



Renewable Energy from the Mechanical World:

A Conversation About Energy

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A conversation about Energy

- Thesis
- Explore the Language and Terminology
- Define a New Approach
- *Commit a bit of Heresy*
- Examples of this in Action



- Generally accepted definition of Energy is inadequate
- We build “work energy systems” to harness energy
- These “work energy systems” [vehicles, elevators] can transform energy from one form to another but not create energy
- Work energy systems both consume and produce energy and we can use them [vehicles & elevator] to create a new source of “clean energy”



Energy Defined

Energy is the ability to do work

- By itself, *not very satisfying.*
- The word **work** is interesting
- Defined as “*exertion or effort directed to produce or accomplish something*”
- Implies motion and purpose

The Types of Energy



Mechanical
Energy



Thermal
Energy



Nuclear
Energy



Chemical
Energy



Electromagnetic
Energy



Sonic
Energy



Gravitational
Energy



Kinetic
Energy



Potential
Energy



Ionization
Energy

Potential vs. Kinetic



- These forms of energy can be grouped into two general types of energy:
 - Potential, or stored, energy
 - Kinetic, or working, energy
 - (there is that word again, work[ing])

Energy can be converted from one form to another.

- Falling Ball Bearing example

Energy of Transformation



- Falling ball bearing moves from rest to motion
- What is the force – the energy – that accelerates the ball bearing?

Gravity: A primal source of energy

- i. Every object in the universe attracts every other object with a force
- ii. That force is proportional to the mass of each and varies inversely as the square of the distance between them
- iii. An object responds to a force by accelerating in the direction of the force by an amount that is inversely proportional to the mass of the object -

Feynman

Energy Transformation



- Gravitational Force is the accelerant that changes “potential” to “kinetic”
- Without gravity the ball bearing won't move
- Therefore, potential energy only exists if there is an external existing force capable of accelerating a mass
- Gravity is the original source of both the Potential Energy (PE) and Kinetic Energy (KE)

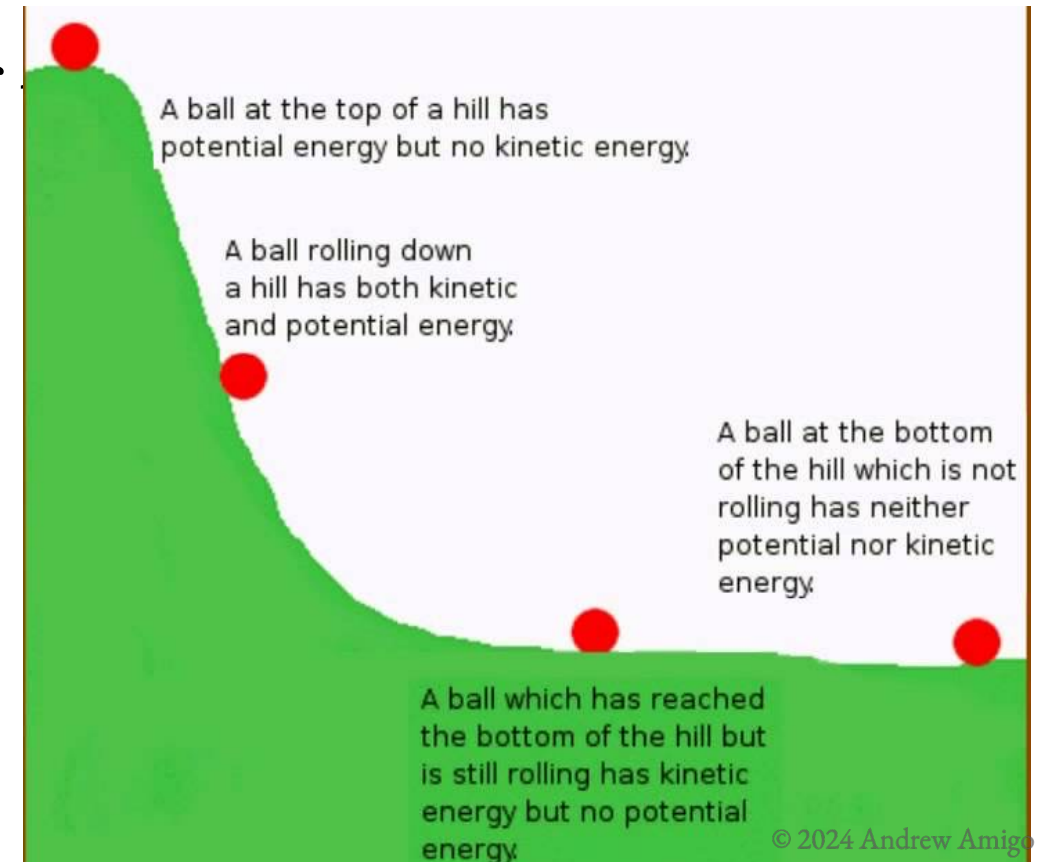
Beginnings of a New Definition



In this limited example: define Energy as the acceleration of an object with mass caused by the **gravitational force**;

accelerating that mass in the direction of

- Potential Energy and Kinetic Energy are theoretical constructs used to explain the potential and actual effects of gravity



Falling Water

Let's apply that same construct to falling water

- Water held by the dam is Potential Energy
- When released Kinetic Energy



- Force of Water hits a turbine Force
- That Force causes a Rotational force (torque) to spin a generator
- Generator creates a magnetic field to scape electrons
- Electricity is conducted into “transformer” to send



What is a Hydroelectric Facility?

- Hydro Facility is a system or process that uses two *Primal Sources* of energy;
 - *gravity* to accelerate the water to spine a turbine, and
 - *electromagnetic field* to produce electrical current
- The output of the system - the electricity - has the ability to power a motor, e.g. to raise an elevator
- This electrical “work” can happen so long as the electricity remains confined in the system
- Hydroelectric Facility is a system that transforms the primal sources of energy to create electrical current - energy with the ability to do work
- **Work Energy Transformation System [work energy]**

Four Primary Forces of Nature



Gravity – weakest of the four (applies to macro scale, large distances: a lot of mass) additional masses increase the force, so it can affect over large distances.

