# ITEZZE Conversion of Mines to Electric Operation (Sept 2021)

## Synopsis

The global mining industry recognises its responsibility to contribute to a sustainable future and is committed to an ongoing reduction of greenhouse gas (GHG) emissions and achieving net zero GHG by 2050. Additionally, with future oil price and supply risks forecast to increase, the industry has embraced the ambitious goals and recognises it requires innovative solutions and advanced technologies to ensure mine operation performance and outputs remain effective, efficient and within customer and shareholder expectations.

# The Oil Issue –

The world passed Peak Oil last year (2020) - Peak Oil is where global output reaches a peak and then begins to decline terminally. Oil output is currently down 5½ million bpd (on 2019 figures) and is dropping by around 3.7 million barrels per day (bpd) per annum; this has been forecast for years – the only difference is that now it has happened. (Refer video links below).<sup>i</sup> Global GDP is dependent on oil. Oil demand fell as the Pandemic cut GDP but is now rising again.

Natural Decline is where conventional ('gusher type') wells/reserves reach an individual peak and then decline at 3-5% of production per annum. HSBC Bank said in 2016 that 81% of global reserves are in Natural Decline<sup>ii</sup>; this equates to 3-5 million bpd of world output being lost per year.<sup>iii</sup> Global oil output (from wells) peaked at 102 million bpd; it is currently down to around 97 million bpd. When the world resolves its Pandemic Issues and begins to travel again, an oil crisis will erupt. US Fracked oil had been building up output to replace the *Natural Declines*, but Fracked oil is very short term – the average well life is 4-7 years; thus, new wells need to keep being drilled to replace the old ones. President Biden as part of Democratic Party national policy has banned the drilling of fracked wells on federal government land and output from US fracked wells has started to drop. The expected declines in production will cause an *Oil Crunch*.<sup>iv</sup> It is expected that oil prices will hit US\$100/barrel in 2021 (comments of various analysts and oil executives)<sup>v</sup> and reach US\$200 a barrel within 1-3 years. Some Analysts expect it to reach \$300/barrel, and the IMF in a 2012 study modelled a 1400% price rise.<sup>vi</sup>

## Mining

Mining trucks are the lifeblood of mine sites around the world. 220-ton mine haul trucks use on average 200 litres of diesel per hour (Downer advice in a 2016 meeting). It can range from 185 to 240 L/hour. Oil prices of USD200/barrel equates to around AUD2-3/liter and USD300/barrel equates to AUD4+/liter. The diesel price (in Australia ex rebate) is \$1/litre. AUD4/Liter decimates most mine operations. Some mines use over 50 million litres per annum<sup>vii</sup>. It is apparent that the combination of GHG reduction targets and global oil price and supply risks necessitates a dramatic shift in the operations of mining trucks.

With electric vehicles now recognized as the solution and future of the global truck and transport industry 21 international mine companies recently launched the *Charge On* Mine Innovation Challenge in an effort to understand the requirements to convert their Haul Trucks from diesel electric to 100% electric. ITEZZE (*IT & ES Industries (Oz) Pty Ltd*) is on the shortlist as one of the companies to work with a mine company to roll out an onsite demonstration system. While scoping the challenge, the Charge on Consortium identified that they need a system to provide 400 kWh of power for 47 minutes (enough to power 60-80 houses for 1 hour).<sup>viii</sup>

This creates a recharge issue as the new Volvo electric truck has shown<sup>ix</sup>. It has a 264 kWh battery that takes 70 minutes to recharge. Hence, it would take at least 100 minutes to recharge a 400 kWh mine truck battery safely. Forcing electrons into batteries can damage the battery which reduces battery life.<sup>x</sup> A mine truck which uses 400 kWh in 45 minutes can't use batteries that take 100 minutes to recharge unless they're swap batteries. (The alternative would be to triple the size of the vehicle fleet so two vehicles can charge their fixed batteries while the third one performs the haul cycle on site).

The patented ITEZZE mine truck swap battery system overcomes this issue with battery<sup>xi</sup> swaps executed in under 1½ minutes at the haul cycle point where trucks line up for the 'Crusher'. This was specified in the mine Challenge as the preferred location and time to achieve a recharge or battery swap. ITEZZE 220-ton haul trucks take a 430 kWh battery robot (known as a 'PIG' – Precision Independently Guided Robotic Battery Drone) that autonomously moves from the recharge site (PIG Recharge Station) to the Battery Swap station (see video)<sup>xii</sup>



or roadside swap bay. Haul Trucks are diesel electric with a generator running electric motors. The generator can be replaced with a swap cradle to accommodate an ITEZZE PIG (*see Diagram 1*). Mines will use different size PIGs for mine haul trucks, excavators, shuttle buses or other equipment.

