APPRAISAL REPORT

FOR BRINDISI AIRPORT PILOT ACTION

Project acronym	ADRIGREEN
Project Title	Green and intermodal solutions for Ports and Airports
Financed through	ERDF
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Related activity:	4.1 –Testing phase
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CONTENT

I. EXECUTIVE SUMMARY

The main objective of ADRIGREEN project is to improve the integration of Croatian and Italian ports and airports with other modes of transportation in order to enhance the processing of passengers during the summer seasons and to improve environmental performances of the Adriatic maritime and aviation systems.

According to project life cycle progress, international investigation has been performed in order to identify best existing solutions for lowering airports/ports environmental impact. Further, these identified solutions have been summarized in Joint Action Plan definition for each region / partner.

Brindisi Airport pilot action objective included adoption of smart solutions to reduce energy consumption in small-medium regional Airports. In order to reduce energy consumption BDS[1] mid-term strategy is to replace current diesel fuel car park with electric or hybrid car park till 2025. In previous years BDS has started the process which has been continued with ADRIGREEN project and will be finalise with other similar internal projects.

Within ADRIGREEN project BDS has purchased one electric vehicles replacing one diesel vehicles. After the pilot action implementation BDS has performed assessment of environmental impact and benefits of the pilot action implemented for BDS and wider public, described in latter stages of this report.

According to environmental analysis implemented pilot action has reduced CO2 emission within BDS premises from which not only BDS employees have benefited, but also passengers of BDS airport and local community.

Analysis performed within ADRIGREEN project gives BDS Management Board clear understanding and recommendations for improvement of environmental management process in all different environment aspects. In this report energy fuel consumption is appraised for the pilot action implemented, however in other ADRIGREEN deliverables, especially in Joint Action Plan definition, clear recommendations are given on the strategical and operational level.

[1] IATA code for Brindisi Airport

II. BACKGROUND OF THE PROJECT IMPLEMENTATION

Green and intermodal solutions for Adriatic ports and airports - ADRIGREEN is a project approved under the INTERREG V-A Italy Croatia CBC Programme 2014-2020. The programme is funded by the European Regional Development Fund under the European Territorial Cooperation objective during the programming period 2014-2020.

Project description:

One of the main problems that characterize the Adriatic coastal area is the imbalance in the development of infrastructures and modes of transport, caused by low level of investments and insufficient approach to innovation. In Italy and Croatia there are many maritime cities, which have to deal with a very high number of passengers, especially during the peak season. Even though the road transportation is still predominant, the number of people that are reaching Adriatic cities by ferries and airplanes is significantly increasing year by year. However, most of Adriatic ports and airports are suffering from lack of integration with various modes of transportation, causing serious traffic congestion problems during the summer season.

The aim of the project is to improve the integration of Adriatic ports and airports with other modes of transportation by testing several intermodal operational and technological solutions. By identifying and analysing already existing procedures, the project partners will test a number of intermodal practices in order to evaluate their adaptability and transferability into the Programme area.

Also, it is very important to create more environmental-friendly and less polluting transport between ports (cities) and airports by reducing CO_2 emissions. This can be achieved by purchasing electric vehicles for transport routes between ports and airports, or for use in port/airport premises.

Background of project implementation

ADRIGREEN project consists of several technical work packages as follows:

1. WP T1 – Identification of innovative solutions and Action plan definition
2. WP T2 – Testing phase
3. WP T3 – Networking and training on Green and intermodal solutions

WP T1 – identification of innovative solutions and Action plan definition

Within first technical work package (WP T1) several activities were performed:

A) Replicability research and analysis replicable operational and technological solutions
B) Environmental assessment
C) Joint Action plan definition

Activities have been started in June 2019 and finalised as of December 2020.

A) Replicability research and analysis replicable operational and technological solutions

Partnership has made a general overview of existing solutions for lowering airports/ports environmental impact and for intermodal connection of ports/airports with other means of transportation. Within this activity SWOT analysis of each project partner was performed to assess current situation and fields for improvement. Also, international investigation research was conducted in order to identify and analyse the best solutions already implemented worldwide that can be easily implemented in Adriatic region. One of the main focus areas of international investigation included on-going operational and technical initiatives for making ports/airports environmentally friendly with particular attention to maintenance activities.

