ecolution kWh

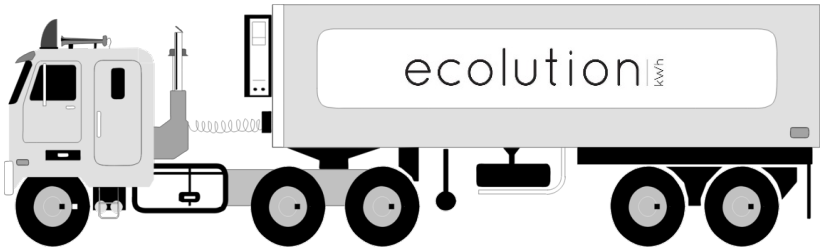
ECOLUTION POWER COMPANY PRESENTATION

SEPTEMBER 2020

MISSION STATEMENT

Eliminate emissions from the supply chain for food and medicine, while creating an e-mobile electric power company and delivering energy in scale to towns, cities and places where it is not readily available…

A JUST-IN-TIME ROLLING ELECTRIC GRID



INTRODUCING THE FIRST ZERO EMISSIONS REEFER TRAILER

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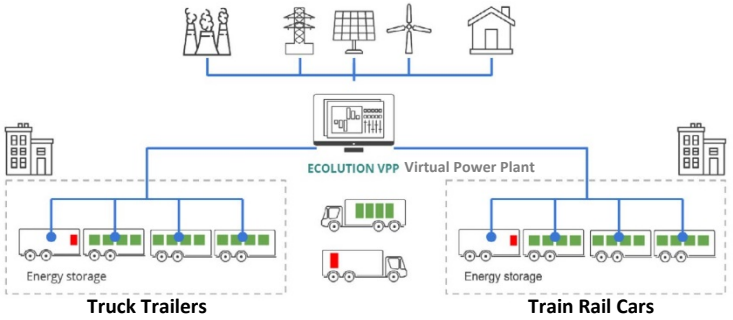


INTRODUCING THE FIRST ROLLING ELECTRIC GRID

KEY LEADERSHIP

Ecolution Power Company is a minority owned business

FOUNDERS

Johanne Medina
CEO

- Visionary self-motivated leader, highly focused and driven by challenges
- Created the vision and path forward for Ecolution
- 20+ years of management experience. His leadership and financial skills helped successfully raise $170M of private equity during the past 3 years

Johnny Then-Gautier
CTO

- Inventor and creator of the Module Active Response System (**MARS**) technology platform
- Beginning in 2015, he worked tirelessly to optimize and build the net zero emissions power generation technology
- Education: BA in International Relations from Universidad del Caribe in Dominican Republic

Craig Bouchard
Executive Chairman

- Co-founded three metals companies that achieved over $1 billion of revenue within 18 months
- Nominated for CEO of the Year in the Global Metals Industries 2018, S&P Platts Annual Awards
- Mentor, impartial, objective, approachable and tactful

Angel Lockward
Co-founder

- Ability to engage and motivate others
- Work discipline, sense of responsibility and resourcefulness to find creative solutions to solve problems
- Education: MBA in Marketing and Negotiations from Universidad Camilo Jose Cela in Madrid

Dr. Luis De Los Santos
Co-founder

- Ph. D. in Agricultural Economics from the University of Göettingen, Germany. Talca University and Pointifica Catolica Madre y Maestra, Dominican Republic
- His work has been funded by several institutions including the Inter-American Development Bank, Food and Agricultural Organization of the UN, US Agency for International Development, Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)

KEY LEADERSHIP

BOARD OF ADVISORS

Ecolution and its game changing technology has been carefully sculpted by world-class team of entrepreneurs and innovators

Richard Giromini

- Is an industrial manufacturing leader with 40+ years of experience in the automotive and commercial transportation industries
- Served as Wabash National Corporation's Chief Executive Officer through 2018. Under his leadership Wabash National grew to a $2 billion+ company, achieving all-time records in revenue and profitability
- Past services include Chairman of the Truck Trailer Manufacturers Association (TTMA)

Ernest Matsuo Higa

- Currently serves as the Chairman, President and CEO of Higa Industries Co., Ltd. And CEO of Wendy's Japan K.K
- A 3rd generation Japanese-American entrepreneur
- In addition to his business activities, he serves on the Board of Overseers at Columbia Business School, is a member of Keizai Doyukai (Japan Association of Corporative Executives), and is the Chairman of the Board of Councilors of US-Japan Council

Jack M. Greenberg

- Currently serves on the Board of Directors of InnerWorkings, Inc. as its non-executive Chairman
- At the end of 2002, he retired as Chairman and CEO of McDonald's Corporation where he has served since 1991
- Previously, he was Partner and Director of Tax Services for the Midwest Region and Chicago office or Arthur Young & Company
- He is a member of the American Institute of Certified Accountants

William Farley

- Sole shareholder of Liam Ventures, Inc., a private equity firm with investments in various industries
- From 1986 to 1999, he served as Chairman and CEO of Fruit of the Loom, Inc. (FTL)
- Built FTL from a domestic $500 million underwear company into a leading intl. manufacturer and marketer of apparel with sales approximating $2.3 billion for the 1999 fiscal year. FTL was sold to Berkshire Hathaway for approx. $1 billion

Randolph C. Read

- Has served as CEO, COO, CFO and a public company Chairman of the Board, including various ventures of the past 39 years partnered with Michael Milken
- Since 2009, he has been President and CEO of Nevada Strategic Credit Investments
- Additionally, he serves as Audit Committee Chairman for SandRidge Energy, Inc. and Special Committee Co-Chairman for Luby's, Inc

KEY LEADERSHIP

ADVISORS

Ecolution and its game changing technology has been carefully sculpted by world-class team of entrepreneurs and innovators

John Lee
CRO

- Specializes in supporting venture-backed Government Anticipated Technology companies with their Government go-to-market strategy and mission/market-led product strategy
- Dual Tech Operator with over a decade of experience negotiating and awarding major systems contracts with the defense industry
- As Contracts Directorate has managed Govt funds in excess of ~$3B for various U.S DoD Programs

Robert Burkart
Engineering

- Automotive & Aerospace Engineer
- Experienced in CIO with a demonstrated history of success in varied industries including aerospace, building materials, and advertising
- Currently, he is leading the ERP deployment and digital transformation projects at InnerWorkings
- Additionally, he is serving as chair of the cyber security and incident response committees, reporting to the Board of Directors
- Pragmatist

Justin Bouchard
Strategic Financing

- A technologist and pioneer in the use of quantitative data in electronic algorithmic trading
- Founded several trading firms including DV Trading, Bouchard Trading
- Founder of AlgoFast: the first fully cloud based commercial algorithmic trading platform
- Macro-Economic Event Trader, HFT Market Maker, Quantitative Data Specialist, Financial Futures Broker
- Early Angle investor in Authy and architect of CO2 restricted financial futures suite

Eric Korita
Business Development

- World class competitor
- 15 years developing strategic partnerships
- Principal partner in three private companies
- VP of sales in the public and private sector
- Determined, enthusiastic and creative

