates



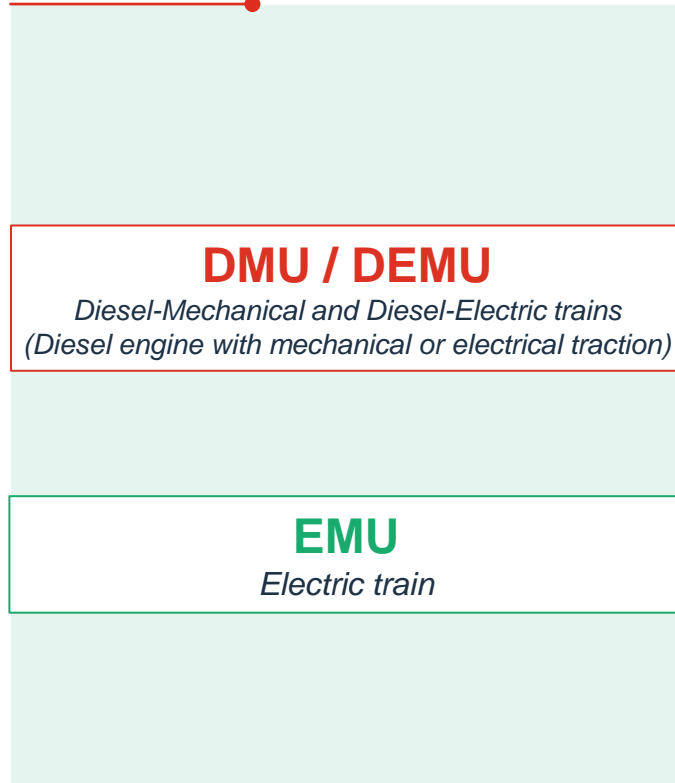
A significant part of worldwide rail networks remains unelectrified for passenger and freight transport

Source UNIFE (2020 data), including High Speed, Mainline, freight routes (Urban railway excluded)

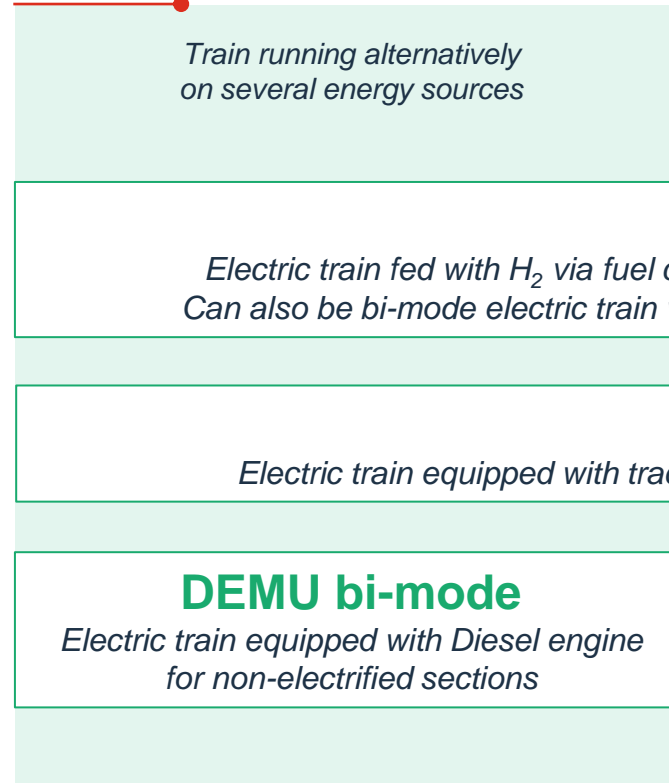
Trains within the related EU taxonomy classification