Diagram 1



Replace with Swap Cradle to take a Robotic 'PIG' Battery.

Mine Trucks can be retro-fitted.

PIGs load onto and off trucks, excavators etc. using a ramp system. ITEZZE entered the *Charge-On Innovation Challenge* proposing a 'long ramp' swap system *(see Diagram 2)* but, given the ultra-fast swap times that would be needed by miners as specified in EOI requirements, it was determined that a short ramp and loading dock system would be used to reduce exchange times to less than 1½ minutes (potentially 1 min 10 secs). Long ramp systems can be used for excavators and other equipment that don't have the mobility of mine trucks and don't move around the site. The short ramp and dock system (which has a raised reinforced concrete base for loading PIGs) is the preferred way to service mine trucks and long-haul freight trucks.

Diagram 2 Trucks can use long ramps for roadside battery swaps or Short-Ramps for swaps at loading docks.



ITEZZE runs a 'Triple Battery System' so the vehicle has three (3) batteries:

- a (built in) 'resident' battery which can be a primary power source;
- a (built in) 'regen battery' which takes and stores the regenerated power from the hub motors as the vehicle brakes (or goes downhill) for later use; and
- the 'swap battery' which can be replaced and swapped.

The vehicle can run on the *Regen* and *Resident* batteries without a swap battery. In small vehicles like cars the *Regen Battery* can be 2-3 kWh and the *Resident Battery* may be 15-30 kWh. In mine haul trucks the *Resident Battery* may be 50-70kWh and the *Regen Battery* (because of the massive amounts of power that a mine truck





may regenerate going downhill) may be 100-150 kWh. The **Resident Battery** can be recharged from main or grid supplies; or from the **Regen Battery** or from the **Swap Battery**. ITEZZE in different formats works for most types of vehicles - cars, trucks, buses, 4WD's, commercial vehicles and other equipment like tractors, harvesters, farm machinery and pumps for irrigation plus bulldozers and excavators. Suppliers can register to supply parts or receive a license to manufacture equipment/machinery for the ITEZZE global rollout

# Retro-fitting

Retro-fitting is the preferred mechanism for changing an existing mine site over to ITEZZE. The PIG Re-charge Station and the Swap Stations are built then trucks are retro-fitted (and replaced) <u>onsite</u> one at a time. On-site recharging and swap technology is maintained and overseen only by ITEZZE licensed operators.

## On Mine sites a single PIG Recharge station can recharge the different size PIGs for running the whole mine



#### **ITEZZE Mine Truck Swap Station**

In operation, PIGs move along service roads from the PIG Recharge Station to the Swap Stations under their own power. They move robotically on the service roads using GPS and Wi-Fi positioning poles for guidance.



The swap station has multiple PIGs operating on it. Each PIG weighs approximately 11.7 tons. Loading Docks on the swap bays are about 3 meters above ground level. Construction of these is a major logistical exercise that takes at least 15-17 months. Each mine with 100 Haul Truck will require around 500-600 PIGs.



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#### Front View of Trucks at Loading Dock



Mine Truck ramps (Long and Short) fold-up inside front grill but can deploy at command.





# Other Vehicles

Cars, Utes and 4WDs and other vehicles use robotic 'Kiosk' systems to recharge and provide Swap Batteries. Swap Batteries range in size from 21 kWh to 70 kWh. The swap batteries are positioned in cars by robotic arms on the kiosk that fit them into swap battery slots in the front of the vehicle. Robotic arms on Kiosks can replace batteries up to 70 kWh (Max weight 890 Kg). Other vehicles requiring larger swap batteries can use mini-PIGs. Freight Trucks can use PIGs for long distance travel and can use an ultra-fast PIG changeover system.





# **Kiosk and Vehicle**



#### Mine Site Set-up - Key Considerations

It may take 15-18 months to construct swap station and recharge infrastructure on a mine. ITEZZE by locating Emergency Swap Stations along haul truck roads reduces the risk of loss from battery failure. PIG factories are built on the basis of orders. Solar/LNG generating capacity is required for most mines. Re-charge facilities are made prior to on-site installation; hence registration is essential for mines wanting to convert their sites.

