

LOCAL SUPPORT, TOTAL COMMITMENT

# Green Ground Support Equipment



TXL-737-E battery powered loader. TLD has already sold more than 100 electric loaders in the world.

**TLD Green**   
**TLD**  
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# GREEN, CLEAN and Energy EFFICIENT

GREEN, CLEAN and Energy EFFICIENCY have driven our engineering efforts for years and the industry continues to invest and innovate in that field

GREEN is not only synonym of ELECTRIC/FC, it means for TLD global energy efficiency optimization and emission concern (CO2 and other particulates)

Latest emissions standards on Diesel engines also dramatically reduced the environmental impacts.

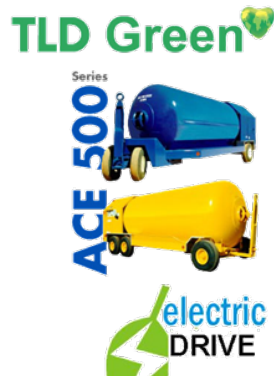
GREEN operations is also a key factor to reduce emission at the airport. APU off policy, idling reductions, parking layout optimization...



**TLD Green**  What GREEN means?



TLD offers a complete range  
of **Green, Clean and Energy  
Efficient GSE**



**TLD Green** Green equipment availability





# Reducing the industry Environmental Footprint by shutting down the turbines on the airport



**Some Diesel driven GSE are Green by definition as they allow the A/C APU shut down at the airports and globally save much fuel and CO2 emission: a “WIN WIN” plan !**

- Shutting down APU has not still be generalized yet on all airports and by all airlines
- Billions of dollars spent on airports with APU fuel consumption
- Millions of tons of CO2 that could easily be avoided by shutting down APU's and using GPUs, ACUs and ASUs with latest engine and smart control systems.



## Fuel consumption and gas pollution during taxiing mainliner airplanes by the year 2020:

- Fuel consumption - \$7.3B
- CO2 emission - 23M ton
- CO2 tax emission is estimated - \$440M  
(European authorities programmed to start charging carbon emission tax from airlines in 2012 – transferred to ICAO analysis)
- FOD damage during taxi over - \$700M
- Taxiing incursion avoidance is a major concern of today civil aviation authorities

**Total annual expense over 8.4B\$ and 23M ton CO<sub>2</sub>**

Based on: SH&E calculated oil prices of \$2.97 per gallon at 2020

## The dispatch towing solution:

- To reduce fuel consumption and emissions on the ground, one solution is to tow the A/C with tractor instead of the A/C using their engines.
- This is what we call the Dispatch towing
- However, it is complicated because of pilot reactions, NLG induced stress and airport infrastructures

# TAXIBOT





- **The TaxiBot (Taxiing Robot) concept** – a Pilot Controlled semi-robotic airplane taxiing towbarless tractor
- **Retaining the principle** – Pilot in Command at all times along the taxiing process, using the same airplane controls as in normal taxi (“transparent to the pilot”)
- **Reducing loads on NLG** – Pilot braking by Main Landing Gear system – as opposed to tractor braking
- **Engines off** – Engines will be turned on at taxi end, only shortly before take-off to enable warm-up and checks
- **Safety driver** – For pushback, emergency and return phase

**Decrease annual expense from 8.4B\$ to 2.9B\$**  
**Decrease CO<sub>2</sub> emission by 20M ton per year**

# Going further towards near zero emission Ground Support Equipment

**GSE offers significant potential for emission reduction as it has some specificities that ease the conversion to clean energy :**

- Captive fleet/Low mileage
- Confine environment in the airport perimeter
- Minimum constraints related to weight/vehicle architecture
- Peak and Valley activity

**But the aviation world (conservatism), and its complex organization with Airports authorities, Airlines, Ground Service Providers, is sometime an obstacle:**

- Complex regulations
- Infrastructures adaptations
- lack of knowledge on duty cycle

## Main Potential solutions explored in the industry:

- Gas/CNG/LPG: Not a real alternative to Diesel
- Electrical from the grid:  
Point of Use equipment at Jet Bridge for Electrical Power and Preconditioned Air are already well spread on the market;

Some experimental Cargo Loaders use diesel for drive system, and “plug in” electrical for operation at stand.

# Main Potential solutions explored in the industry

## - Electrical with Lead Acid battery:

Popular choice for tow tractors, belt loader and other vehicles in the same power range that service the aircraft:

- Proven solution, from the shelf components available
- 48 or 80 V standard systems
- No special maintenance training
- 8 hours night recharge compatible with operation

Lead Acid batteries have also been successfully used for more demanding applications like regional and narrow body conventional and towbarless pushback tractors, but also on Cargo Loaders.

**Infrastructure related to charging infrastructures remain a problem in some airport but Globally Technology is well accepted in the industry.**



## Main Potential solutions explored in the industry

But when the applications require more energy (cargo tractor application, long distance towing,...), lead acid battery are not without their drawbacks: range can be limited, remote charging facility, the battery swapping/charging infrastructure complex and slow.

### - Electrical with Advanced Lithium Battery:

More solutions on the market with Advanced battery, more affordable (still 4 times more expensive) but with shorter charging time, more charge/discharge cycles, more tolerant to opportunity charge.

Manufacturers now package Drop-in-Place replacement Li Battery for 80V lead acid battery, with minimum change on vehicles.

If cost trend is confirmed, it remains a good solution for tow tractors, belt loader and other vehicles in the same power range

# Main Potential solutions explored in the industry

## - Hybrid Diesel-Electric

Hybrid series and hybrid parallel are proposed on the market for tow tractors but it remains a marginal solution for specific application as not cost effective.

Experimental WB Towbarless tractor is currently under evaluation at FRA.

Most applications are using Advanced Lithium Battery

# Main Potential solutions explored in the industry

## - Hybrid FC

Fuel cells can offer the same displacement benefits in GSE as they have done in some materials handling vehicle market: longer runtimes, lighter systems and compact, and fast refueling.

Industry start to offer Fuel Cell packaged with the same form, fit, and function as the 80V Battery

Experimental fleet are currently evaluated.

This is a major step to ease the introduction of such technology more widely.

## Main Potential solutions explored in the industry

- Hybrid FC

But cost remain remains high and only few equipment, or applications can support this extra cost: special tow tractor operations, intensive cargo operations...

Liquid Hydrogen infrastructure installation is also seen as a challenge by most operators with new regulations.

Some experimental FC GSE were simply rejected as H2 next to the A/C was considered as a potential risk.

# The challenges for Hybrid FC Success in GSE:

- Select the right application where the economical equation can make sense to operators:
  - Focus on Duty-cycle, applications, not on potential volumes
  - Mobile GPU is often seen as a good potential application for FC in GSE
  - Battery Range Extender can also be a solution to address some demanding Electric applications (to replace diesel electric solutions)
  - Small “Power to Gas” facility to supply “green Power” to battery charger, and H<sup>2</sup> to FC GSE.
- Hydrogen needs to be “demystified” at the airport:
  - Guidelines, standards needs to be developed: SAE?



# Support Quality Innovation

Our continuous common goals