The Weak Force:

- The weak nuclear force is responsible for particle decay.
 - a neutron can decay to a proton, electron, and electron neutrino (creates a free electron)
 - The weak force is essential for stellar nucleosynthesis—the process that creates new atomic nuclei in the cores of stars.
- The weak force essential to the Sun

Four Primary Forces of Nature

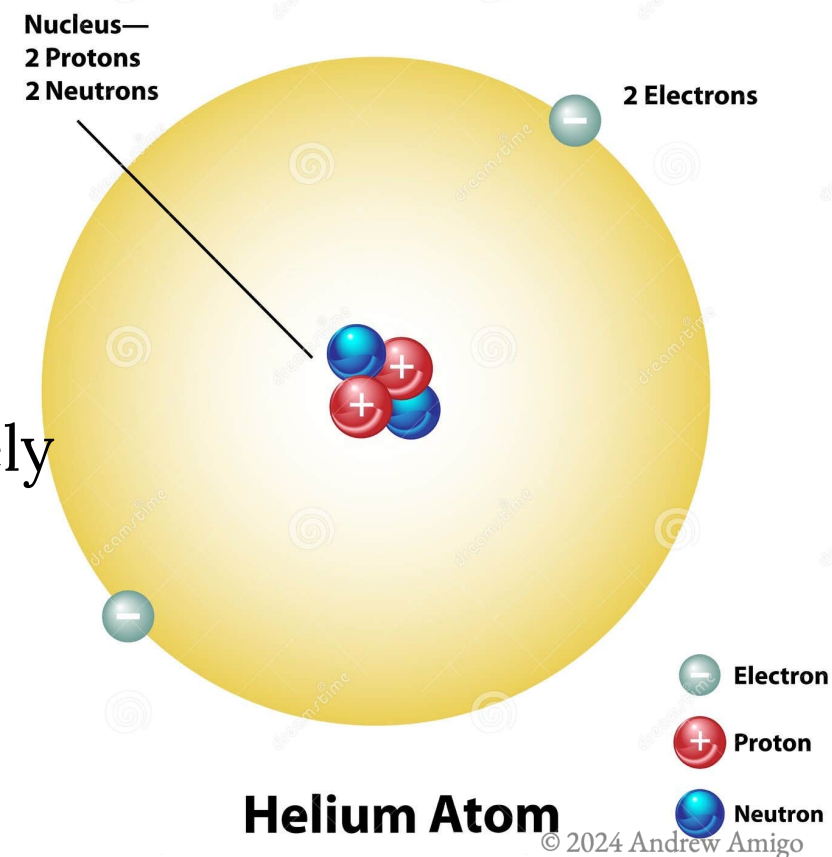


- **Electromagnetic Force**

- Like charges repel, opposites attract Coulomb force (electrostatic forces)
- Charge concentrations tend to sort themselves out, they balance neg and positive attract and become neutral
 - e.g., governs bonds

- **Strong Force**: helium two protons in nucleus two electrons

- Protons should repel, the strong force on extremely small distances
- Nucleic distances and holds the protons together



The Theory of Everything



- The fundamental forces may be different aspects of the same force
 - Electric & magnetic forces were unified into an electromagnetic force
 - Unification of the electromagnetic force with the weak nuclear force into an “electroweak force”
 - Theory that attempts to unify all four forces is called the ***theory of everything***
- For our purposes it does not matter if there are 4 forces or three or they are really all one unified force

Primal Forces of Energy



- These forces are the source – the primal source – of energy in the universe

These 4 forces create energy

- Create electrons & atomic and subatomic particles
- Power the Sun (and the sun light)
- Gravity
- Electromagnetism
- Create the chemical bonds of hydrocarbons

Energy Defined



- **Energy is** the [4] primal forces' movement of particles or planets as determined by the relative experience of an observer
 - Movement: energy is the presence of motion
 - Observation: the act of observation is an act of interaction
 - Relativity: what is observable/ measurable is dependent on one's relative position to the event being observed

Original Definition Modified



Original Definition: “Energy is the ability to do work”

- what we are actually referring to is “work energy”

Work Energy is a measurement of the ability of a **system** to **transform** the **Energy** [defined above] to move objects from static state to a kinetic state that is cable of achieving a desired outcome. (a.k.a. “the ability to do work”)

- **System Based Transformation of Energy**
- The System can use mechanical, chemical, electrical, etc.

The Flow of Electrons



- Electricity is the flow of electrons

- Voltage is the pressure
- Amperage is amount of electrons



Amps * Volts = power

- Not the consumption of the electron nor the creation of electron
- It is not the internal “energy” of the electron – it is external force of an electromagnetic field
- The “work” is done by the electrical field

Electrons are created by the [4] primal forces of nature

- Humans build a system that transforms “work energy” to get electrons to flow in a certain direction

Solar Panel System



- Solar Panel creates a magnetic field with a phosphorous top layer of silicone (negative) & boron bottom layer (positive) charge
- Light - Photons from the Sun [no mass]
- Photons used to “trap” an electron from an atom
- The panel has a positive and negative charge – allowing the electron to flow through the panel and down a wire
- One electron at a time

Chemical Energy



- Chemical energy is the form of PE stored within atoms and molecules
- It's the energy stored within chemical bonds
- Chemical energy is observed when a chemical reaction occurs or matter changes forms
- Energy is either absorbed or released when chemical energy changes form as the result of a chemical change
- Chemical Energy is the energy of “fossil fuels”

Hydrocarbons: No Dead Dinosaurs



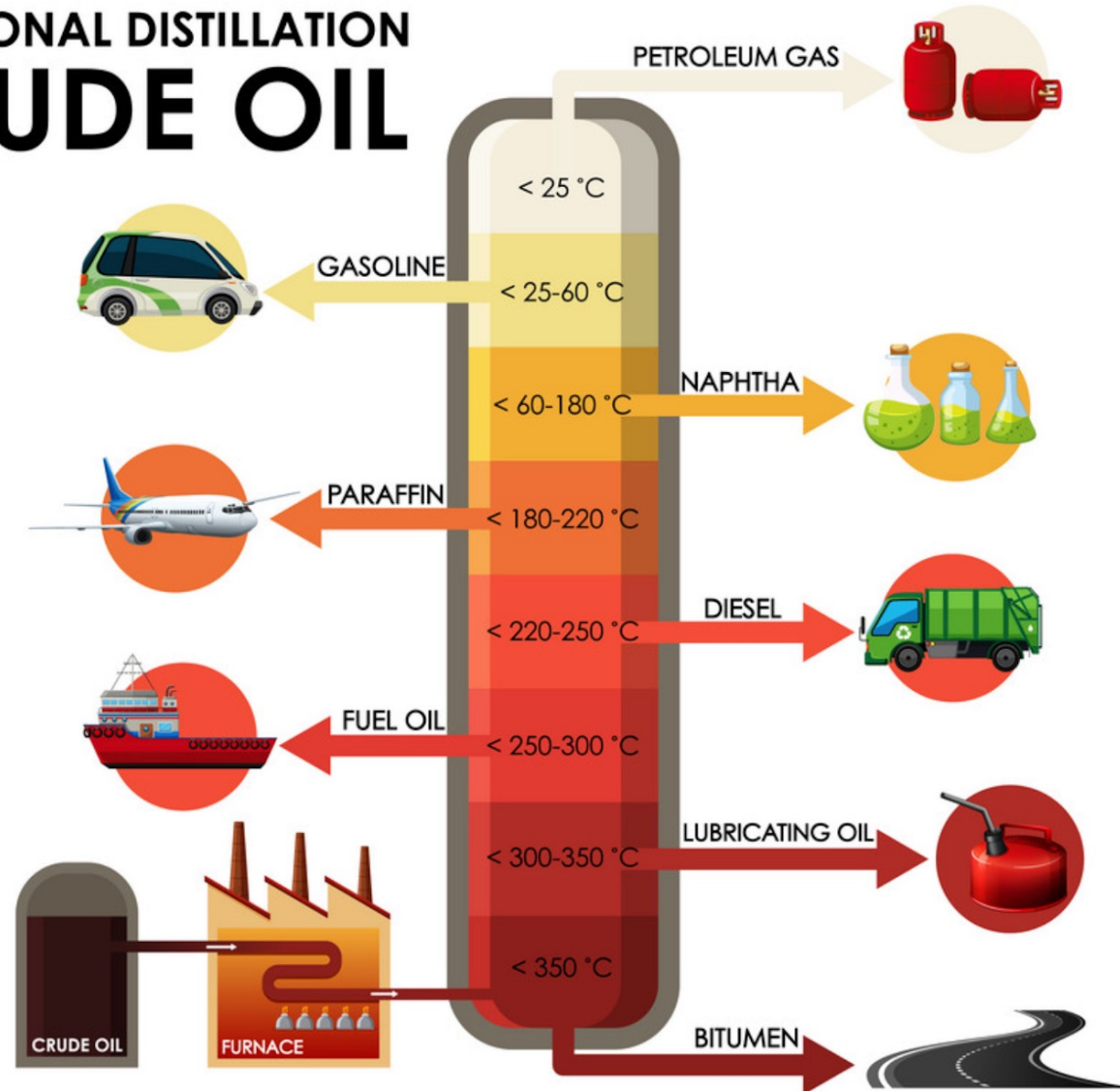
- Growing consensus that hydrocarbons not related to “fossils”
- Hydrocarbons found on other planets
- Created by planetary scale pressures combining hydrogen and carbon
- Break the chemical bonds (electromagnetic) and release energy

