

# Soft Li-ion battery systems for hybrid and electric vehicles

Increasing energy efficiency and meeting environmental challenges



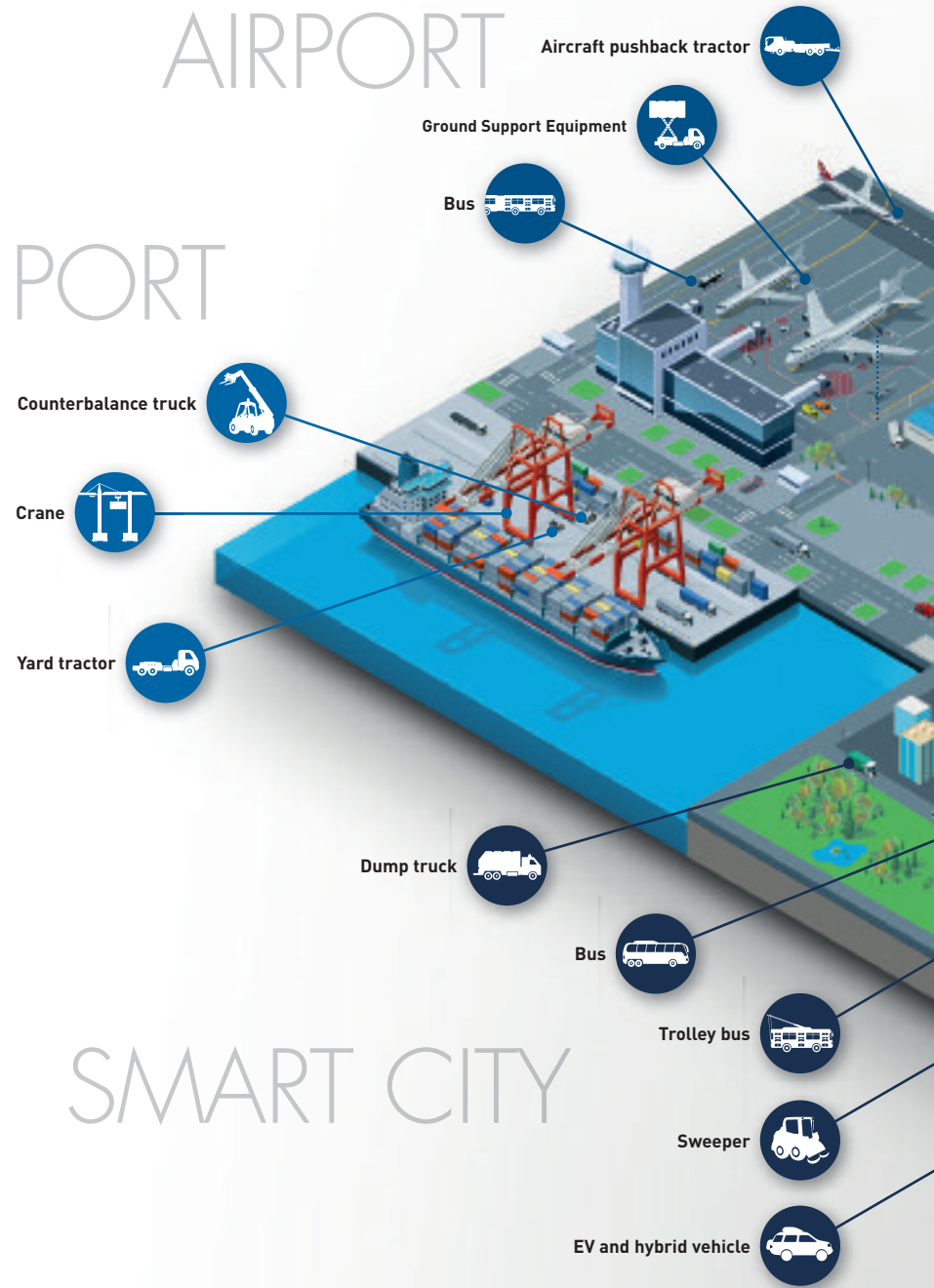
**SAFT**

# Saft Li-ion battery systems: **meeting the**



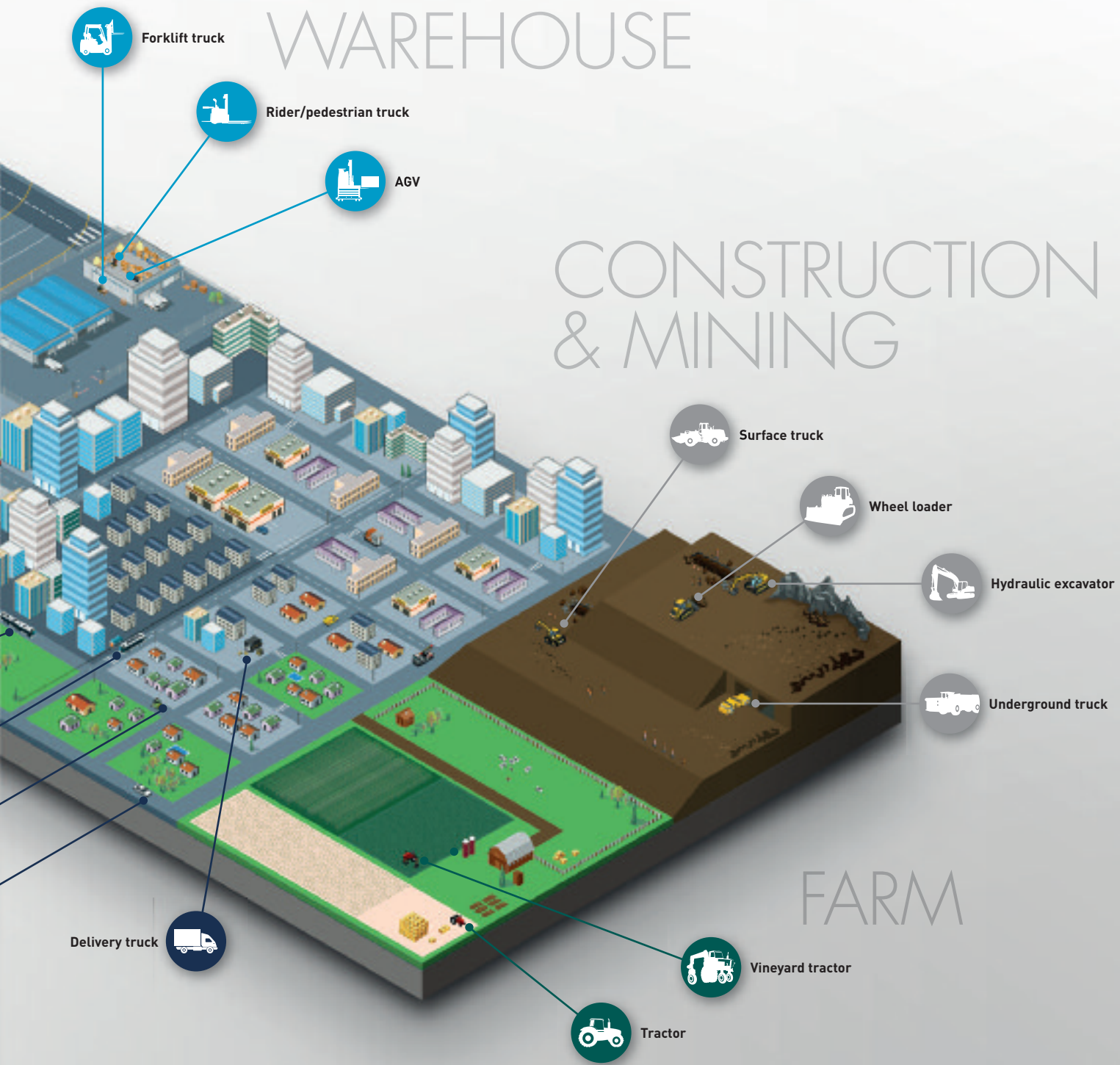
Driving modern transportation services with Saft's Li-ion battery know-how

The twin challenges of global climate change and dwindling fossil fuel reserves are driving development of electric vehicles (EVs) - including hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs). Saft's battery know-how is focused on specific applications where electric propulsion ensures efficient and sustainable operation that reduces vehicle running costs throughout an extended service life.





# needs of sustainable transportation



# Saft – the power for sustainable transportation



## On-road for smart cities – down to 'the last mile'



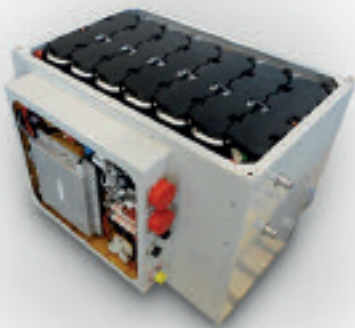
Today, there is considerable legislation to replace conventional internal combustion engine vehicles operating in busy cities with electric powered alternatives that eliminate local emissions and reduce noise nuisance. These advanced modes of public, freight and amenity transportation offer sustainable solutions that cut pollution and enhance quality of life for city workers and residents.

## Off-road for efficient industrial equipment



Saft's Li-ion technology has important advantages over lead-acid batteries when powering electric warehouse forklift trucks and AGVs. These include: opportunity and fast charging, higher energy efficiency, longer cycle life and reduced maintenance. Also, Saft's Li-ion eliminates the frequent water topping up and thus reduces associated maintenance costs. Industrial vehicles, such as mining and farm trucks, are now integrating hybrid functions for specific environments where electric motors bring major benefits over internal combustion engines. Electrified Ground Support Equipment (GSE) is also particularly attractive for airports and seaports that are under growing pressure to reduce CO<sub>2</sub> emissions, fuel consumption and noise.