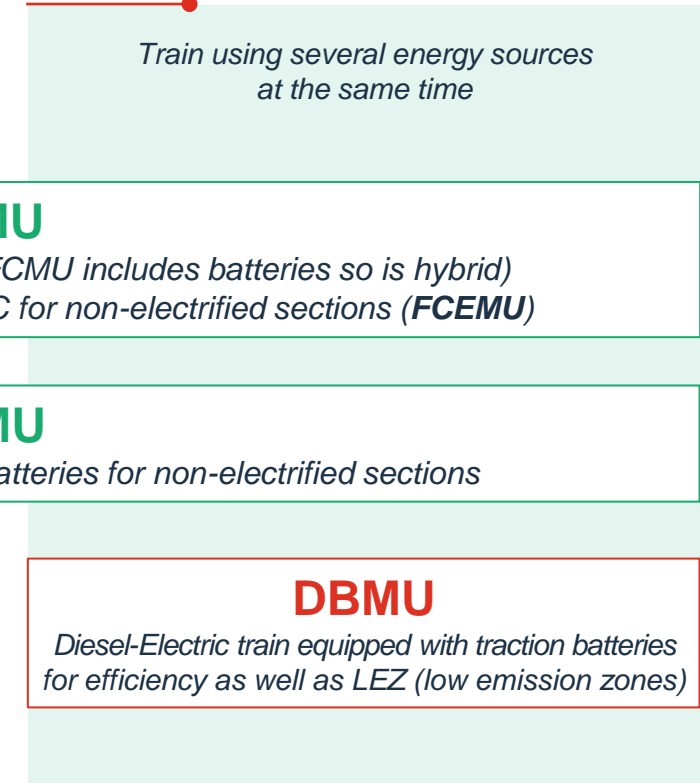
Monomode



Bi-mode



Hybrid



D: Diesel / **E:** Electric (catenary) / **B:** Batteries / **FC:** H₂ via fuel cells

Non-aligned with EU taxonomy (not sustainable)

Aligned with EU taxonomy (sustainable)

H² Trains – Long range train for non-electrify lines

- Alstom serial Coradia iLint™ regional train travels **1,175 kilometres without refueling its hydrogen tank**
- 100% emission-free journey across Germany from Bremervörde to Munich Main station
- New global milestone for clean, alternative drives in rail transport



The infographic features a dark blue background with three circular images: a hydrogen symbol (H₂) with a water drop, a blue and white Coradia iLint train on tracks, and a close-up of a train's front grille with a 'H₂O' label. A large green circle contains the text: 'Alstom's in-house hydrogen fuel cell powered a train to travel a record **1175 km** on one tank of hydrogen'. Below this, it states 'Coradia iLint™ distance run (Germany, September 15th 2022)' and '© Alstom'.

H₂

Alstom's in-house hydrogen fuel cell powered a train to travel a record **1175 km** on one tank of hydrogen

Coradia iLint™ distance run (Germany, September 15th 2022)

© Alstom

H² Trains - Different sub-systems combination

1 H₂ storage system

Tanks

Mechanical structure & piping

H₂ storage system

2 Fuel cell system

MEA

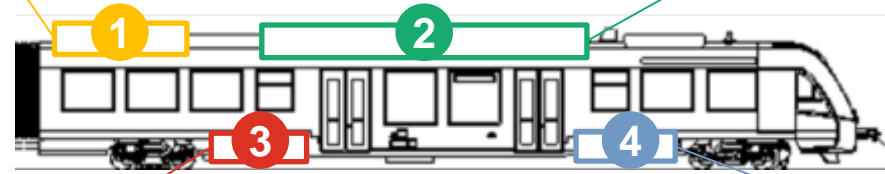
Bipolar plate

Power Module

Air blower/compressor

Cooling system

Fuel cell power pack

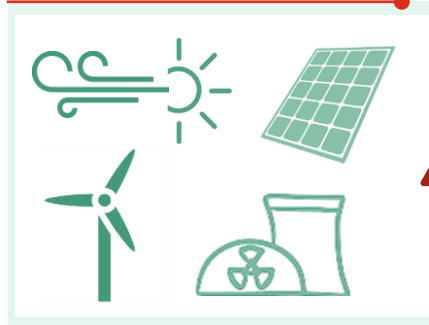


3 Battery & converter system

4 Traction motor and inverter system

H₂ value chain for railway goes beyond Rolling Stock

Electricity generation



Electrolyzer solution

Power Supply



Electrolyzer

Supply compressors



Supply & storage

Transport



Storage tanks

H₂ refueling system (HRS)



Fueling Compressor & control

Fueling storage & dispenser



Rolling stock + Service



Alstom Battery train references

Light rail, Commuter & Regional services



Coradia Continental

- 11 BEMU trains for VMS – Germany
- Under tests

Demonstrator with DB

- Passenger operation in Baden-Württemberg & Bavaria
- First fully homologated BEMU in Germany
- Running since earlier 2022