Compound	Carbons	Formula	Boiling Point, °C
Methane	C1	CH ₄	- 161.0
Ethane	C2	C ₂ H ₆	- 88.0
Propane	C3	C ₃ H ₈	- 46.0
Butane	C4	C ₄ H ₁₀	- 1.0
Pentane	C5	C ₅ H ₁₂	36.1
Hexane	C6	C ₆ H ₁₄	68.7
Heptane	C7	C ₇ H ₁₆	98.4
Octane	C8	C ₈ H ₁₈	125.7
Nonane	C9	C ₉ H ₂₀	150.8
Decane	C10	C ₁₀ H ₂₂	174.1
Kerosene	C12 - C16		200 – 300
Distillate Fuel	C15 - C18		Up to 360
Lubricating Oils	C16 - C20		350 & up
Residual Fuel Oil and Grease	C20 & up		
Pitch and Tar	C26 & up		
Petroleum Coke	C26 & up		

Hydrocarbons Refined



FRACTIONAL DISTILLATION CRUDE OIL



Renewable & Clean Energy



- Renewable & Clean are used to differentiate “work energy” that is derived from non-hydrocarbon sources
- Not a scientific distinction – political term
- Nuclear energy: yes but no
- Hydroelectric: yes, except
- Windmills: Yes
- Solar Farms: Yes

No Free Ride



ATLANTIC CITY, N.J. (AP) — New Jersey’s **first offshore wind farm** may **“adversely affect” whales** and other marine mammals, but its construction, operation and eventual dismantling will not seriously harm or kill them, a federal scientific agency said.

The National Oceanic and Atmospheric Administration issued a report Tuesday evaluating an analysis by the U.S. Bureau of Ocean Energy Management of the Ocean Wind I project to be built off the southern New Jersey coast.

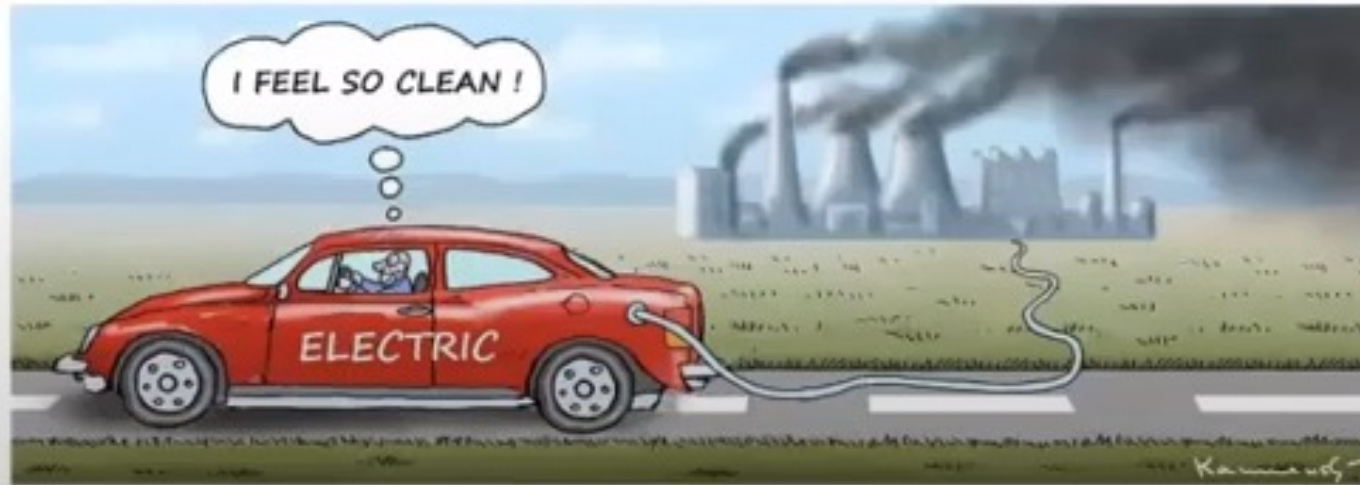
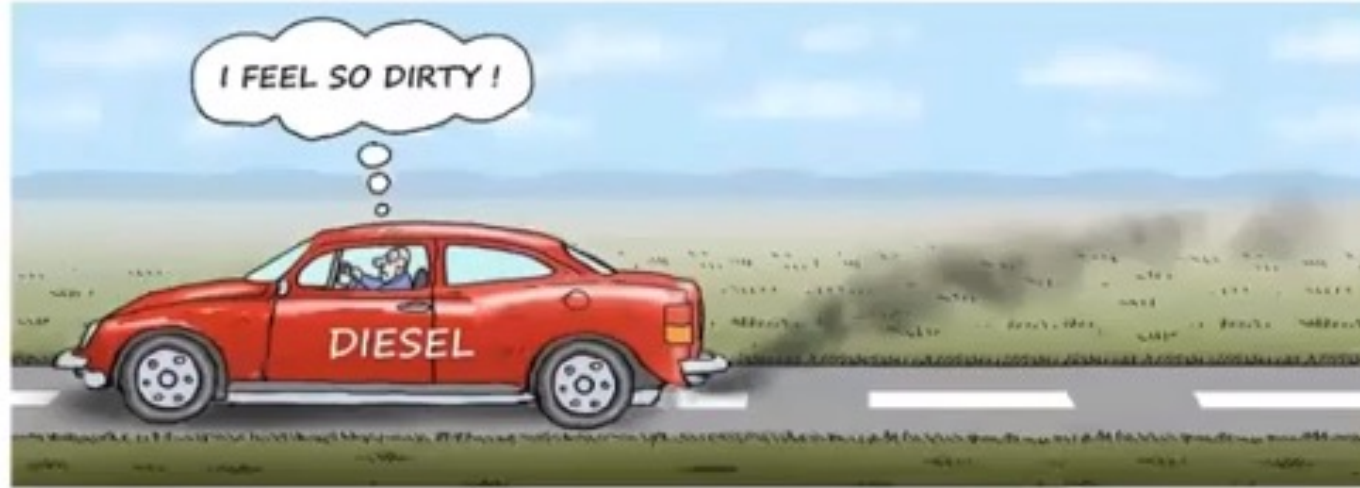