Summary of practical sustainable applications to achieve carbon reductions at airport and port infrastructures are as follows:

Solution	Brief description	Port reference case studies	Airport reference case studies
Solar panels	Solar panels installed in different areas of the port/airport (e.g., rooftops of buildings and warehouses) for generating renewable energy.	Rotterdam, Amsterdam, and Gothenburg	Copenhagen, and Helsinki Airport
Geothermal heat pump/ Aquifer thermal	Renewable thermal energy for large heating and cooling loads. Cooling/heating system employs a water-based thermal energy storage system that stores heat/cold in ground-water reservoirs.	Marseille	Paris-Orly, Nashville, Calgary, Stockholm-Arlanda, and Copenhagen Airport

energy storage[2]			
Energy monitoring system	Monitoring system of the energy consumption of airport/port equipment, buildings and other facilities for supporting decision-making and implementation of measures for improving energy efficiency.	Valencia, Koper, and Jade Weser Port	Copenhagen Airport
Smart grid	Electricity network based on digital technology that can cost-efficiently integrate the behaviour and actions of all generators and consumers that are connected to the grid.	Antwerp	-
Daylighting strategy	A daylighting strategy can reduce electricity for lighting and peak electrical demand, cooling energy and peak cooling loads, maintenance costs associated with lamp replacement, and electrical service to the building. Maximize south glazing and minimize east- and west-facing glass[3].	Yokohama	Denver, and San Francisco Airport
Green roofs	Green roofs are covered with vegetation and a growing medium planted over a waterproofing membrane. When weight restrictions need to be considered, it is possible to utilize substrates that provide an adequate nutrient supply with relatively low specific weight. Main environmental goals: absorbing rainwater, providing insulation, and helping to mitigate the heat island effect in the built environment.	Värtahamnen, and Copenhagen	Frankfurt, Ibiza, Munich Airport, Paris Orly, and Bordeaux–Mérignac Airport
Concrete pavement instead of asphalt	Pavers are lower maintenance and generally have a longer lifespan compared to asphalt.	Värtahamnen	-

[2] Baxter et al. (2018). An assessment of airport sustainability, Part 2—Energy management at Copenhagen Airport. *Resources*, *7*(2), 32.

[3] https://www.lrc.rpi.edu/programs/daylighting/pdf/guidelines

LED	Light emitting diode (LED) is a highly energy efficient lighting technology.	Venice, Hamburg, and Los Angeles	Stockholm Arlanda, Copenhagen, Schiphol, and Oslo Airport

Source: international investigation ADRIGREEN

For more details, please see related document International investigation ADRIGREEN.

B) Environmental assessment

Next step in project implementation comprised of producing Environmental Impact Assessment (EIA) for each project partner based on ad-hoc guidelines produced by technical expert in the project, Polytechnic University of Marche. In order to asses current situation in each partner, evaluation grid for EIA was produced to cover different environmental aspects; environmental impact of local air quality, waste and water management, energy consumption, carbon footprint and noise pollution.

There are different levels of implementation of efficient environmental management within ADRIGREEN airports as can be summarised in table below:

Activity	**Implemented in airports**
<u>Water management</u>	
Education and training of airport staff	4/6
Monitoring of water consumption	3/6
Harvest and reuse rainwater	2/6
Surface water and groundwater quality monitoring	4/6
Runoff water management	5/6
Waste management	
Waste handling – more fractions (paper, metal…)	3/6
Aircraft waste advanced handling	1/6
Waste prevention initiatives	1/6
Training on recycling	2/6
Mitigation measures in place	3/6
Electricity and fuel consumption	
Photovoltaic systems installed	3/6
LED lighting	6/6
Operational and maintenance procedures in place	5/6
Initiatives to reduce energy consumption	3/6
Energy audit	2/6
GHG emission–high (0,2-0,3 kg CO_2eq/pax)	4/6
Switch to electrical or bio-fuel vehicles	4/6
Charging stations	5/6

Data extracted from: ADRIGREEN WP3-D2 APT

For more details, please see related document EIA ADRIGREEN.

C) Joint action plan definition

Joint action plan definition has been produced by Polytechnic University of Marche with recommendations for improvement for each type of environmental activitiy (*please see: Adrigreen_WP3_D3_200218_Final*):

Since Brindisi Airport pilot action comprises of *“adoption of smart solutions to reduce energy consumption in small-medium regional Airports”* below are presented reference case studies for actions aimed at decreasing energy consumption:

General measure	Specific action	Metrics	Airport reference case studies
Decreasing energy consumption	Building management system	Total energy consumed (electricity consumption (kWh); fuel consumption (m3; l; kg)); GHG emissions (kg CO2eq/m3; kg CO2eq/passenger)	A3 airport (this study).
Decreasing energy consumption	Cogeneration plant	Total energy consumed (electricity consumption (kWh); fuel consumption (m3; l; kg)); GHG emissions (kg CO2eq/m3; kg CO2eq/passenger)	Website of Leonardo da Vinci Airport (—); Malpensa Airport (SEA Energia 2019).
GHG = Greenhouse Gases.			