0 **Zero Emissions**

1 **ONE** GLOBAL ENERGY PLATFORM

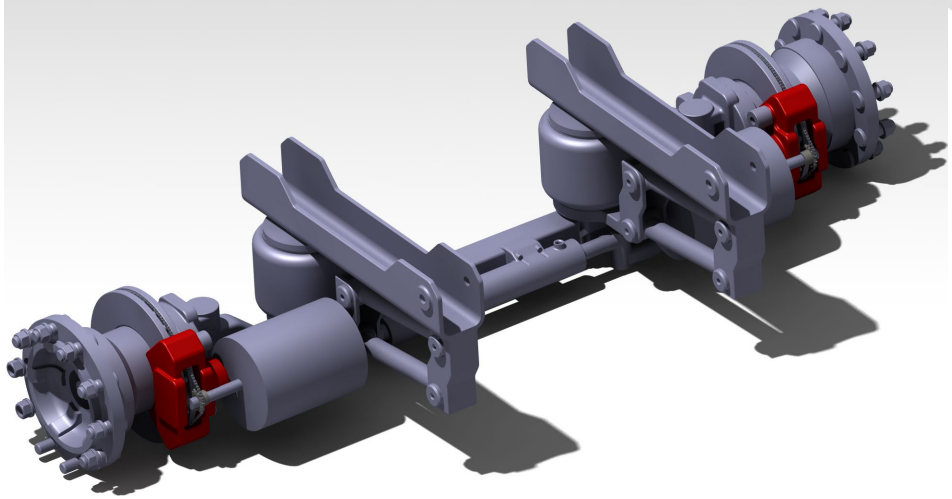
An opportunity to invest in a scalable clean technology

2 **TWO** MARKET SOLUTIONS:

ZERO EMISSIONS REEFER TRAILER AND RAIL CAR MICROGRID APPLICATIONS

3 **THREE** CORE BUSINESS

OFFERINGS: ZERO EMISSIONS REEFER TRAILER, RAIL CAR MICROGRID AND DISASTER RECOVERY/MILITARY MICROGRID



Patent No.: US 10,668,814

Patent Pending

I. ECOLUTION POWER COMPANY

WE ARE ECOLUTION

Vision: Help our partners to create a commercial just-in-time rolling electric grid

A UNIQUE BUSINESS MODEL…

The world's largest taxi company owns no vehicles

Uber

The world's largest hotel company owns no real estate

airbnb

The world's most popular media creates no content

The world's most watched motion picture and television network owns no theaters, TV stations or cable network

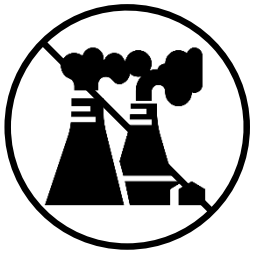
NETFLIX

The world's most valuable retailers have no stores

amazon

Alibaba Group 阿里巴巴集团

The world's largest communication companies, with well over 4 billion customers, have never not met their customers. (WeChat, You Tube, Tik Tok, What's App, Instagram, and Snapchat)



Soon, the world's largest energy company will own no power plants

ecolution kWh

POWERED BY A UNIQUE BUSINESS STRATEGY

These distinct business offerings enable disruption across the "Green Perfect Cycle"[1] value chain

MISSION STATEMENT

- Eliminate emissions from the supply chain of food and medicine
- Helping create an e-mobile electric power company without major capex
- Delivering power in large scale to towns and cities, and places where it is not currently available

TARGETED STRATEGIC PARTNERSHIPS

BNSF Railway, RJ Corman Railroad Company, Target, Draper, Toyota, Sysco, U.S. Army, elematec, American Electric Power, Walmart, FedEx, Wabash National, Great Dane, U.S. Air Force

BUSINESS MODEL COMPONENT

CORE BUSINESS

Reefer Trailer
E^2 GENSET Mobile Platform

- Reduce weight by 600 pounds
- Zero emission in trailer
- Increase power generation

Train Rail Cars
E^3 HEP Mobile Platform

- Rolling microgrid through towns and suburbs
- Conducive to e-mobility
- 5 MWh per rail car

Military Trailers (Municipal)
E^4 HEP Mobile Platform

- Disaster recovery extensions of the microgrid
- Mobile generation, storage and distribution of energy

FIXED PLATFORMS

Charge Station

- Turns train station into a regional charging station
- Can be slow charge station
- Infrastructure exists today

Storage Unit

- Swappable batteries
- Scalable
- Powers a community / military base

TARGET USE CASE

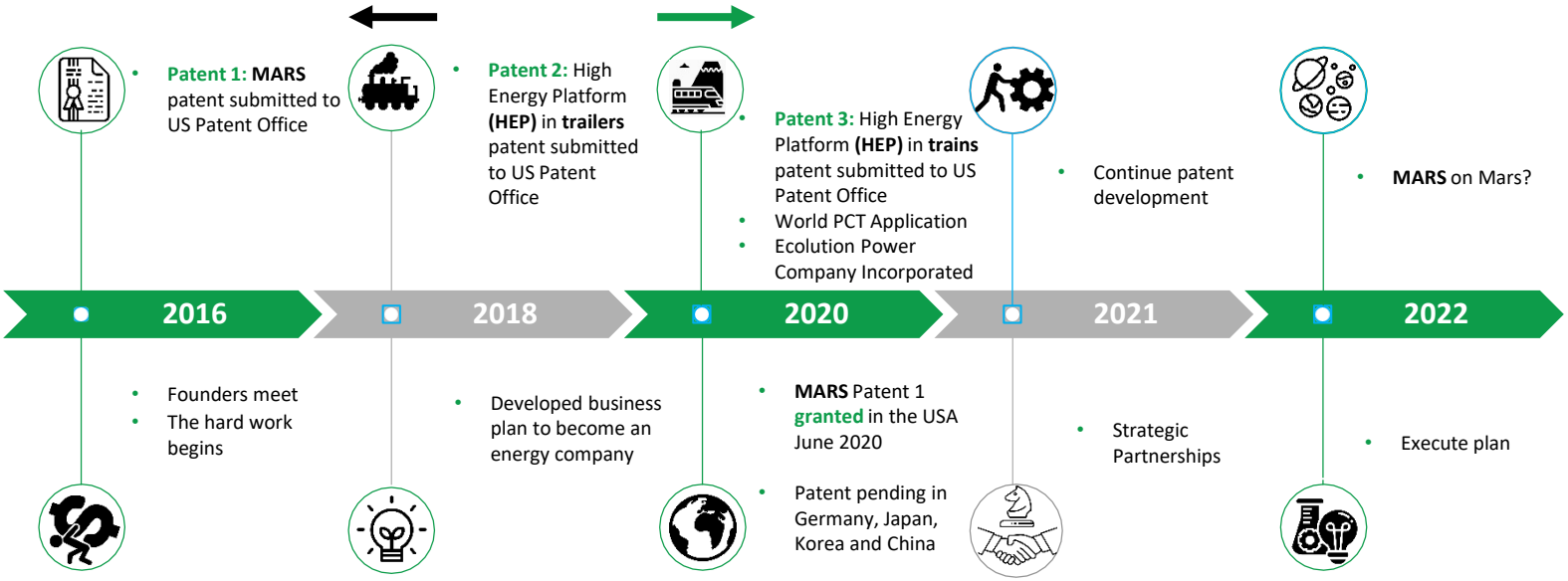
Low Energy Platform (E^2)	High Energy Platform (E^3)	High Energy Platform (E^4)	Capacity-as-a-Service	
Licensing fee per trailer	Energy-as-a-Service $/kWh	Licensing fee per trailer	Energy-as-a-Service $/kWh	Energy-as-a-Service $/kWh