The hard truth of building clean solar farms

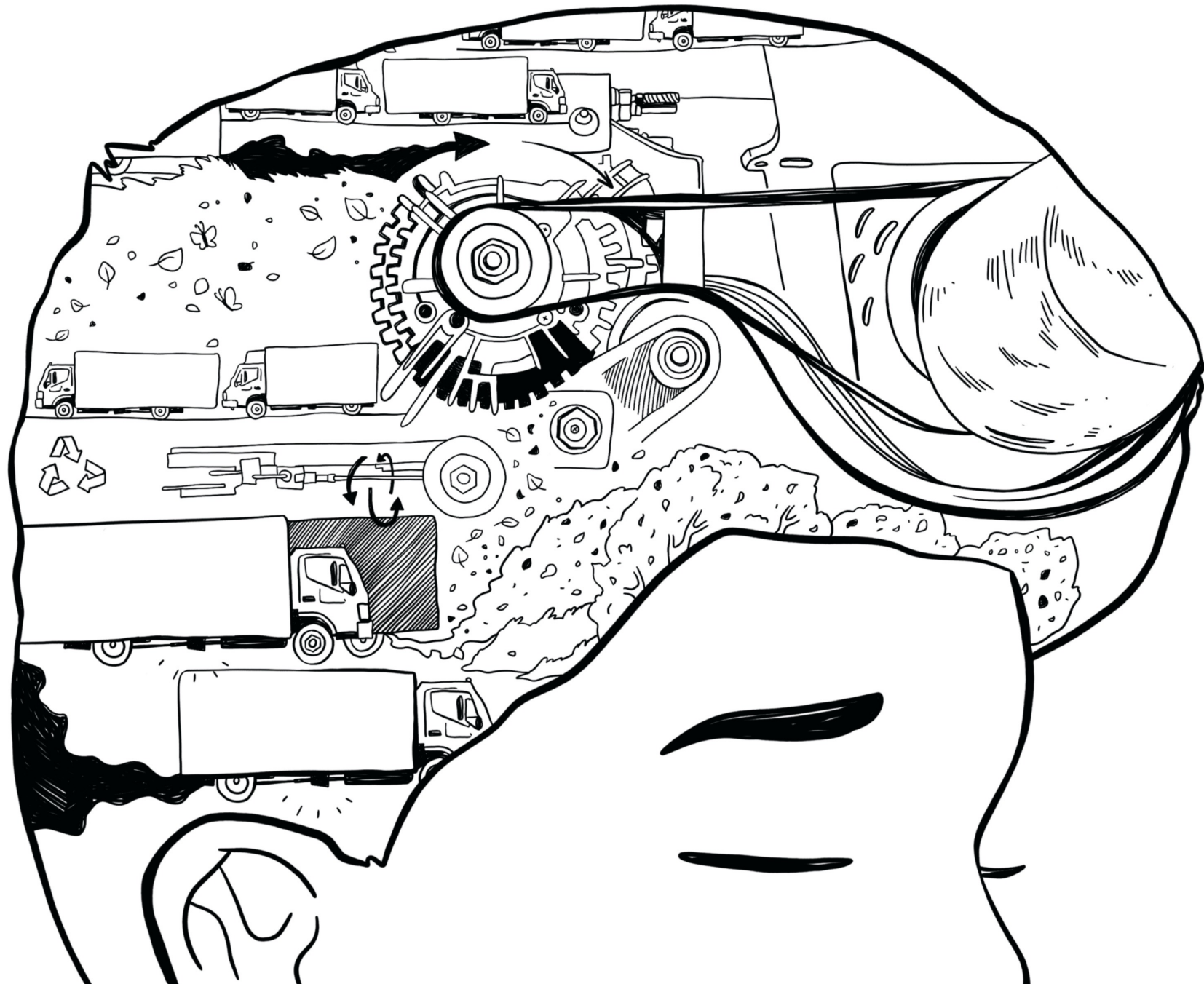
The construction of **four solar farms in the US** violated the **Clean Water Act**, showcasing the challenges of building a clean power grid. Last month, the US Environmental Protection Agency and Department of Justice announced more than a million dollars in penalties against companies for [polluting local waterways](#). The culprits? Four solar farms in Illinois, Alabama, and Idaho.



Observation and Relativity



Clean Electric Car by Marian Kamensky, Austria



What are we trying to accomplish?



- Transform “energy” into “work energy” via systems that has the least negative impact to humans, animals and the planet
- Stop thinking in terms of creating energy – realize we are only transforming it from one form to another
- Understand that work energy system is both a work energy consumer and a work energy producer

Goal:

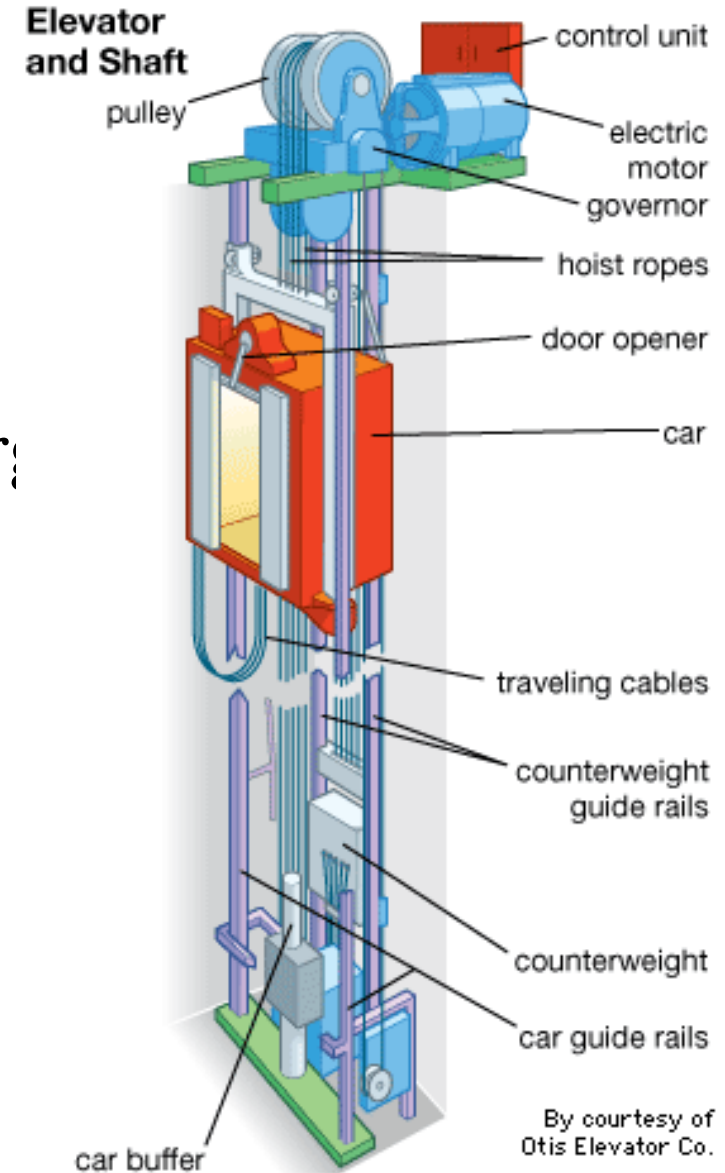
Change the way we configure work energy systems to produce more work energy with less impact