Source: Adrigreen_WP3_D3_200218_Final

Also, according to survey reported by the European Environment Agency (2019), the purchase of electric vehicles is the most popular mitigation action to contain the environmental impact of the airports’ vehicle fleet as can be seen from table below.

	Share of (51) EU28 European Free Trade Association airports [%]
Electric vehicles	86
Hybrid vehicles	47
Vehicles that run on sustainable alternative fuel	35
Provide incentives for taxis that use 'green' vehicle solutions	18

Source: Adrigreen_WP3_D3_200218_Final

Therefore, within ADRIGREEN project Joint action plan definition, following measures were underlined regarding decreasing of fuel consumption:

General action	**Specific action**	**Metrics**	**Airport reference case studies**
Decreasing fossil fuel consumption	Purchase of electric vehicles (e.g., electric aircraft tug, electric baggage tractor, etc.)	Electricity consumption (kWh) versus kg or l of fossil fuel; GHG emissions (CO2eq)	Copenhagen Airport (2018).
Decreasing fossil fuel consumption	Provide charging stations for electric vehicles	Electricity consumption (kW); GHG and airborne pollutants emissions	A1 airport (this study); Helsinki Airport (Finavia 2019).
Decreasing fossil fuel consumption	Anti-idling communication campaign	GHG and airborne pollutants emissions	Copenhagen Airport (2018).
Decarbonizing fuel consumption	Use of alternative renewable fuels (diesel from waste and residue) for diesel vehicles	Consumption of renewable fuel vs fossil fuel (l); GHG emissions (CO2eq)	Helsinki Airport, and other Lapland Airports (Finavia 2018).
GHG = Greenhouse Gases			

Source: Adrigreen_WP3_D3_200218_Final

Since within ADRIGREEN project BDS pilot action comprises of purchasing of electric vehicles in order to replace existing diesel car park with electrical car park to achieve reduction of fossil fuel consumption, BDS pilot action is in line with recommendations specified in Joint Action plan definition.

WP T2 – Testing phase

Testing phase is the core phase of the project where identified solutions and best practices are to be put in place and tested within each partner pilot action. First deliverable of this work package related to Feasibility study for each pilot action where initial financial and environmental analysis have been performed.

Initial financial and environmental assessment of Brindisi Airport pilot action demonstrated feasible and sustainable plan for reducing fuel consumption and CO2 emission by replacing old diesel car park with new electric car park.

This plan is to be carried on by BDS in the future until full replacement of old diesel vehicles with electric ones is achieved. In latter stages of this document BDS needs analysis as well as pilot action implemented and environmental analysis are explained.

III. BRINDISI AIRPORT NEEDS ANALYSIS SUMMARY

Brindisi Airport had rapid traffic growth in last years that has introduced airport to new environmental challenges, such as increase of air pollutions and integration of environmental protective measures. These challenges will mostly be worked out and mitigated through large infrastructure projects connecting with the airport. One of the various projects has a total cost of 112 million euros with resources of 60 million euros borne by the Development and Cohesion Fund; the completion of the financial coverage is envisaged as part of the Recovery Plan. A project was presented for the construction of a single track line between Brindisi Station and the Airport, with 2 bridges, one towards Taranto / Bari, the other towards Brindisi / Lecce in order to potentially allow rail services from all the main Apulian towns. The construction of a new airport service station with 2 tracks is planned. Once the final design has been completed, the authorization process is starting. The new link is expected to be completed by 2025.

To cope with the new environmental challenges, Brindisi airport therefore plans to increase the level of multimodality / intermodality and the environmental performance of the airport through a series of dedicated projects.

The ADRIGREEN Project represents a unique opportunity for Brindisi Airport to continue its development toward an environmentally friendly airport. In addition, thanks to the project, the Airport will analyse and evaluate existing and future strategies, concepts and technology to improve intermodal solutions. Brindisi Airport is especially interested in improving and integrating communication and transport between units, and in opportunities to implement new innovative technologies according to the latest environmental and sustainable development principles.

Consequently, Brindisi Airport pilot action includes purchasing of electric vehicles to be used for aircraft assistance activities, covering the following pilot action field:

- adoption of smart solutions to reduce energy consumption in small-medium regional Airports

The new solutions tested at the Airport will reduce airport air pollution and will better integrate airport systems. Gained experience and benchmark information will provide inputs for future sustainable development of the whole region.

IV. DESCRIPTION OF PILOT ACTION IMPLEMENTED

The pilot action of Brindisi Airport is particularly concentrated in the purchase of:

- Electric tractors used for aircraft assistance activities (handling).