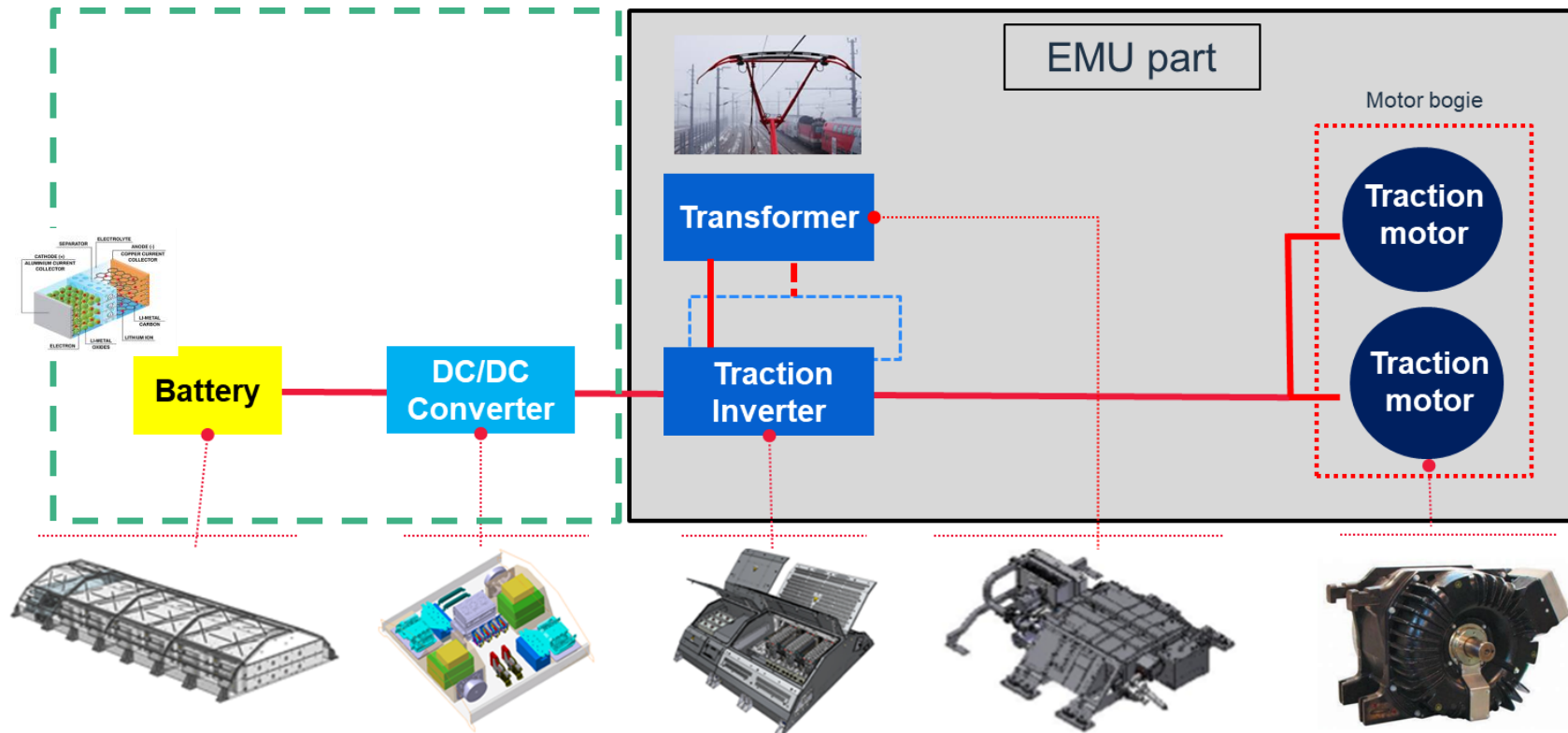
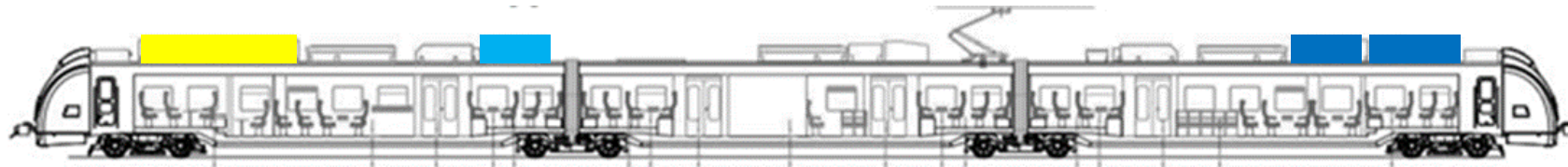
X'trapolis