Elevator



- Status Quo:
 - Energy is the ability to do work
 - An elevator consumes energy to lift and lower people in a building
- Change to new language: An elevator is a “work energy system”
 - Capable of consuming & producing work energy
 - Consume on the lift
 - Produce on the decline
 - Electric Motor consumes electricity in one direction and produces it in the other

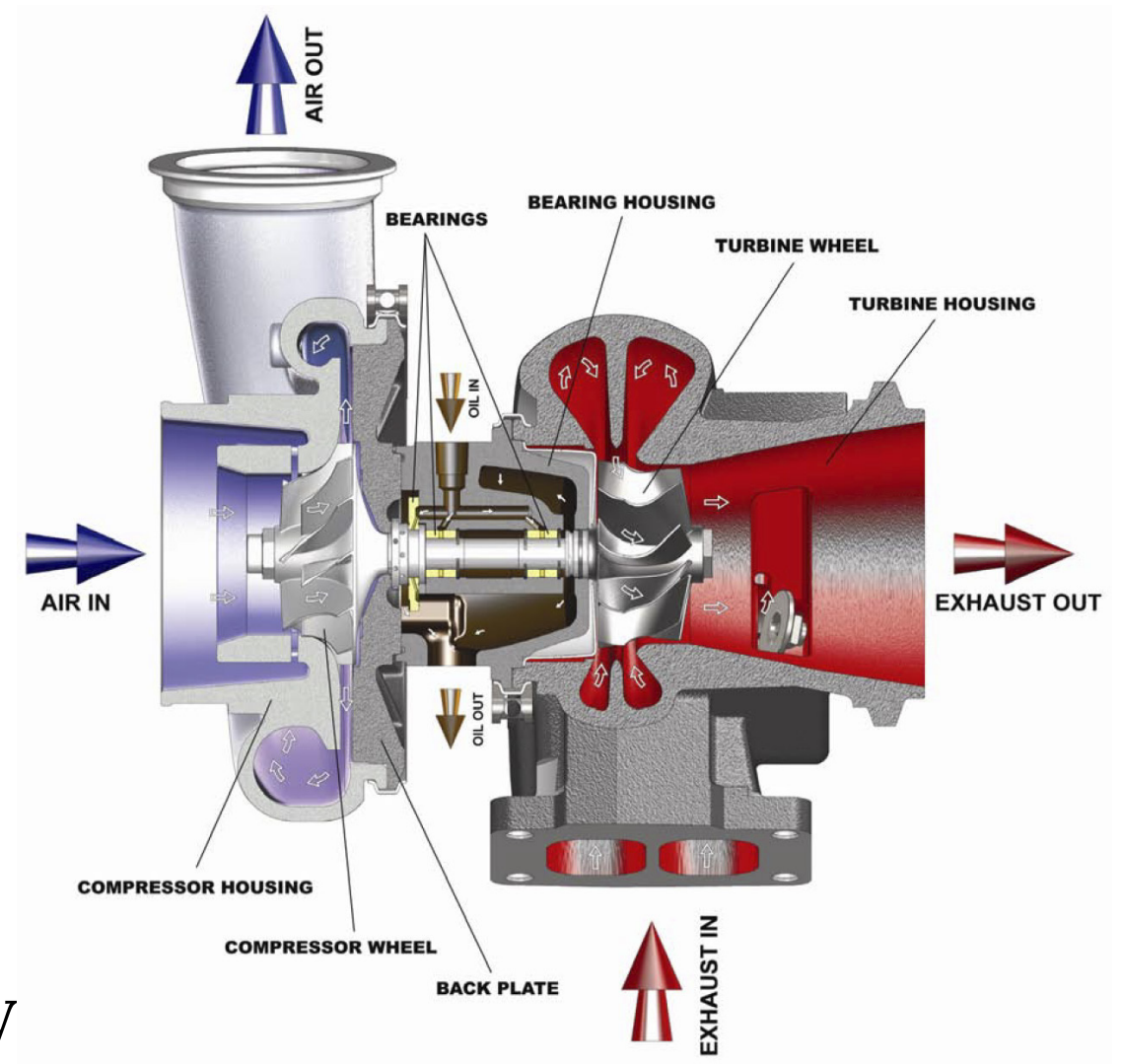
“Renewable Energy” from the mechanical world



Turbo Charger Example



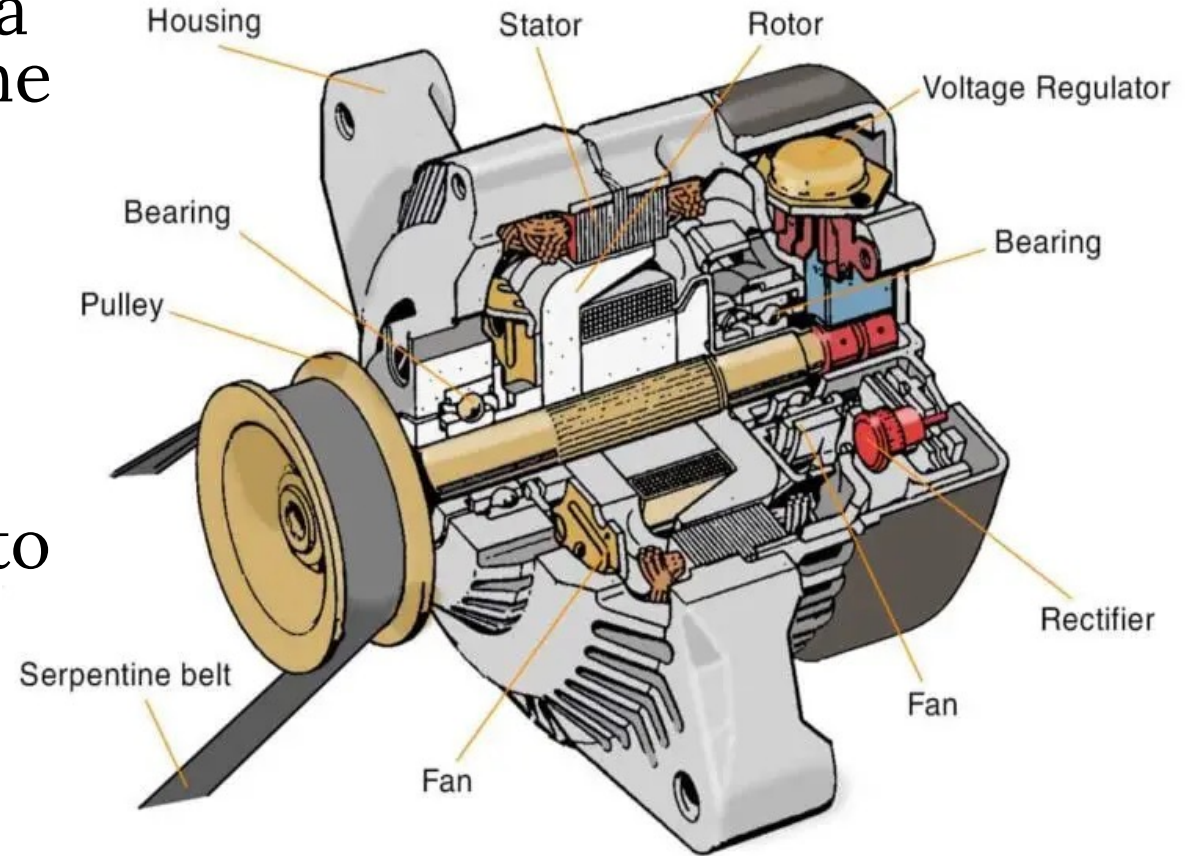
- Turbo consumes the power from engine exhaust gas
- Which robs the engine of power requiring the engine to burn more fuel
- The Turbo also compresses cold air and forces it into the engine to produce more power than it used
- A parasitic system consuming work energy NET increase in work energy