According to the need's analysis performed, Brindisi Airport has identified following fields for improvement in landside and airside area:

- energy efficiency improvements within airport processes,
- cost effective optimisation of business processes.

The purchase and implementation of electric tractors for handling operations will significantly reduce CO2 emissions and reduce energy consumption in the execution of daily processes at Brindisi airport as the old diesel-powered vehicles will be completely replaced and put out of order. Furthermore, as these vehicles are used in the ground area, it will be visible to stakeholders and the general public who contribute to the airport greenfield policy and zero-emissions strategy adopted within Brindisi airport and presented to the public.

Therefore, as part of the ADRIGREEN project, Brindisi airport purchased 1 electric tractors for handling operations, replacing the remaining 1 diesel vehicles. With the use of this new electric tractor, energy consumption and polluting emissions in the air will be reduced.

V. ENVIROMENTAL ANALYSIS

Financial analysis

Brindisi Airport has performed financial analysis of equipment purchased and used. In conducting financial analysis following assumptions were taken into the consideration:

- purchase price of new vehicle and old (replaced vehicle),
- additional yearly maintenance expenses,
- electric battery change each five years,
- discount interest rate of 1%
- economic life usage period of vehicles (10 years).

Other information:

- new electric tractor Simai TE252 used for aircraft assistance activities (handling) put in use in December 2019.

According to financial analysis, purchase of electric vehicles is more feasible on respected period. Financial analysis is presented in Feasibility Study for Brindisi Airport pilot action, for more details please see related document.

Environmental analysis

Environmental analysis has been performed in two major steps:

1. Initial environmental analysis within FS of Brindisi pilot action

Within Feasibility Study for Brindisi Airport pilot action initial environmental analysis has been performed which related to basic calculation of CO_2 emissions according to technical specifications of equipment purchased compared to the one replaced.

Accordingly, listed below are technical specifications of pilot actions:

- New Diesel Tractor - CO_2 emissions are estimated at 532 g / km, on an annual basis, assuming 2.000 km, is 1.064 kg;
- New Electric Tractor Simai TE252 - CO_2 emissions are estimated at 172 g / km, on an annual basis, assuming 2.000 km, is 344 kg

2. Environmental analysis based on evaluation grid for specific pilot action

Next step in conducting environmental analysis included development of evaluation grid based on specifics of pilot action implemented and type of electric vehicle purchased.

Evaluation grid has been developed by Polytehnic University of Marche based on methodology provided by European environment agency (*1.A.4 Non road mobile machinery 2019*).

Main purpose of evaluation grid and appraisal report is to asses pilot action performance and to show how the environment and transit of passengers benefited from pilot actions.

Emissions of airbonre pollutants (NOx and PM) and CO2 deriving from diesel vehicles

For diesel vehicles, the emissions of NOx, PM, and CO2 were evaluated following Tier 1 according to (Ntziachristos et al. 2019), as follows:

$$E_i = \sum_j EF_j \times FC_j \times U_l$$

Where

- E_i is the emission value of NOx [g], PM [g], and CO2 [kg];
- EF_j is the emission factor specific for the type of fuel and the vehicle category (Table 1), [g/kg fuel] for PM and NOx; [kg CO2/kg fuel] for CO2;
- FC_j is the fuel consumption related to the j-category of vehicle (Table 2) [g/km];
- U_l is the usage per year for the l-vehicle (Table 3) [km/year].

Table 1 Tier 1 emission factors for diesel passenger cars and light commercial vehicles adapted from Ntziachristos et al. (2019).

Category	Fuel	Airborne pollutants and CO2	Unit of emisison factor	Emission factors
Passenger car	Diesel	NOx	[g/kg fuel]	12,96
Passenger car	Diesel	PM	[g/kg fuel]	1,10
Passenger car	Diesel	CO2	kg CO2/kg fuel	3,169
Light commercial vehicles	Diesel	NOx	[g/kg fuel]	14,91
Light commercial vehicles	Diesel	PM	[g/kg fuel]	1,52
Light commercial vehicles	Diesel	CO2	kg CO2/kg fuel	3,169

Table 2 Typical fuel consumption per km, by category of vehicle (Tier 1) adapted from Ntziachristos et al. (2019).