1. **Green Perfect Cycle:** it is the process of generating and delivering energy from renewable sources to the end user / consumer
2. **E^2:** means **E**colution's **E**nergy = **E^2**. E^2 also represents the Low Energy Platform
3. **E^3** (trains) and **E^4** (military trailers) represent High Energy Platforms (HEP)

Patent Pending

DEMONSTRATING GROWTH AND PROGRESS SINCE 2016

Our patents provide a once in a generation opportunity. A new way to deliver energy.



Grants			• Invitation to NSF SBIR grant program • Submitted ARMY SBIR grant application in July 2020 • Submitted NSF SBIR grant application • Submittal of AFWERX Energy Challenge	• State of California • Europe & Asia	
Capital Accumulation		Angel Funding	SAFE	Series A	Dream Exchange IPO

A ROAD MAP TO WORLD CLASS STRATEGIC PARTNERS

SUPPLY CHAIN

OUR BUSINESS

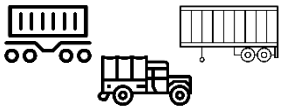
BUSINESS MODEL

R&D

- Ecolution partners with strategic ODMs for **MARS** component design
- Ecolution partners with OEMs for **MARS** component assembly / retrofit

Component Manufacturers
Original Design Manufacturers
(ODM)

- ODMs design **MARS** components
- ODMs sell **MARS** components to OEM



Manufacturers
Original Equipment Manufacturers
(OEM)

- OEM purchases **MARS** components from ODM to assemble final product (s)
- OEM sells final product to customer / end user

Customers / end user

FedEx, TARGET, amazon, Walmart, Sysco, U.S. AIR FORCE, U.S.ARMY

TARGET USE CASE

DRAPER, AEP American Electric Power, BNSF Railway

elematec, TOYOTA

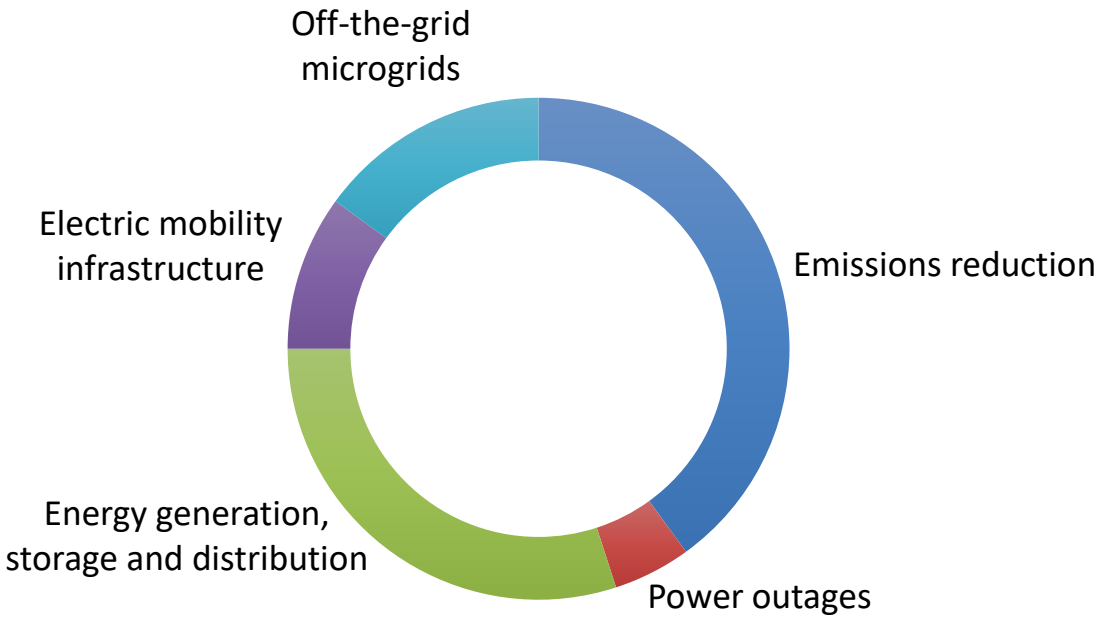
Great Dane, WABASH NATIONAL, RJ Corman Railroad Company, BNSF Railway

R&D exclusive work	Strategic	Strategic	Licensing fees	Energy-as-a-Service $/kWh

ROBUST DEMAND FOR OUR SOLUTIONS…

THEMES DRIVING DEMAND

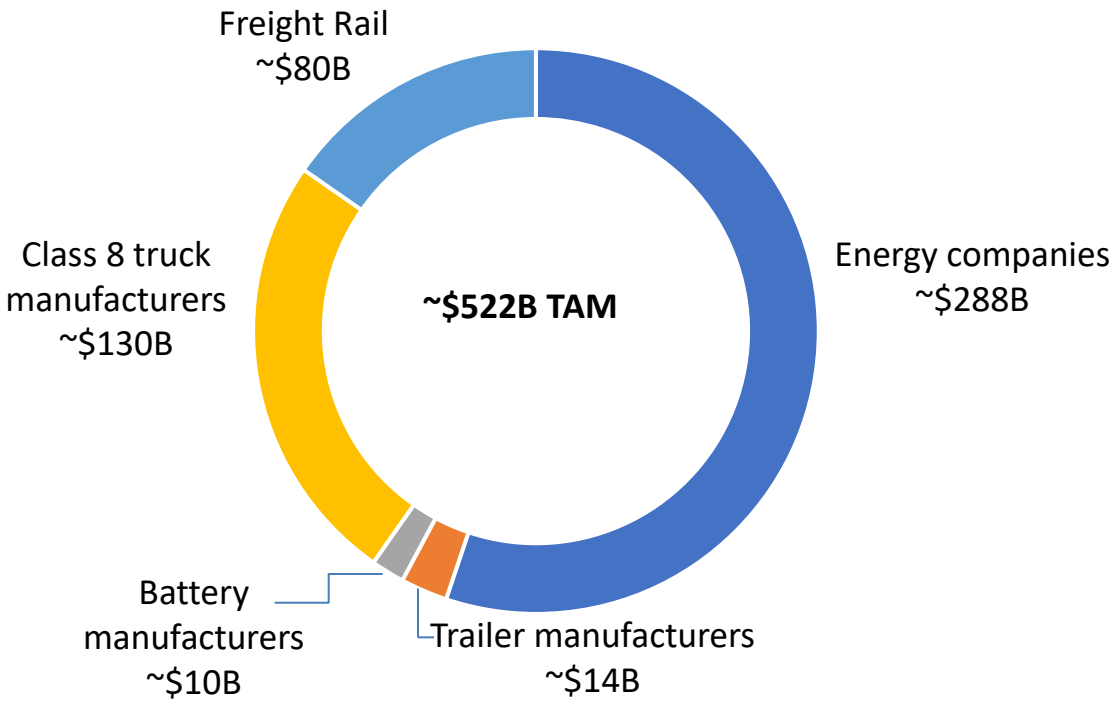
Assumptions of societal and commercial demands in transportation logistics and energy



OVERVIEW OF ECOLUTION'S ADDRESSABLE MARKET IN THE U.S.