Alternator



- An auto motive alternator is spun via a belt connected to the crankshaft of the engine
 - Robbing power from engine
- To excite, the alternator draws electricity from the battery
- Once running it produces electricity to provide continue power to fuel injectors that increase net fuel economy
- Parasitic system that consumes “energy” in order to produce energy



gmundcars.com

Problem: Diesel is the primary source of energy in commercial vehicles and will be for many years to come





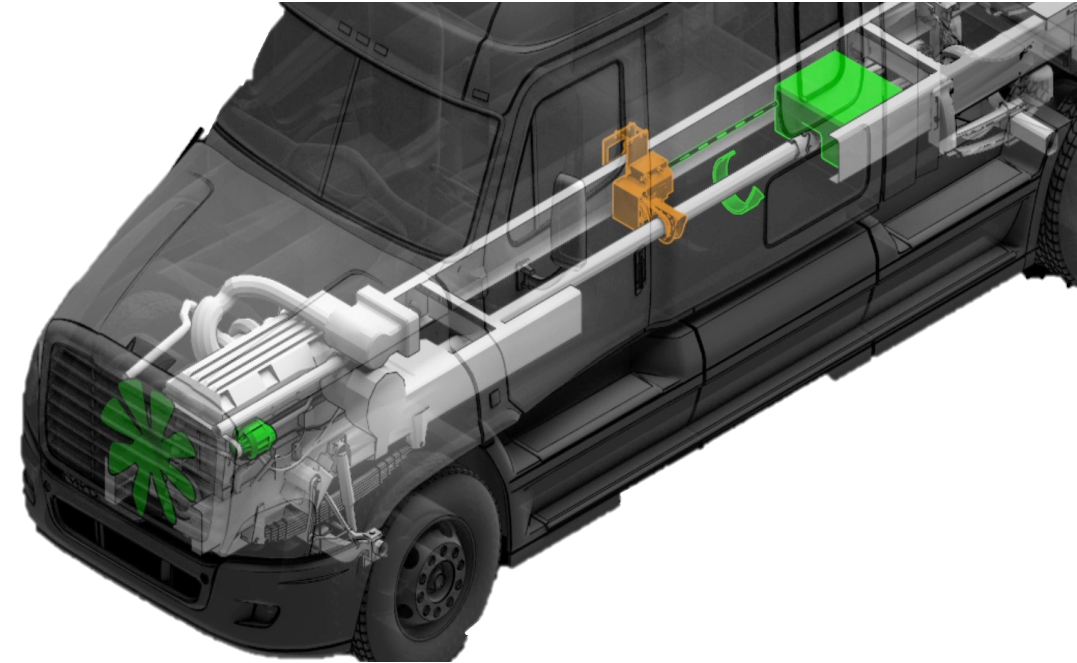
Electrify the diesel platform

– save money & reduce emissions

Blackburn makes clean electricity to power:

- Electrified diesel engines
- Electric refrigeration
- Autonomous vehicles platforms

Increase MPG, reduce CO2, increase profits with ***all*** the power, performance & reliability of diesel