Vehicle category	Typical fuel consumption [g/km]
LCV	80
PC	60

PC– passenger car; LCV– light duty vehicle

Table 3 Usage per year of the diesel vehicle that are going to be replaced at Brindisi Airport

	Fuel	Vehicle category	Usage [km/year]
Vehicle	diesel	LCV	2.000

PC– passenger car; LCV– light duty vehicle

$$E = 3{,}169\ \frac{kg\ CO2}{kg\ fuel} \times 0{,}08\ \frac{kg\ fuel}{km} \times 2.000k\frac{km}{year} = 507{,}04\ \frac{kg\ CO2}{year}$$

Emissions of greeenhouse gases deriving from electric vehicles

For the electric tractor, the CO2 equivalent emission (E_i) was evaluated as follows:

$$E_i = \sum_j FC_j \times EF_j \times T_i$$

Where

- FC_j is electricity consumption related to the battery capacity of electric vehicles [kWh];
- EF_j is the emission factor of 397 g CO2 eq/kWh that was determined for Italy in 2017 (Gestore Servizi Elettrici 2018);
- T_i is the number of recharge per year for the i-vehicle, [-].

For the i-vehicle, the number of recharge per year (T_i) was obtained as follows:

$$T_i = \frac{U_i}{R_i}$$

Where

- U_i is the usage per year for the i-vehicle (Table 4), [km/year];
- R_i is the range of the i-type of battery calculated below, [km].

Table 4 Usage per year of the electric vehicle purchased to replace diesel vehicle at Brindisi Airport.

	Type of vehicle	**Manufacturer**	**Number of units**	**Utilization each unit [km/year]**	**Engine power [kW]**	**Range [km]**	**Battery capacity [Wh]**
Electric Tractor	TE 252	Simai	1	2.000	2 * 10 kW 0,6 kW	76	49.600

See figure 1 in the ANNEX section.

As part of the feasibility study for the initial environmental analysis of the pilot action of the Brindisi airport it was calculated that the hourly consumption in kWh of the electric tractor was on average 12,72 KWh, calculated as 60% of the nominal power value of the two 10 KW traction motors and 60% of the value of the 0.6 KW steering motor plus 0.36 kWh of power consumption in stand-by, so:

$$\boldsymbol{EP_a = (2 \times 10)60\% + (0,6)60\% + 0,36 = 12,72 kW/h}$$

See figure 1 in the ANNEX section.

The battery capacity of the Simai TE252 electric tractor has been calculated with the following formula:

$$BC\ [Wh] = BC[Ah] \times BV[V]$$

Where:

- BC is the battery capacity expressed both in Wh and in Ah (Simai TE252 technical specifications BC is esxpressed in Ah)
- $BV$is the battery voltage

$$BC[Wh] = 620\ [Ah] \times 80[V] = 49.600[Wh] = 49{,}6[kWh]$$

See figure 1 in the ANNEX section.

$$\boldsymbol{R[km]} = \frac{\boldsymbol{BC[kWh] \times S[km/h]}}{\boldsymbol{EP_a[kW/h]}}$$

Where:

- R is the medium range of Li-ion battery of Simai TE252
- S is 19,5 km/h the medium speed of Simai TE252 14 km/h at full load and 25 km/h when empty

$$R[km] = \frac{49{,}6\ kWh \times 19{,}5 km/h}{12{,}72\ kW/h} = 76{,}0377 km \cong 76 km$$

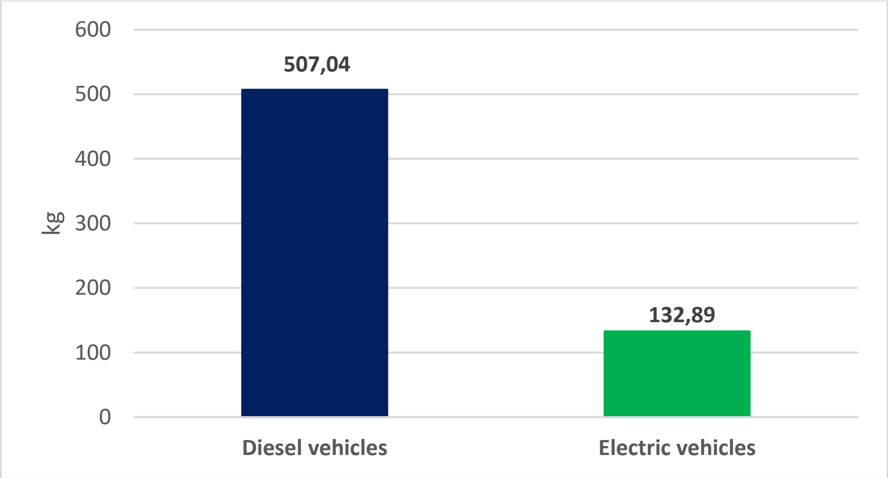
Then the calculation of the CO2 equivalent emissions for the electric tractor are obtained as follows from the previous formula:

$$E = FC \times EF \times T$$

$$E = 12{,}72\ kWh \times 0{,}397 \frac{kg\ CO2eq}{kWh} \times \frac{2.000\ km/year}{76\ km} = 132{,}89 \frac{kg\ CO2\ eq}{year}$$