Ecolution is the only company offering both transportation and energy solutions; addressing both markets simultaneously

BREAKDOWN OF U.S. HALF A TRILLION DOLLARS TAM



REVENUE PROJECTION IN U.S. MARKET

Our company will remain a technology provider and R&D focused company. We will not manufacture components, trailers, or train cars

REVENUE TABLE

		Reefer Trailer E^2 GENSET Platform	Military Trailers E^4 HEP Platform	Train Rail Cars E^3 HEP Platform
Revenue	**Selling Price**			
	Base Case	$1,500 per trailer/yr	$12,000 per trailer/yr	$0.01 per kWh
	Revenue @ Y5			
	Qty Units	7,800	260	18,544
	kWh			607,600 kWh
	Base Case	**$11,700,000**	**$ 3,120,000**	**$112,672,574**

REVENUE NOTES

Ecolution KWH and the Ecolution Power Company will remain a technology provider and R&D focused company. Ecolution will not manufacture components, trailers, or train cars.

Ecolution will lease its technology to the customer/end user in return for a monthly license fee. In the case of reefers, this will be approximately $1,500 per trailer per year. For Disaster Recovery Truck Trailers using our technology: $1,000 per month. We intend to charge the train companies $0.01 per each kWh produced using our technology.

II. MARKET & BUSINESS MODEL SUMMARY

BATTERY STORAGE CAPACITY OVERVIEW

TARGETED STRATEGIC PARTNERSHIPS

amte power, Envision, InoBat, microvast, PSA Groupe, Toshiba, BYD, Farasis, LG Chem, Morrow, Samsung, Verkor, Panasonic, CATL, Freyr Renewable energy storage, Leclanché Energy Storage Solutions, northvolt, SK innovation, Johnson Controls

BATTERY STORAGE CAPACITY PER UNIT

	Reefer Trailer E^2 GENSET Platform	Military Trailers E^4 HEP Platform	Train Rail Cars E^3 HEP Platform
No. of units	1	1	1
Storage Capacity			
Capacity in kWh	98.0 kWh	1,215.2 kWh	2,430.4 kWh
Capacity in MWh	0.1 MWh	1.215 MWh	2.430 MWh
Capacity in GWh	0.0001 GWh	0.001 GWh	0.002 GWh

BATTERY STORAGE CAPACITY ALL UNITS @ Y5

	Reefer Trailer E^2 GENSET Platform	Military Trailers E^4 HEP Platform	Train Rail Cars E^3 HEP Platform
No. of units	7,800	260	18,544
Storage Capacity			
Capacity in kWh	98.0 kWh	315,952.0 kWh	45,069,337.6 kWh
Capacity in MWh	0.1 MWh	315.952 MWh	45,069.338 MWh
Capacity in GWh	0.0001 GWh	0.316 GWh	45.069 GWh

Patent Pending

BATTERY MANUFACTURING PROJECTS IN EU

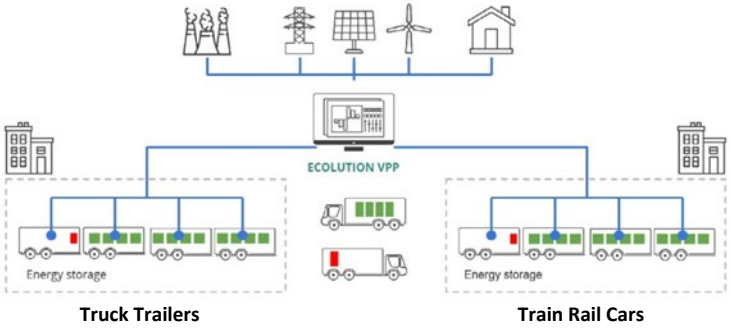
(Company, completion year and city, current capacity, max capacity)

- Northvolt, 2024 Salzgitter, 16 GWh, **24 GWh**
- Envision AESC, 2010 Sunderland, **1.9 GWh**
- AMTE power, 2023 GB, 10 GWh, **35 GWh**
- CATL, 2022 Erfurt, 14 GWh, **100 GWh**
- PSA, 2022 Kaiserlautern& Dury, 16 GWh, **64 GWh**
- Leclanché, 2020 Willstat, 1 GWh, **2.5 GWh**
- BYD, 202X, EU, X GWh
- Samsung, 2018 God, 3 GWh, **15 GWh**
- SK Innovation, 2020 Komaron, **7.5 GWh**
- InoBat, 2020 Bratislava, **10 GWh**
- LG Chem, 2018 Wroclaw, 15 GWh, **65 GWh**
- Farasis, 2022 Bitterfeld, **16 GWh**
- Microvast, 2021 Brandenburg, 1.5 GWh, **6 GWh**
- Northvolt, 2021 Skelleftea, 32 GWh, **40 GWh**
- Freyr, 2023 Mo I Rana, **32 GWh**
- Morrow, 2024 Agder, 8 GWh, **32 GWh**
- Verkor, EU, **16 GWh**

ADVANTAGES OF OUR PRODUCTS

- Elimination of emissions in TRU GENSET
- Reduce emissions in train industry
- Converting railcars into power plants
- Mobile energy generation, storage and distribution
- Take energy where is needed
- Reduce cost of the battery
- New infrastructure for EV charging in train stations
- Train station powers the community

- Virtual Power Plant (VPP) & Rolling Microgrid



III. PRODUCT DEVELOPMENT & STRATEGY TIMELINE

TECHNOLOGY COMPARISON

The E^2 GENSET unit is lighter, produces energy with zero emissions

ECOLUTION'S E^2 GENSET UNIT VS TRU GENSET

	E^2 GENSET	TRU GENSET SGCO-3000
PRIMARY POWER GENERATION UNIT	Alternators	Diesel Engine Generator
FUEL TANK SIZE	N/A	50 gal (198 litres)
BATTERY STORAGE SIZE	45.4 kWh	N/A
OUTPUT POWER	12 kW	15 kW
REFUEL/RECHARGE TIME	Real-Time	10-15 Minutes
EST. HOURS DRIVE OPERATION 4 DAYS (10HRS/DAY)	40 Hours	40 hours
EST. HOURS IDLE OPERATION 4 DAYS (14HRS/DAY)	56 hours	56 hours
PPU SUSTAINABILITY PROFILE	Hauling trucks are abundant	Access to oil reserves can be costly and prices are highly volatile
MAINTENANCE REQUIREMENTS	Minimal	At least 3 times per year
DIRECT IMPACT ON EMISSIONS	Zero	* Average of 3,000 hours per year, annual PM emissions estimated to be 24.4 tons and annual carbon dioxide (CO_2) emissions are estimated to be 29,330 tons per year
EST. GENSET WEIGHT	900 lbs	2,154 lbs
EST. COST	$14,500	$18,000