RelGen

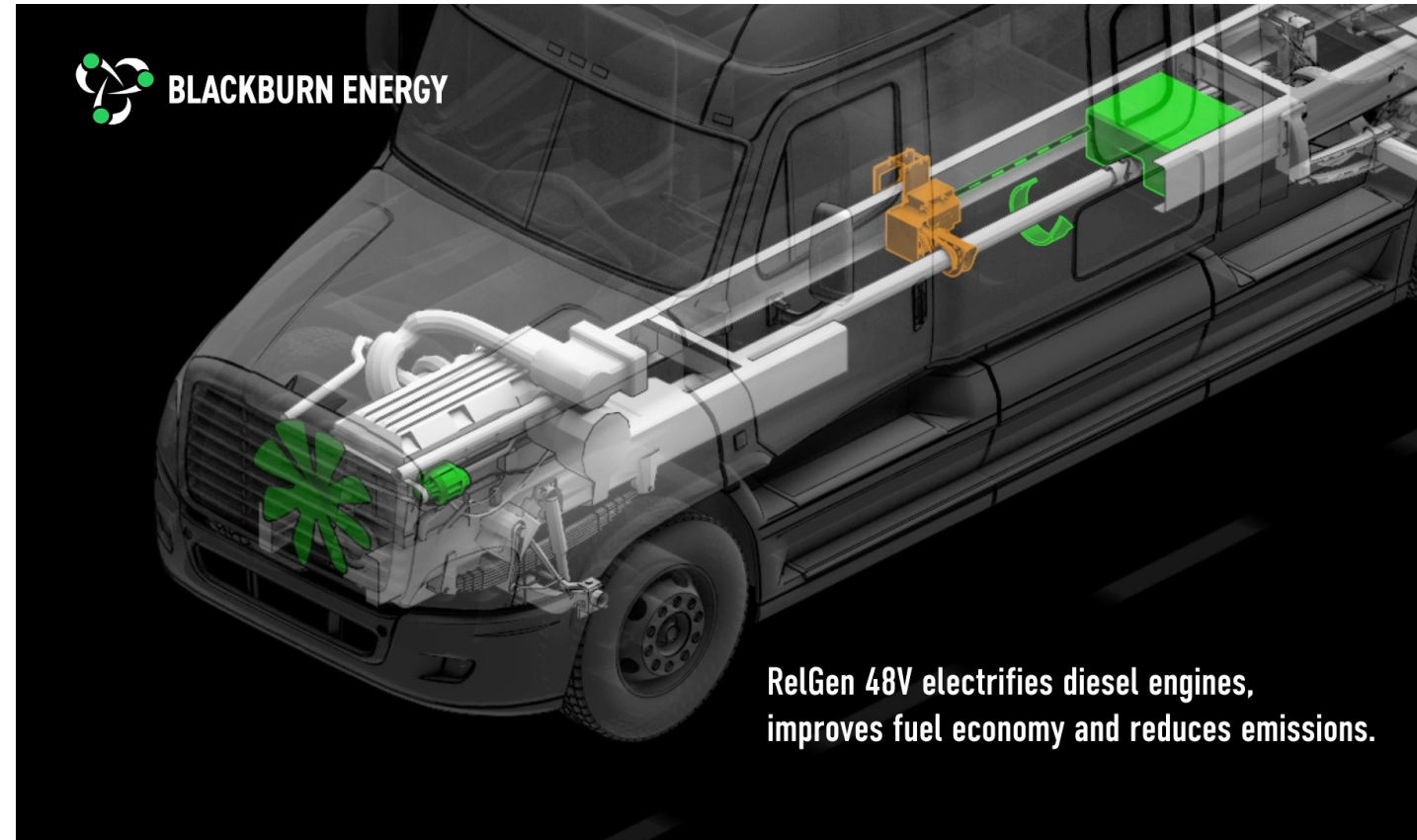


imgflip.com



Impact

- 297 billion miles driven per year by U.S. commercial trucks
- RelGen[®] increases fuel economy by 1 MPG for each mile
- \$30 billion¹ for the commercial trucking industry per year
- Reduction of 6 billion gallons per year & 61 million metric tonnes of CO2 emissions²



¹ Assumes fuel cost of \$5.00/gallon. Source: Federal Highway Administration. (<https://www.truckinfo.net/research/trucking-statistics>)

² EPA, n.d., Greenhouse Gases Equivalencies - Calculations and References, from <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references-diesel>

Energy & Combustion Lab Results



 BLACKBURN ENERGY
HYBRID CHARGING

 **ecr** | ENERGY & COMBUSTION RESEARCH LABORATORY

UML CERTIFIED RESULTS FOR FUEL SAVINGS AND EMISSION AVOIDANCE

Hybrid Charging Solution
For Electric APUs - **\$5,995**
One Year Payback

ANNUAL SAVING		
2,900 GALLONS	\$8,846.44	29.53 TONNES CO ²

Blackburn Energy, Inc. 11 Chestnut St. Amesbury, MA 01913
Andrew.Amigo@BlackburnEnergy.com / 1.978.675.6516

 BLACKBURN ENERGY
HYBRID CHARGING

 **ecr** | ENERGY & COMBUSTION RESEARCH LABORATORY

UML CERTIFIED RESULTS FOR FUEL SAVINGS AND EMISSION AVOIDANCE

Hybrid Charging Solution
For Liftgates - **\$2,995**
One Year Payback

ANNUAL SAVING		
1,268 GALLONS	\$3,868	12.91 TONNES CO ²

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RelGen Transforms Global Infrastructures

RelGen makes trucks mobile, independent sources of renewable energy to help power electricity grids.

RelGen can be used on pick-up trucks, vans, and buses to power everything from cordless tools to mobile phones.

Other societies with different power needs can use RelGen to generate electricity for medical clinics, schools, businesses etc.





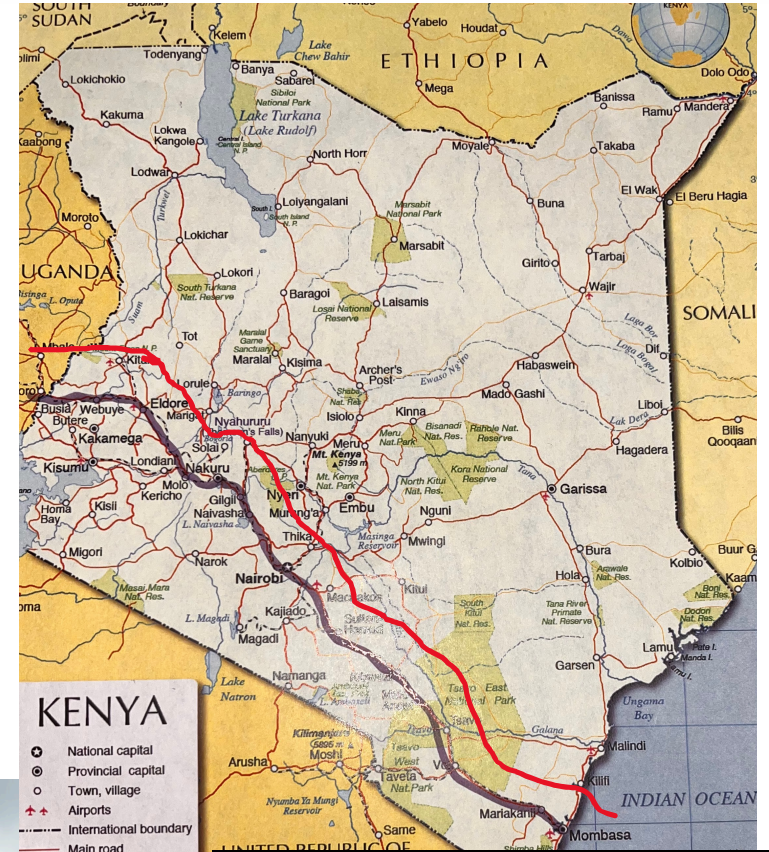
Blackburn Energy's Kenya Project



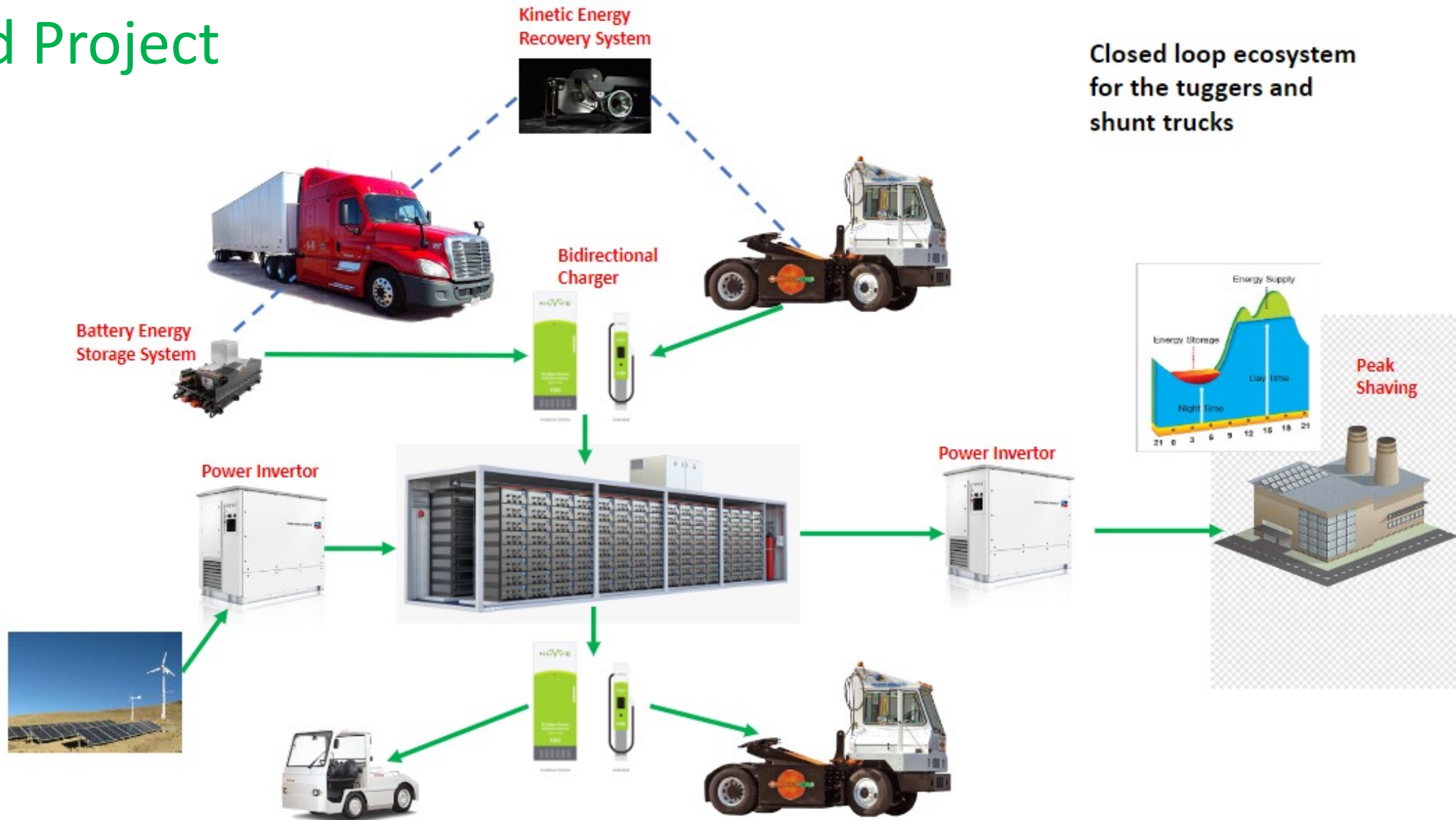
Collaborative Efforts Towards Rural Electrification in Kenya Using Battery Power