Results

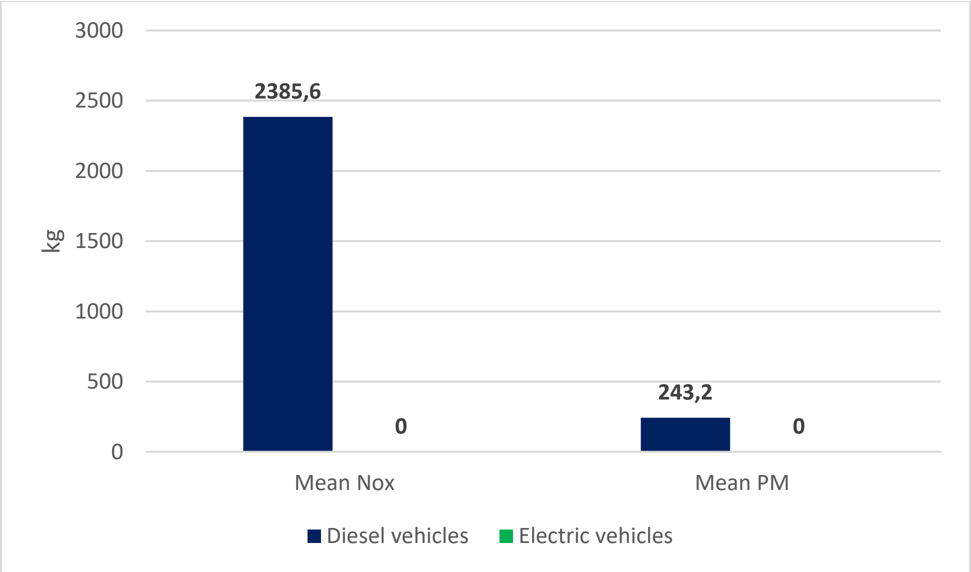
Each year, the diesel vehicles emits about 3,8 times the greenhouse gases deriving from the electricity utilised by the electric vehicles (Graphic 1). End of waste and the life cycle assessment of diesel and electric vehicles were not assessed.



Graphic 1 – Comparison between greenhouse gases emissions deriving from diesel vehicles (CO2) and electric vehicles (CO2 eq) per year.

Local emissions of airborne pollutants such as NOx and particulate matter (PM) is assumed to be null for the electric vehicles. However, the emission of airborne pollutants should be considered depending on the location of production and the technology utilised for producing electricity.

On the contrary, utilising the diesel vehicles would result in local emissions of NOx and PM (Graphic 2).



Graphic 2 – Comparison between local emissions of airborne pollutants (i.e., NOx and PM) deriving from diesel vehicles and electric vehicles per year.

References

Ntziachristos, L.; Samaras, Z., et al. 2019. EMEP/EEA air pollutant emission inventory guidebook 2019. Available at https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view

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VI. ANNEX I – TECHNICAL SPECIFICATIONS