*** Source: Electric Power Research Institute (EPRI)**

TECHNOLOGY COMPARISON

TOTAL COST OF OWNERSHIP (TCO) CALCULATION

	"**Retrofit**" Reefer Trailer E^2 GENSET Kit	"**New**" Reefer Trailer E^2 GENSET Kit	**New** Reefer with TRU GENSET
Investment Cost			
GENSET cost + labor	$14,500	$14,500	$18,000
Reefer trailer w/o GENSET Cost		$52,000	$52,000
Diesel GENSET credit	(10,000)		
Downtime costs by retrofitting	$3,000		
Total investment reefer	**$7,500**	**$66,500**	**$70,000**
Usage-related Cost			
kWh per day (24 hrs)		76.8	
kWh per year (250 days)		19,200	
Diesel gallons per day (24 hrs)			12.5
Diesel cost to produce 1 kWh		$0.26	
Diesel fuel cost per gallon		$3.00	
Diesel gallons per year (250 days)		**1,280**	**3,125**
***Diesel fuel cost per year**		**$4,992**	**$9,375**
Total cost for a 10-year usage period		**$49,920**	**$93,750**
EST. unit weight		**900 lbs**	**2,154 lbs**

Savings Per Reefer Trailer in the U.S		
Diesel gallons savings per year		1,845
Diesel cost savings per year	$	4,383
Diesel cost savings in 10 years	$	43,830
**Weight savings in lbs		1,254

Savings for 1,000 Reefer Trailers in the U.S.		
Diesel gallons savings per year		1,845,000
Diesel cost savings per year	$	4,383,000
Diesel cost savings in 10 years	$	43,830,000
**Weight savings in lbs		1,254,000

** **Weight savings:** The calculated value of the additional load capacity (1,200 pounds) created by the E^2 GENSET has not been considered.

TRAINS

OUR PATENT APPLICATION IS IN PROCESS. WE WILL ADD DESIGN WORK TO OUR DECK UPON SUBMISSION OF OUR PATENT #3 IN SEPTEMBER, 2020

Our vision is to enable a transformation of the aging train companies into e-mobility power generation

Train companies run on small margins with large amounts of annual capital expenditures and significant carbon emissions. Ecolution desires to help change the industry for the better. Our technology allows the owner of the train to retrofit roughly three cars per train to include our **MARS** system and a large cylindrical battery unit lining its platform.

A single train car could generate as much as 5 MWh per day retrofitted with the **MARS** system. Its battery storage system would be capable of accommodating the storage required to meet the needs of the communities served by the train line.

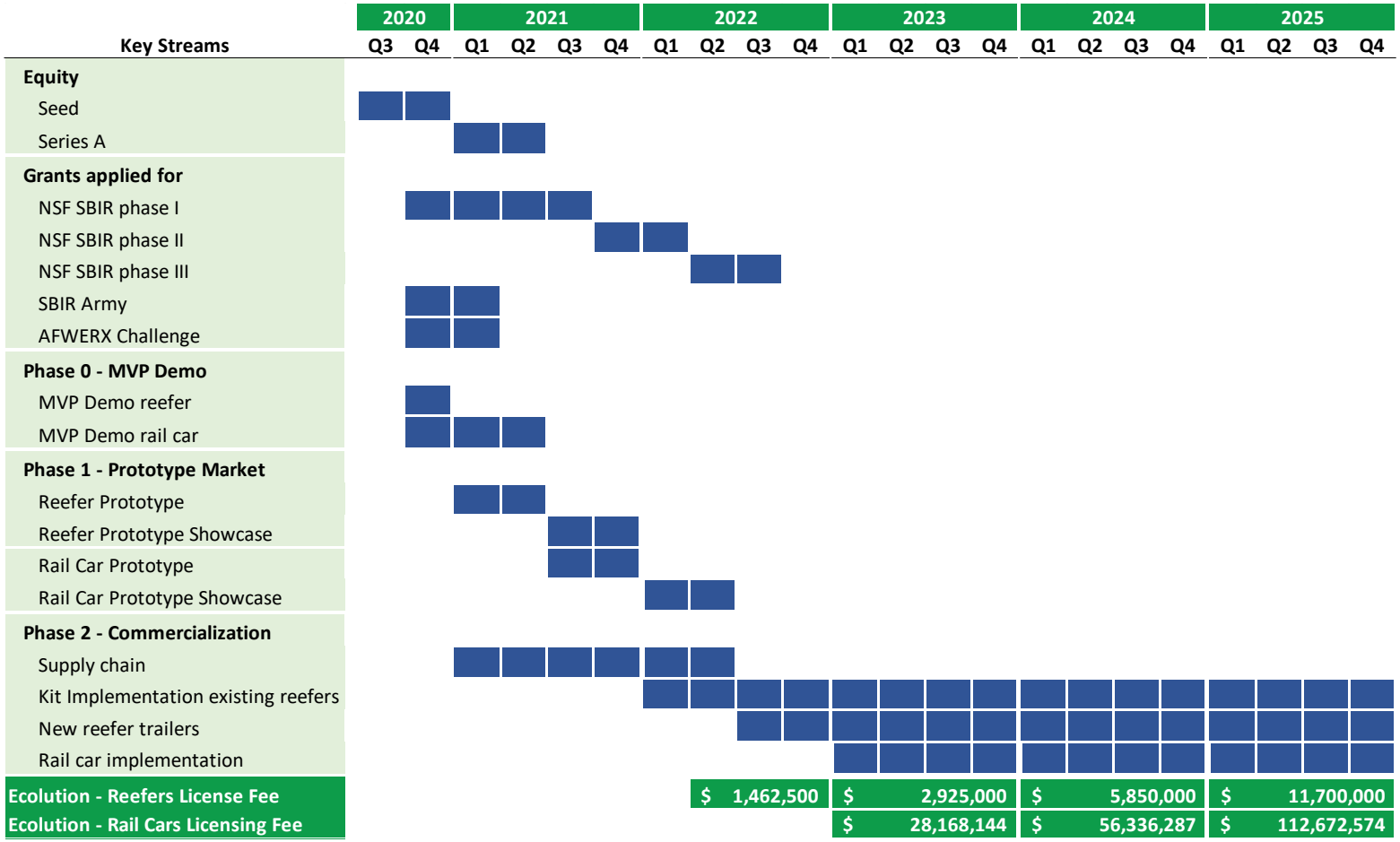
Our vision is to enable the aging train operators into e-mobility power companies capable of feeding the power needs of the train stations, providing power to the town or community surrounding the station.

Tomorrow's train station can become the center of e-mobility in each town, slow charging electric vehicles, bikes and scooters parked at the station, and powering the buildings and stores in the community at a price per kWh which is less than that available on the grid.

Patent Pending

CLEAR PATH TO BE FIRST TO MARKET IN THE U.S.