- 13 BEMU trains for DART – Ireland
- Under development

Citadis™ with onboard energy storage

- 62 trams for Nice - France

Battery Trains – Different sub-system combination



Battery trains as complement to catenary lines





Coradia™ Continental for Verkehrsverbund Mittelsachsen (VMS) – service: 2023

-  11 BEMUs
3-car regional trains
-  > 100 km autonomy under all conditions
-  10-year maintenance
-  zero zero-emission while ensuring cost-effective and comfortable service



Battery trains as complement to catenary lines

X'Trapolis™ for Irish Rail – service: 2025

-  13 BEMUs
5-car, 84-m battery commuter trains
-  80+
km journeys outside electrified network
-  15-year
support services including HealthHub™
-  zero
zero-emission while ensuring cost-effective and comfortable service



APS in Bordeaux

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Two types of systems for catenary-free lines

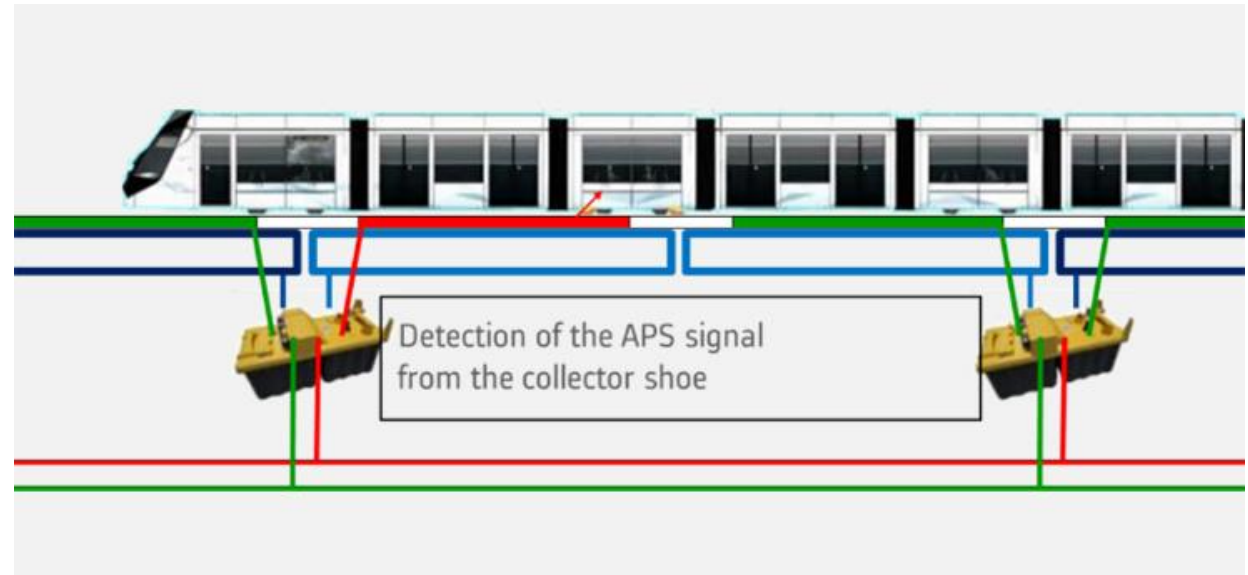
- On-Board Energy Supply (OBES) & charging
 - On-board Super-Capacitors or Batteries
 - To run one or several inter-station
 - Super-Capacitor are fast charging at every stop
 - Batteries are charging on the move under catenary

- Continuous Ground Power Supply
 - Power supplied by segmented third rail between running rails
 - Third rail segments safely powered only under passing vehicle



Citadis™ APS integrated solution - key principles

- Power supplied to the tram through a segmented street-level power rail
 - Conductive segments are switched off/on/off as the tramway progresses, ensuring total safety for pedestrians
 - Segmented power rail fed by buried power boxes
 - Power picked up by collector shoes on tram central bogie



Citadis™ SRS fast charging solution - key principles

- Power supplied to the tram at each station to recharge OBES through a street-level power rail during the Dwell time
 - The conductive segment is switched on when the tramway stops in station and off when tramway leaves the station, ensuring total safety for pedestrians
 - Power rail fed by buried power boxes
 - Power picked up by collector shoes on tram central bogie