DEVELOPED BY:

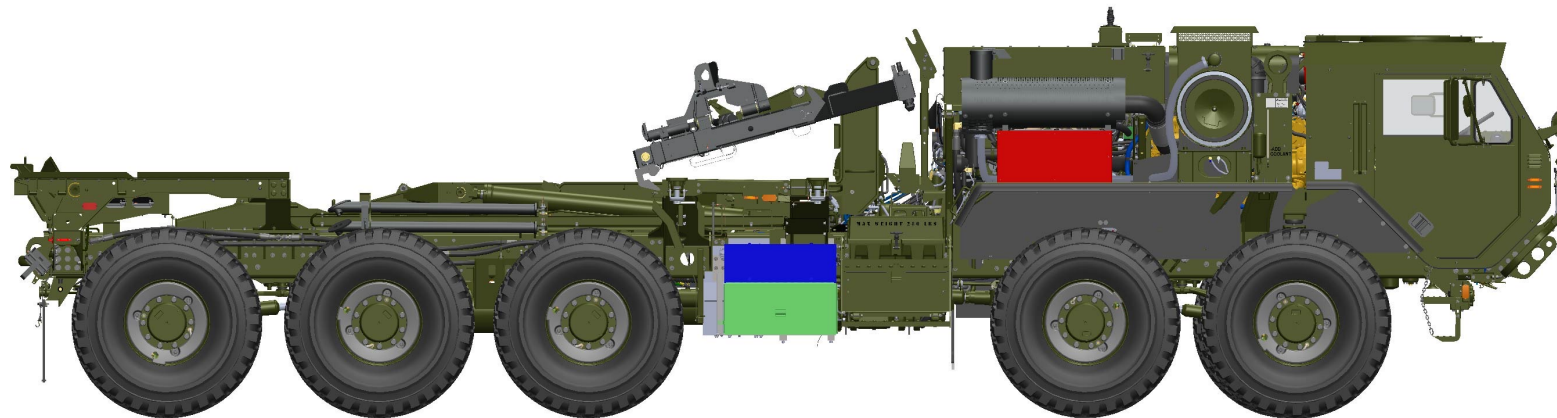


Microgrid Project



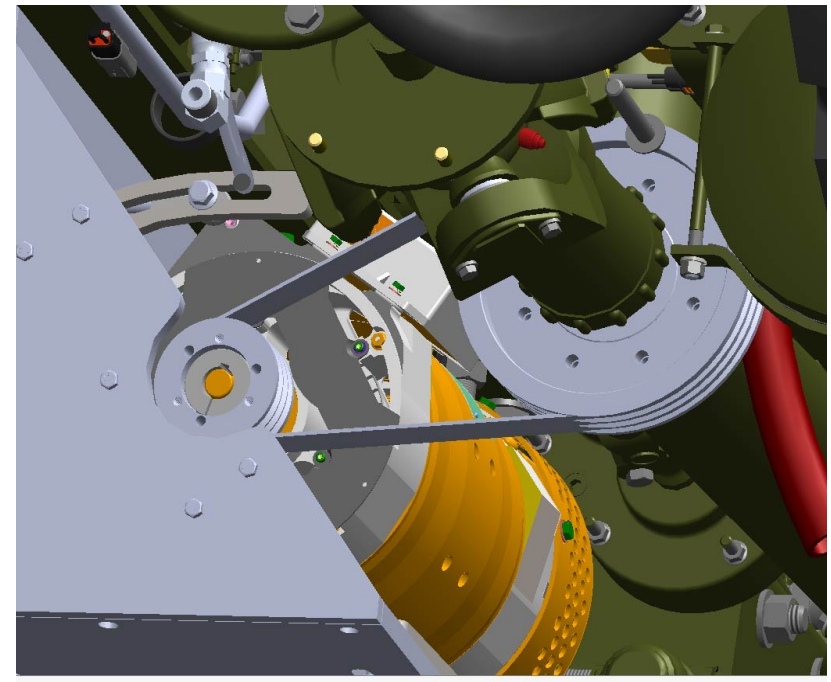
Closed loop ecosystem for the tuggers and shunt trucks

LVSR Silent Watch Powered by Hybrid Charging



Why this matters to the USMC?

- A complete Silent Watch system for the MKR18
- Save an average of 86 gallons of fuel per LVSR/per day
 - ½ of a tank of fuel per day
 - 1,200 MKR18 = 103,000 gallons saved each day
 - 365-day cycle = 3.7 million gallons of diesel
- Extend LVSR range by 170 miles of range
- Reduce amount of fuel transportation needs
- Lower thermal and acoustic signature
- Reduce maintenance
- Reduce CO₂, NO_x
- Create a Foundation for Future



CAD Drawing of Hybrid Charging
without front protective cover

Adoption by Design

- Installation with the GMTK
- No special training needed
- RelGen installs on existing frame rails with no modification
- LVSR Cab remains unmodified
 - Operates with one single switch



Auxiliary Battery Box (red) & Systems Box without cover (blue)

We can **REDUCE EMISSIONS** in trucking globally **FASTER THAN ANY OTHER SOLUTION**.

Eliminating 2 hours of idle per day on 335 million commercial vehicles worldwide would **ELIMINATE OVER 2 GIGATONS OF CO2 EACH YEAR**





**THANK
YOU!**

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EMPOWERED TRUCKING