DEFINED ROADMAP



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ecolution kWh

A JUST-IN-TIME ROLLING ELECTRIC GRID

www.ecokwh.com
info@ecokwh.com

EXPLANATION OF MARS & PATENTS

EXPLANATION OF ECOLUTION'S NEAR ZERO EMISSIONS MARS SYSTEM

OUR UNIQUE SIMPLE, PRACTICAL PATENTS…

With recently patented technology, Ecolution hopes to turn long-haul class 8 truck trailers and train cars fleet into a rolling electric power company; one with nearly net zero carbon emissions

HOLY GRAIL

The **law of conservation of energy** states that the total energy of an isolated system remains constant. The energy created is believed to be conserved over time, thus implying that energy can't be created or destroyed. Rather, it can be transformed or transferred from one form to another. One interpretation of the law of conservation of energy is that a perpetual motion machine cannot exist, meaning that a system without an external energy supply cannot create an unlimited amount of energy.

The science of Ecolution is consistent with this law and with all of the laws of physics and energy. Here is the reason why: The principal supply of energy comes from the vehicle or train engine. Modern combustion engines, electric vehicle engines and hybrid engines all operate at well below their capacity to generate power. This includes periods of running at idle, low speeds and even high speeds. We intend to capture and put to work some of that underutilized capacity.

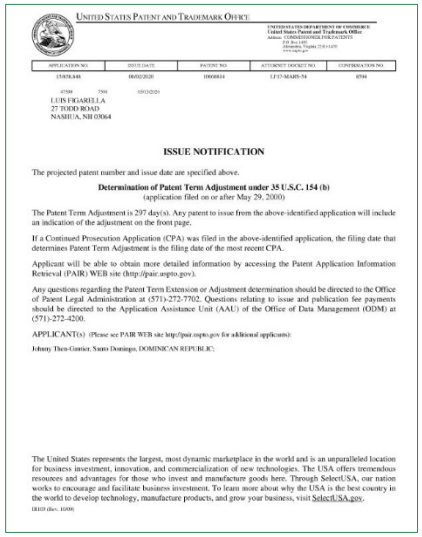
OUR BUSINESS MODEL

Our business model is to quietly patent a wide swath through the electric mobility market, choosing local partners across the global community to commercialize technology, manufacture components, trailers and train cars. We want then to achieve competitive advantage over their competitors. Our financial objective is to license our technology, create a significant IRR for our shareholders, and continue to create leading edge technology. We intend to choose a limited number of partners to co-develop our technology in North America, Europe and Asia.

OUR PATENTS

Ecolution developed the **Module Active Response System** (we call it "**MARS**"). **MARS** is the combination of our global patents both issued and patent pending, applied to existing truck trailer and train components, new components we will create, and the proprietary software application that will govern the transformation of electricity within the vehicle.

We received our first US patent on June 2, 2020. We have applied for patents in Germany. Japan, South Korea and China. Our second US patent is now applied for and in the que. Our third patent will be global. It will be applied for by September of 2020. We believe our intellectual property provides us with a material sustainable competitive advantage for the next 20 years.



UNITED STATES PATENT AND TRADEMARK OFFICE

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 297 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

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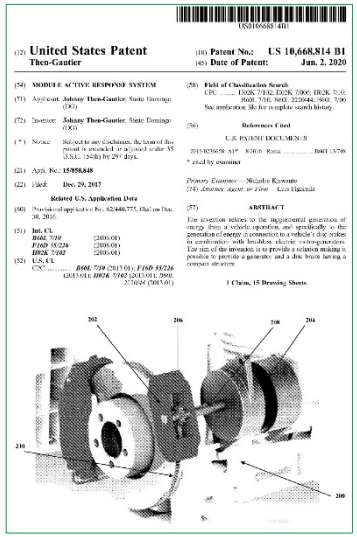

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(12) United States Patent
Then-Gautier

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(45) Date of Patent: Jun. 2, 2020

(54) MODULE ACTIVE RESPONSE SYSTEM

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 297 days.

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(22) Filed: Dec. 29, 2017

Related U.S. Application Data

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B60L 7/10 (2006.01)
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H02K 7/102 (2006.01)

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CPC B60L 7/10 (2013.01); F16D 55/226 (2013.01); H02K 7/102 (2013.01); B60L 2270/20 (2013.01)

(58) Field of Classification Search
CPC H02K 7/102; H02K 7/006; H02K 7/10; B60L 7/10; B60L 2220/44; B60L 7/00
See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

2015/0236585 A1* 8/2015 Ryan B60L 15/38
* cited by examiner

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(57) ABSTRACT

The invention relates to the supplemental generation of energy from a vehicle's operation, and specifically to the generation of energy in connection to a vehicle's disc brakes in combination with brushless electric rotating motors. The aim of the invention is to provide a solution making it possible to provide a generator and a disc brake having a compact structure.

1 Claim, 15 Drawing Sheets

EXPLANATION OF ECOLUTION'S NEAR ZERO EMISSIONS MARS SYSTEM

OUR UNIQUE SIMPLE, PRACTICAL PATENTS…

With recently patented technology, Ecolution kWh hopes to turn long-haul class 8 truck trailers and train cars into an electric power company; one with nearly net zero carbon emissions

MARS

MARS is a collection of existing components and a few proprietary components customized and installed in a truck trailer or train car. **MARS** generates Kinetic Energy from the "brake disc" rotation during the movement of the trailer or train car. The higher the speed, the higher is the rate of rotation of the brake disc, the more energy is captured.

Illustrating with the case of the Reefer trailer, the brake disc is strategically coupled to an "alternator" by means of a "transmission chain" ; think of a motorcycle chain, but a much stronger chain.

As the Truck is in motion and pulls/hauls the trailer, the strategically coupled alternator starts the process of generating electric current from the truck's motion **(Kinetic Energy)**.

The energy captured is then processed in an electric converter contained in a newly designed battery storage unit where the energy is stored in rechargeable batteries.

Via telemetry software (software that tracks and manages energy kWh), the stored energy can then be distributed from the trailer to any electrical equipment that requires power.

Significant power is lost in the form of heat energy converted by the brakes while heavy vehicles are stopping. This power could have been converted into a much more useful form of electrical energy and used to power electrical devices. While this has been widely done on electric vehicles for range extension, this has not been done on conventional fossil fuel vehicles to power auxiliary systems.

The **MARS** system attaches to the rotating mass of the vehicle; be it a wheel, brake disc, brake drum or a driveshaft based on the vehicle configuration and customer desired use case. Our patented system uses electronics to regulate the units electrical output based on vehicle conditions, battery charge levels, battery or device draw on the battery and ambient conditions to set the optimum power generating levels to achieve the highest energy recuperate but also consume the least fuel from the main vehicle drive engine.

The unit's interactions with the vehicle are seamless to the driver or other passengers of the vehicle and are automatically engaged or disengaged by the unit's electronics and engagement mechanisms (likely a small clutch). This ensures that unlike some other devices the fleet owner has little to fear about the operator not using the unit correctly.