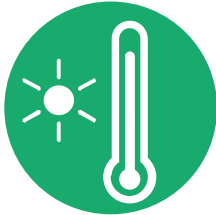


How to choose an appropriate catenary-free System

- Each line is specific
- No technology fits all

Alstom's 3-steps methodology

Environment



CAPEX & OPEX



Line Alignment & Traffic

3

types of technologies



20

years experience in
catenary-free



Already

in commercial service





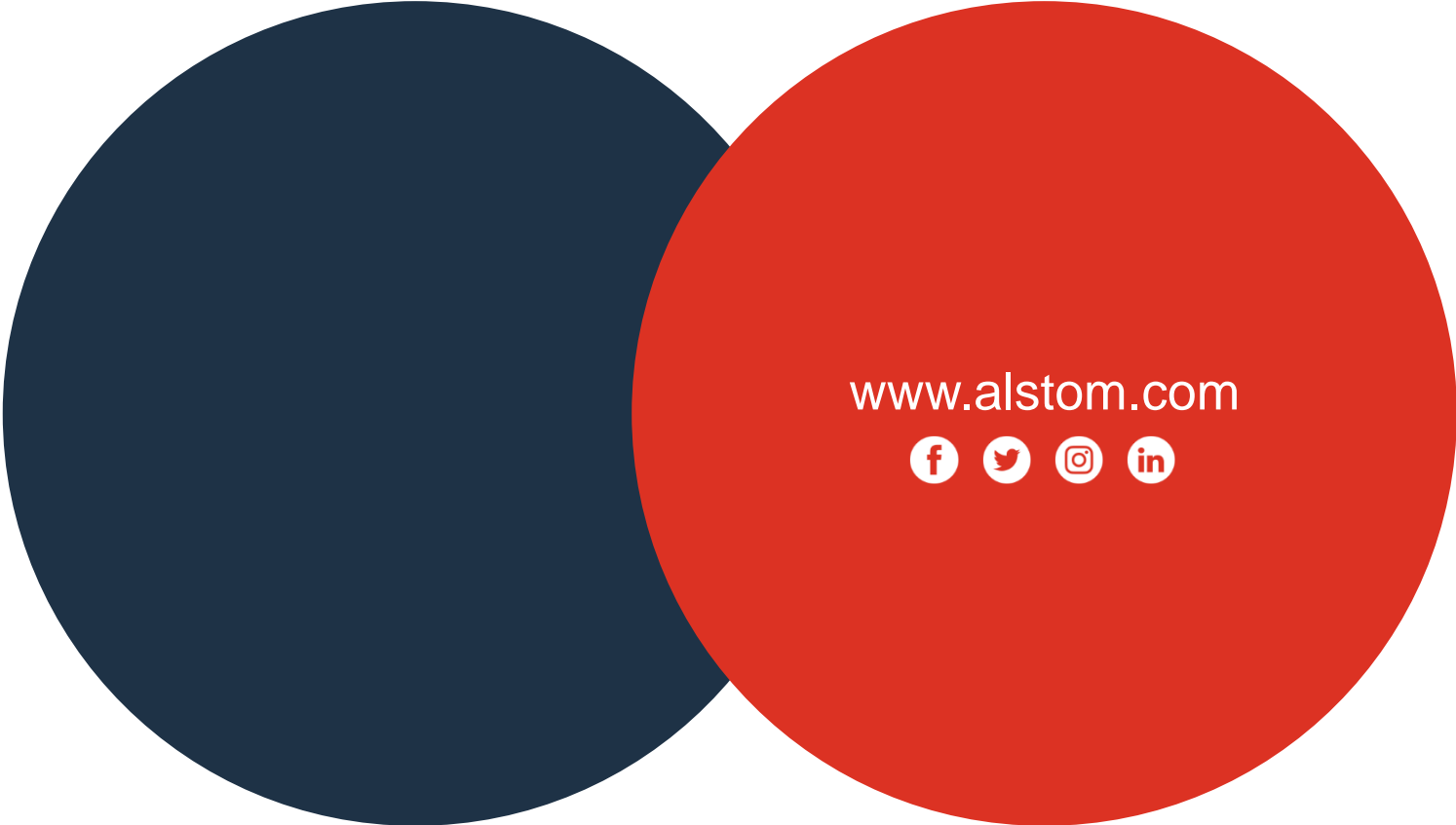
Thank you for your attention!

For more information:

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