## The Urgency of Changing over to ITEZZE

Oil supply is currently collapsing. Oil production is dropping by around 3.7 million barrels per day per year. To prevent societal collapse the move to electric is needed. The av. Australian household uses 60 liters of fuel per week; a price increase of AUS\$1-70/liter takes over AUS\$100/week from their <u>after tax</u> disposable income; so, they stop spending on other things and the ripple effect then destroys the economy. Western households are all similar. Oil is integral to modern society. In order to prevent oil prices passing \$140/barrel (some oil execs are already talking US\$170 /barrel) <u>over</u> 74 million new electric cars and trucks need to be sold pa. Doing this will replace the drop in oil output as it falls with reductions in vehicle use and removes upward pressure on oil prices. Every year for the next 10 years this has to happen and <u>new</u> power needs to be generated to run these EVs twice as much as is sold per year now. According to the Office of the Chief Economist in 2015, prior to EVs becoming popular, oil provided 2142 PJ of Australia's energy and electricity - 803 PJ. So, new electricity will be needed and the Grids cannot handle the draws from fast charging from 6-8 am in the morning and 4-6 pm in the evening, so mines will need their own dedicated power supplies provided by themselves or third parties.

#### Conclusion and to Register with ITEZZE –

ITEZZE solves the problems of range constraint; reduces EV prices to under US\$23,000 and gives EVs '*petrol convenience*.' There will obviously be strong uptake by many parties which may cause equipment and material shortages. Switching to electric takes time/planning, so mines should register asap. For info or to apply: Call ITEZZE on +61 1300 483 993 or email: mineregistration@itezze.com and cc: corporate@itezze.com.au

The Videos – A Crude Awakening - The Oil Crash

<sup>11</sup> Are We Sleepwalking Into The Next Oil Crisis? <u>https://oilprice.com/Energy/Energy-General/Are-We-Sleepwalking-Into-The-Next-Oil-Crisis.html</u>

<sup>iv</sup> See: The Catalyst Video: The Oil Crunch - https://www.abc.net.au/catalyst/oil-crunch/11012836

<sup>&</sup>lt;sup>xi</sup> Battery swaps means the batteries can take time to recharge without damaging the battery inward structure. Hence, mine trucks using ITEZZE have 4 -7 swap batteries per truck that recharge slowly in a safe format and then are dispatched to replace the mine truck batteries as required.
<sup>xii</sup> Video: ITEZZE Mine Technology System at <a href="https://www.dropbox.com/s/jwxs4a7r4u9cdb0/Mine%20Truck%20Swap%20Animated%20Graphic%20Video.mp4?dl=0">https://www.dropbox.com/s/jwxs4a7r4u9cdb0/Mine%20Truck%20Swap%20Animated%20Graphic%20Video.mp4?dl=0</a>



References – Oil Trading Giant Trafigura Sees \$100 Oil In Late 2022 | OilPrice.com

<sup>&</sup>lt;sup>III</sup> Oil Price Spike Inevitable As New Discoveries Hit Seventy-Year Low | OilPrice.com Oil Discoveries Hit 70-Year Low | OilPrice.com

<sup>&</sup>lt;sup>v</sup> Vagit Alekperov: Oil prices above \$100 may bring down the market ABC.AZ and As Middle East tensions boil over, why isn't oil surging back to \$100 a barrel? - ABC News & Oil Trading Giant Trafigura Sees \$100 Oil In Late 2022 | OilPrice.com and https://oilprice.com/Energy/Oil-Prices/Why-Bank-Of-America-Thinks-Oil-Prices-Are-Heading-To-100.html <sup>w</sup> The IMF Working Paper WP/12/256 - Oil and the World Economy: Some Possible Futures https://www.imf.org/external/pubs/ft/wp/2012/wp12256.pdf (his makes scarry reading since the World passed Peak Oil last year (2020) and they can't model a dramatic and sustained drop in production that the world is experiencing).

vii Report - Diesel Use in Australia

<sup>&</sup>lt;sup>viii</sup> See <u>https://chargeoninnovation.com</u>. The figure of 400kWh compares (on the basis of Australian grid numbers) with 315 kWh for a substation serving 60 homes.
<sup>ix</sup> See video on page at: <u>AB Volvo buys Chinese vehicles business for about SEK 1.1 billion (msn.com)</u>

<sup>&</sup>lt;sup>x</sup> Hyundai and GM have both recently had to recall Electric Vehicles to replace their batteries. A Tesla recharge unit which can technically produce 300 plus KW of power takes 1 hour and 3 minutes to put 200 miles of power into a 70 kWh Tesla Model 3 battery. This is probably because doing it any faster may damage the battery. See following (on limits to fast recharge): <u>https://www.economist.com/science-and-technology/new-800v-electric-cars-will-recharge-in-half-the-time/21803666</u>.