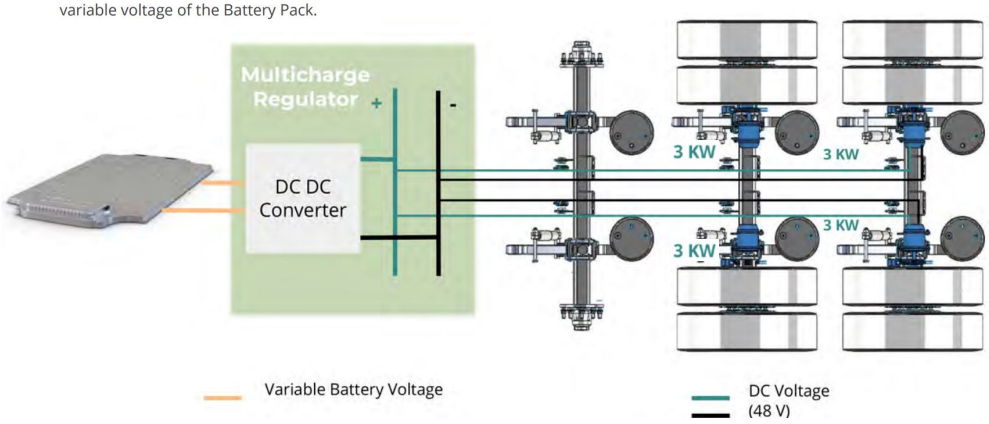
The **MARS** equipped trailer will utilize its motion based electrical power generation capabilities to store the energy in an electric battery located in the trailer. This will allow the trailer to efficiently recharge batteries as the trailer is in motion either in a steady state cruise mode or a regenerative braking mode. Once the batteries have been recharged the energy stored shall be used.

MVP ARCHITECTURE

MINIMUM VIABLE PRODUCT FOR THE E^2 GENSET

MARS System Proposal MVP Architecture

For the MVP, Idneo suggests the use of 3 KW alternator (48 V DC output voltage). Each output of the generator is connected to a single DC Bus. A DC - DC converter transform the fixed DC Voltage of the DC Bus in the variable voltage of the Battery Pack.



Battery Pack Capacity: 20 KWh
Battery Pack Density: 150 KWh/Kg
Vehicle weight without battery: 24 Tn
Trip Time: 10 h
Frontal Area: 5m2
Mean acceleration: 0.112 m/s2
Coefficient of drag:0.63
Mean speed: 60 mph

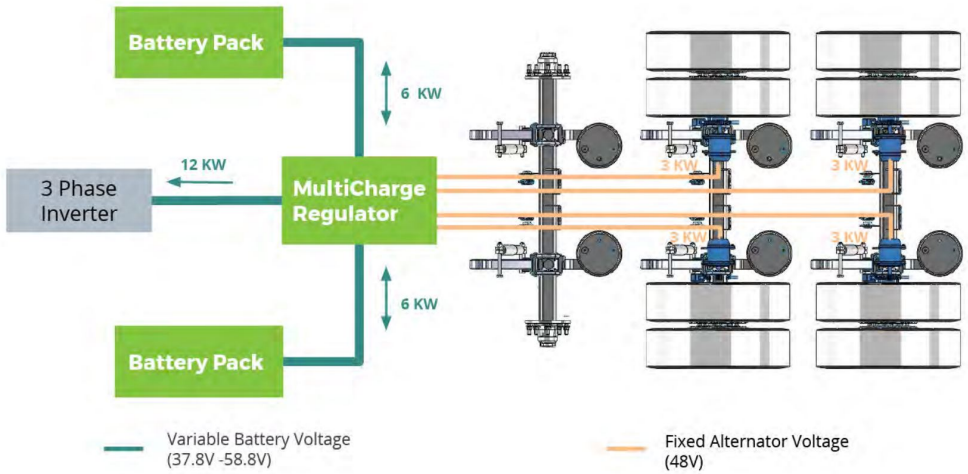
Energy Consumption Calculations

Mean Speed	60	mph
Distance	600	Miles
Distance	965604	meters
Trip Time	10	h
#Generators	4	-
MARS Mechanical Power	2.581	Kw
MARS Mechanical Total Power	10.325	Kw
MARS Mechanical Energy	103.253	kWh
Generation Efficiency	0.75	
Mars Electrical Power	1.936	kW
Electrical Energy Generated	77.440	kWh
Mean Reefer Power Required	3.2	KWh
Reefer energy consumed	32	kWh
Energy storaged in battery	45.44	kWh
Hours idle with E^2 GENSET	14.20	h

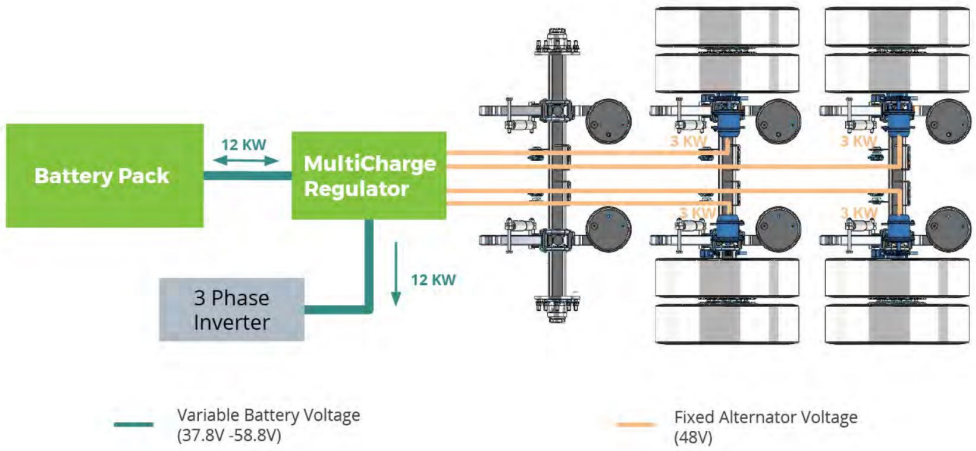
MVP ARCHITECTURE

MINIMUM VIABLE PRODUCT FOR THE E^2 GENSET

DISTRIBUTED ARCHITECTURE

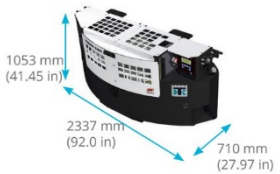


CENTRALIZED ARCHITECTURE

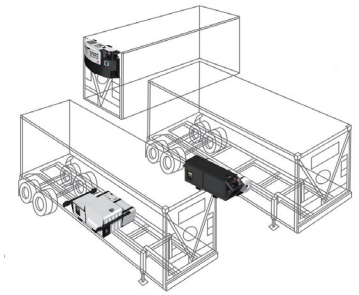


SG-3000 SERIES GENERATOR SET	
Engine	TK Diesel engine, mechanical direct injection, naturally aspirated with closed crankcase ventilation
Fuel Type	No.2 Diesel (under normal conditions) No.1 Diesel (cold weather fuel)
Rotational speed	1890+/-10 RPM 1560 + 10-0 RPM
Generator	460/230 Vac, 3 Phase, 60Hz
Output Power	15 kW
Apparent Power	18.75 kVA
Rotational speed	1800 RPM
Electrical System	SG+ microprocessor controller
Battery	12V, 925 CCA at –18ºC (0ºF)
Fuel Tank	Included in all models
SG Clip-On SG Centre-mount SG Side-mount	125 gal (473 litres) 80 gal or 50 gal (302 litres or 198 litres) 75 gal (283 litres) Round steel tank

SGCO-3000



Weight:
818 kg (1804 lbs) - Total Weight, including Gen Set, oil, coolant, dry fuel tank and battery. Genset to be provided with decal indicating gross weight inclusive of fuel.