CARATTERISTICHE	1.1	Costruttore			SIMAI S.p.A.	SIMAI S.p.A.
	1.2	Modello			TE252	TE293
	1.3	Motorizzazione			elettrica	elettrica
	1.4	Tipo di guida			a bordo seduto	a bordo seduto
	1.5	Portata sul pianale	Q	t	0,2	0,2
	1.5.1	Capacità di traino nominale (S2=60' / S2=30')	Q	t	25	29
	1.7	Sforzo al gancio nominale	F	N	5800	5800
	1.9	Interasse	Y	mm	1550	1550
PESI	2.1	Peso proprio con batteria		Kg	3670	4000
	2.2	Carico sugli assi anteriore/posteriore a carico (c/operatori cad 80kg)		Kg	2231 / 1908	2220 / 2140
	2.3	Carico sugli assi anteriore/posteriore a vuoto		Kg	1900 / 1770	2020 / 1980
RUOTE-TELAIO	3.1	Gommatura:Cushion(Cu),Superelastic(SE), Pneus(Pn) Poliuretano(PE)			SE/Pn	SE/Pn
	3.2	Dimensione ruote anteriori			6.50-10	6.50-10
	3.3	Dimensione ruote posteriori			7.00-12	7.00-12
	3.5	Numero di ruote anteriori/posteriori (X=motrici)			2 / 2X	2 / 2X
	3.6	Carreggiata anteriore	b_{10}	mm	1130	1130
	3.7	Carreggiata posteriore	b_{11}	mm	1130	1130
DIMENSIONI	4.7	Altezza tetto di protezione/cabina	h_6	mm	1900	1900
	4.8	Altezza sedile	h_7	mm	890	890
	4.8.1	Altezza piano di calpestio		mm	390	390
	4.12	Altezza accoppiamento	h_{10}	mm	310 - 380 - 450 - 520	310 - 380 - 450 - 520
	4.13	Altezza pianale di carico (min / MAX)	h_{11}	mm	1070	1070
	4.16	Lunghezza piano di carico	l_3	mm	1430	1430
	4.17	Sbalzo posteriore	l_5	mm	457	457
	4.18	Larghezza piano di carico	b_9	mm	1060	1060
	4.19	Lunghezza complessiva	l_1	mm	2996	2996
	4.21	Larghezza complessiva	b_1	mm	1300	1300
	4.32	Altezza di guado – centro dell'interasse	m_2	mm	205	205
	4.35	Raggio di curvatura anteriore	Wa	mm	3170	3170
	4.35.1	Raggio di curvatura posteriore		mm	2040	2040
	4.36	Raggio di curvatura interno	b_{13}	mm	1340	1340
	4.36.1	Larghezza corridoi per volta a 90°		mm	2500	2500
PRESTAZIONI	5.1	Velocità operativa a carico / a vuoto		Km/h	14 / 25	12 / 25
	5.5	Sforzo al gancio orario con carico		N	-	-
	5.5.1	Sforzo al gancio orario senza carico		N	5800	5800
	5.6	Sforzo al gancio massimo con / senza carico		N	- / 18000	- / 20000
	5.7	Pendenza superabile a carico / a vuoto		%	vedi diagramma	vedi diagramma
	5.8	Massima pendenza superabile a carico / a vuoto		%		
	5.10	Freno di servizio / parcheggio (I=Idraulico E=Elettromagn. M=Meccanico)			I / I	I / I
	5.10.1	Tipo freno di servizio anteriore/posteriore			disco / dischi multipli	disco / dischi multipli
MOTORE ELETTRICO	6.1	Potenza nominale motore trazione S2 60 min		kW	2*10	2*10
	6.1.1	Potenza nominale motore sterzo S2 60 min		kW	0,6	0,6
	6.3	Batteria secondo DIN 43531 /35 /36 A, B, C, no			DIN 43536A	DIN 43536A
	6.4	Voltaggio batteria	U	V	80	80
	6.4.1	Capacità nominale	K_5	Ah	620	620
	6.5	Peso batteria		Kg	1565	1565
	6.6	Consumo di energia (ciclo VDI)		kWh/h	-	-
VARIE	8.1	Tipo di trasmissione			inverter AC	inverter AC
	8.4	Livello del suono all'orecchio dell'operatore DIN 12053		dB(A)	69	69
	8.5	Accoppiamento di traino, tipo DIN			-	-

Questa scheda tecnica indica i valori tecnici del trattore elettrico / trasportatore elettrico a pianale secondo la norma VDI 2198. Le dimensioni sono orientative e possono essere variate. Le prestazioni sono da intendersi per macchina nuova di fabbricia, a rodaggio completato; sono rilevate nello Stabilimento di San Donato Milanese in condizioni climatiche normali. Prestazioni e pesi sono dati con motore e batteria di serie (evidenziata in grassetto) e con ruote con anelli superelastici. Equipaggiamenti diversi possono variare alcuni valori.

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Figure 1 - Technical specifications of electric tractor Simai TE252