Saft provides complete, fully-integrated battery solutions tailored to customer needs



**Saft Lithium-ion battery systems ensure optimal performance and reliability of each vehicle's operation. Saft Li-ion battery systems are a key enabler that makes electric vehicles a practical reality for even the most demanding applications, given their greater energy density, lower weight and longer life capability.**

# Soft Li-ion battery systems: offering maximum flexibility and modularity

## Soft's Modul'ion® range

Electrical characteristics  
(at 25 °C)

MEDIUM POWER				POWER	
Modul'ion®-6	Modul'ion®-14	Modul'ion®-12	Modul'ion®-12	Modul'ion®-12	Modul'ion®-12
20.41 MFe	24.82 MFe	20.89 MFe	40.41 MFe	20.60 PFe	40.30 PFe
20 V	24 V	20 V	40 V	20 V	40 V
19,8	23,1	19,8	39,6	19,8	39,6
41	82	82	41	60	30
812	1 894	1 623		1 188	
131	124	141		103	
101	109	103		75	
Natural convection		Liquid cooled/heated		Liquid cooled/heated	

## Versatile fully-integrated modules for a choice of power and energy

Soft has developed its Modul'ion® range as the basis for the creation of vehicle battery systems that deliver high power, fast charging and high energy density. The modules are available in 20 V and 40 V, 24 V in both Medium and High Power versions. Combination of series and parallel assembly enables configuration up to 1 000 V. All modules incorporate Soft's electronic board for the cell voltage and temperature monitoring and balancing functions that are vital for the safety of the complete battery system.



Modul'ion®-6  
20 V



Modul'ion®-12  
20 V & 40 V



Modul'ion®-14  
24 V





# Saft's next generation energy technology empowers future mobility



## Saft's 100 year experience in energy storage solutions

Saft is the leading supplier of hybrid Li-ion energy storage systems for military programs, satellites, space vehicles, aviation, telecoms and storage for renewables energies applications.

Saft has over 20 year experience in the development and volume delivery of nickel-based and lithium-ion (Li-ion) batteries for electric and hybrid vehicles. Numerous customers applications rely on Saft's Li-ion systems performances

to achieve their energy saving objectives, to reduce noise and CO<sub>2</sub> footprint, to limit maintenance, all leading to deliver a reduced overall Total Cost of Ownership (TCO).

Customers seeking innovations in their markets can rely on Saft's unique technology platform and industrial know-how in Li-ion battery systems for the industrial hybrid and electric vehicle market.

### Saft Li-ion battery systems deliver a variety of features and benefits

- Fast charging optimize use of vehicle during its work shift
- Enhanced cycling performance improves TCO of vehicle
- High rate charge and discharge capabilities for cells and modules enables more efficient regenerative braking
- Built-in battery monitoring and information (State of charge - SOC, State of health - SOH...)
- Battery communicates relevant diagnostic information to the host application
- Remote access to battery information capable

## Saft: quality, safety and environmental standards

**Quality:** ISO TS 16949, IRIS, ISO 9001, Saft World Class Continuous Program

**Transport:** UN 2795, UN3480, class 9 (group II)

**Transport regulation:** ADR, IMDG Code, OACI/IATA

**Environment:** ISO 14001, fully recyclable

**REACH:** Saft has adopted internal procedures to ensure conformity with the European Reach Regulations.

**RoHS:** Although batteries and accumulators are not within the scope of the RoHS directive, Saft has taken voluntary measures to ensure that the substances forbidden by RoHS are not present in the battery, with the exception of the electro-chemical core.



## Industrial scale Li-ion manufacturing in Europe and the US

Saft has developed multiple lithium-based battery chemistries and a broad portfolio of Li-ion cells in cylindrical and prismatic formats to suit various market requirements:

- Oxide based cathodes:  
NCA, NMC, Blends
- Iron Phosphate technology:  
SLFP® patented chemistry

Saft' sites in Jacksonville (US), Nersac (FR), Poitiers (FR), and Raskovice (Czech Republic) manufacture at industrial scale level the different cells, modules and Li-ion systems. Saft supports its customers throughout their project and the application life cycle, from first design concept, through prototyping and testing to large scale manufacturing.



## Research and development centre

Advanced R & D activities are carried out at sites in Bordeaux (France) and Cockeysville (US) by a multidisciplinary team of engineers and research scientists dedicated to the development of lithium-ion solutions. Saft's reputation is founded on its technological leadership and it devotes a significant proportion of its revenues to maintaining this advantage. More than 10% of sales are reinvested in research.

# Saft is committed to the highest standards of environmental stewardship

As part of its environmental commitment, Saft gives priority to recycled raw materials over virgin raw materials, reduces its plants' air and water releases year after year, minimizes water usage, reduces fossil energy consumption and associated CO<sub>2</sub> emissions, and ensures that its customers have recycling solutions for their spent batteries.

Regarding industrial batteries, Saft maintains long standing partnerships with collection companies in most EU countries, in North America and in other countries. This collection network receives and dispatches our customers' batteries at the end of their lives to fully approved recycling facilities, in compliance with the laws governing trans-boundary waste

shipments. Saft has selected a recycling process for industrial lithium-ion cells with very high recycling efficiency. An updated list of collection points is available on our Web site. Please contact your local representative for further information.



## Saft

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