Class 8 Truck with Reefer Trailer Ecolution's MARS system, when applied to Reefer Trailers, presents our MVP opportunity. We can eliminate the Reefer's transport refrigeration unit generator set (TRU GENSET) and replace it with a MARS mobile charging system. This will also allow the MARS system to provide the electricity generated directly to the refrigeration unit of the Reefer in real-time while the truck is in motion and provide the energy needed to heat or cool the truck when it is not moving.

THE MATH

Our analysis has been based on the reference document *Performance Metrics Required of NextGeneration Batteries to Make a Practical Electric Semi Truck* (Viswanathan, June 2017)

> "In terms of energy efficiency, this scenario generates enough energy for the reefer's consumption requirements. This means that it is possible to eliminate the genset with gas tank. The MARS system reduces weight, eliminates diesel consumption and reduces emissions".
>
> *- ENGINE By idneo*

E2 GENSET Performance Equation

$$Ep = [(\frac{1}{2}\rho \cdot C_d \cdot v^3_{rms} + C_{rr} \cdot W_t \cdot g \cdot v + T_f \cdot W_t \cdot g \cdot v \cdot Z) / N_{bw} + \frac{1}{2} W_t \cdot v\, 3\, a\, (\frac{1}{\eta_{bm}} - \eta_{bm})] (\frac{D}{v})$$

ρ, density of air (kg/m³)
g,acceleration due to gravity (m/s²)
A, frontal area of the vehicle (m²)
a, mean acceleration/deceleration of vehicle (m/s²)
ηbw, battery-to-wheels efficiency
ηbrk, braking efficiency (with regenerative braking)
Wt, Total Weight (kg)
Z, road gradient (%)
tf, fraction of time spent on road grade (%)
D, range (m)

Batttery	Battery Capacity	44.8	kWh	**Engine truck without MARS**			**Engine truck with MARs**		
	Energy density	150	Wh/kg	Battery Weight	0	Kg	Battery Weight	298.67	Kg
Vehicle	Vehicle weight without batteries	24000	Kg	Wt	24000	Kg	Wt	24298.67	Kg
	crr	0.0063	-	g	9.8	m/s2	g	9.8	m/s2
	Area	5	m2	Distance	965604	m	Distance	965604	m
	Coefficient of drag	0.63	-	**Time**	10.00	h	**Time**	10.00	h
Driving	Mean Speed	60	mph	Energy Rolling Resistance	1430793383	J	Energy Rolling Resistance	1448598812	J
	Mean acceleration	0.112	m/s2	Energy Consumed for Rolling Resistance	**397.443**	**kWh**	**Energy Consumed for Rolling Resistance**	**402.389**	**kWh**
	Distance	600	miles	Mean Speed	26.822	m/s	Mean Speed	26.8224	m/s
MARS	#Generators	4	-	Energy Inertia	1297771776	J	Energy Inertia	1313921825	J
	Generation Efficiency	0.75	-	**Energy consumed for inertia**	**360.492**	**kWh**	**Energy consumed for inertia**	**364.979**	**kWh**
	Generated Torque	22	Nm	Drag Energy	1312974012	**J**	Drag Energy	1312974012	J
	Brake disk diameter	18	in	**Energy Consumed by Drag Energy**	**364.715**	**kWh**	**Energy Consumed by Drag Energy**	**364.715**	**kWh**
	Gearbox relation	0.142	-	**Total Energy**	**1.123**	**MWh**	MARS Mechanical Power	2.581	Kw
							MARS Mechanical Total Power	10.325	Kw
							MARS Mechanical Energy	103.253	kWh
							Mars Electrical Power	1.936	kW
							MARS Electrical Energy Generated	**77.440**	**kWh**
							Total Energy	**1.235**	**MWh**

$$Mars\ efficiency = \frac{MARS\ Electric\ Generated}{Vehicle\ Energy\ Consumed\ with\ MARS - Vehicle\ Energy\ Consumed\ without\ MARS)} \times 100$$

MARS effiency **69%**

Brake disk diameter	0.4572	m						
Turns	672267.2							
Brake disk speed	1120.445	rpm	MARS Speed	7890.461	rpm			
Brake disk speed	117.333	rad/s	MARS Speed	826.289	rad/s	Generator Torque	3.124	Nm

OPTIMIZATION OF ALTERNATORS VS REGENERATIVE BRAKING

MARS is not regenerative braking

REEFER TRAILERS AND RAILCARS

In the refrigerated (reefer) trailer/railcar application, the MARS system converts kinetic energy into electrical power by means of an alternator or generator coupled to a driven wheel of a trailer or rail car. This device will convert kinetic energy into electrical power in three modes of truck/train operation, accelerating, steady state speed and decelerating.

Positive acceleration is the least efficient mode as the truck/train's engine is already operating at high load. Steady state driving is comparable from an energy efficiency standpoint to the reefer trailer/railcar's current diesel Generator Set (GENSET) setup that powers a typical reefer today. The win, meaning where the MARS system proves highly beneficial is in deceleration activities or downhill grades where today's trailers/railcars do not convert their stored kinetic energy into anything useful. This energy is simply wasted as heat shed through the brakes and wheels or compression (Jacob or Jake) brakes.

One implication is that our MARS system is most efficient during in-town delivery where there are many starts and stops. In a typical duty cycle our alternators are largely turned off during acceleration and on during steady state (depending on how much power generation is desired,) deceleration and the stop.

With respect to trains, we capture large amounts of energy as the train slows and comes to a stop so the local commuter trains, cross country passenger rail or freight rail with frequent stops through cities and small-towns are ideal for power generation and using the electricity created to convert the train station into an e-mobility power platform. The station (or a place close to the transmission line) can become a battery storage unit downloading power from the train to a power grid accessible or a power usage location. Businesses in the town can receive their electric power from this micro-grid either as primary or a very high reliability backup power source where needed for critical applications like medical facilities or critical infrastructure. Electric vehicles of all types would be able to slow or fast charge at the station. This would eliminate the need for substantial capital expenditure and the delays of local permitting ordinances to build battery charging infrastructure and would more quickly allow for electric vehicle charging infrastructure creation.

Optimizing the truck/train's acceleration cycle and capturing energy from this optimization will enable the reduction of operating cost of the refrigeration activity of the Reefer, saving large sources of carbon dioxide and small particulate emissions, as well as reducing freight carrier's cost to operate costly refrigerated trailers, ultimately benefitting the consumer in the form of reduced perishable food and medicine prices.