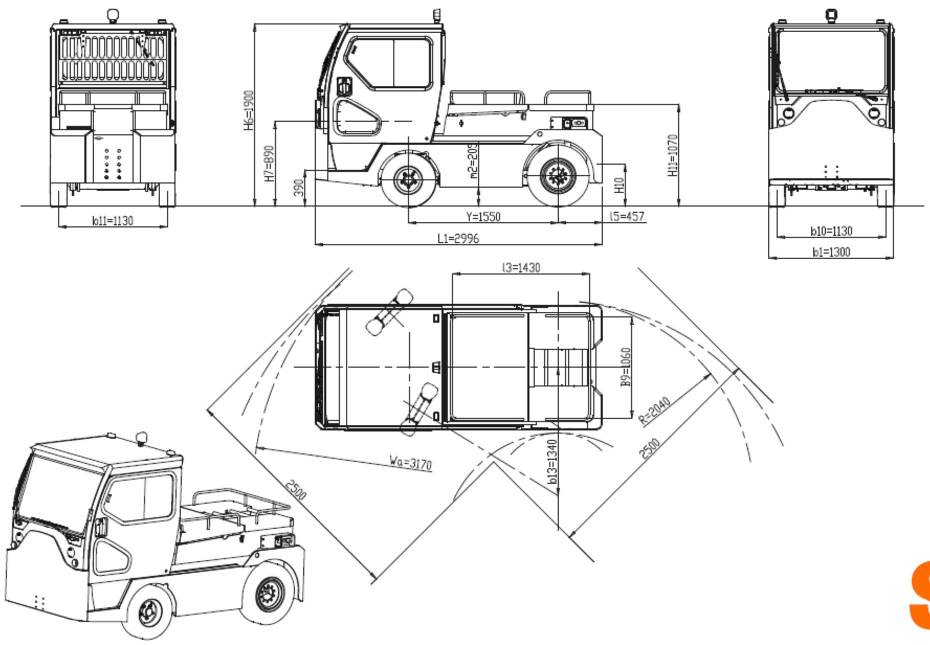

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Figure 2 - electric tractor size Simai TE252

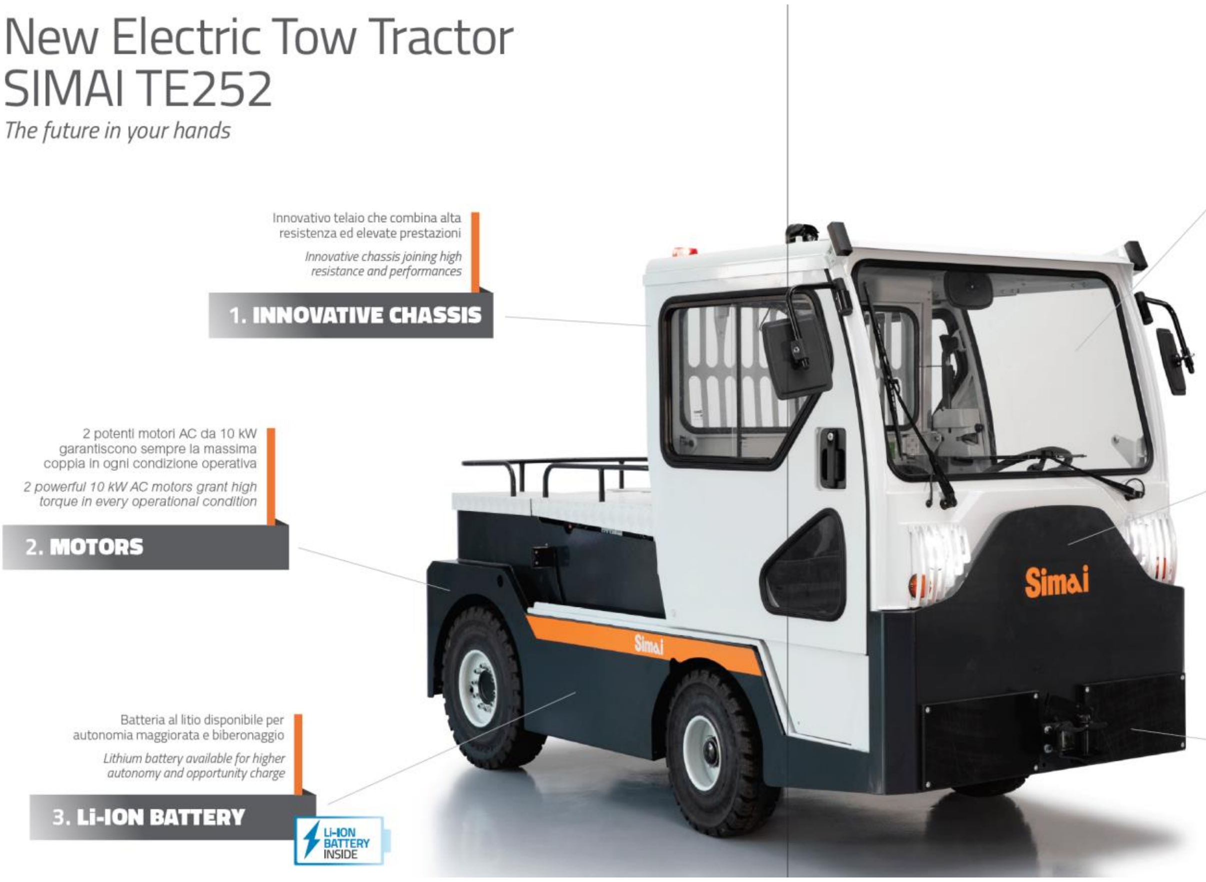

Figure 3 - LI-ION Battery for Simai TE252