



#### **Bioenergy, Biomass and Fuel Cells:**

August 21st 2021











## Bioenergy, Biomass and Fuel Cells: The Economy of Green Fuel – Which Solution?

August 21<sup>st</sup> 2021







## A Quick Thank You: 10<sup>th</sup> WRETC 2019



Inspire the Young



## A Quick Thank You

- 22<sup>nd</sup> August 2019 10<sup>th</sup> WRETC in Delhi
- Permission from Queen and Sony Global Licensing
- "Is This The World We Created!"
- Written by Freddie Mercury (St Peters School, Panchgani)
- Played to photos of climate change impacts images
- May 2020 due to Covid Health Economy Solution opened
- With FES this formed the Economy Solution Group <u>www.fueleconomysolution.co.uk/thanks</u>







#### **Before We Start**

- Just 15 hours ago:
- Unicef report
- <u>https://www.forbes.com/sites/unicefusa/2021/08/20/un</u> <u>icef-report-shows-1-billion-children-at-extremely-high-</u> <u>risk-from-climate-change/</u>
- 33 countries
- Over 1 billion children (1 in every 2 on the planet) at "extremely high risk" from climate change
- There is no time to lose...every second counts









## **Presentation Summary**

- 1. What is a green fuel?
- 2. Fuel Economy Solution overview
- 3. The Economy Solution Group
- 4. Bioenergy circular economy opportunities
- 5. Combustion vs Pyrolysis comparison of benefits
- 6. Biofuels challenges to overcome in key markets
- 7. ESG Forecast trends and investment opportunities







#### The Economy of Green Fuel – Which Solution?









## The Economy of Green Fuel – Which Solution?

#### ALL OF THEM!!

Variations of scale required Locally available feedstocks Mineral availability and cost Energy Demand Local & National RE/other energy mix Technology advances – what's a green fuel anyway?!







## 1. What Is a Green Fuel?

- From renewables e.g. Solar/wind/wave energy?
- Can carbon neutral fossil fuels be green e.g. coal?
- Is better food with own biomass energy possible?
- Does combusting biomass repay it's carbon debt?
- Can catalysis improve biomass carbon debt payback?
- Can vertical farming and nutraceuticals combine?
- Do we include functional foods in bioenergy/biomass?







#### **Protecting the Foundation of Life**









#### **Protecting the Foundation of Life**



The Endoplasmic Reticulum – Kornfeld and Kornfeld et al (1985)









## **2. Fuel Economy Solution**

- Fuel Economy Solution founding brand of ESG
- The core FES technology is combustion efficiency
- Ultimate System Integrator (USI) product range
- Combustion chamber catalysts refinery and secondary
- Refinery end bespoke biofuel stability additive packages
- Private label supply also available
- Reshape the burn of fossil fuels, biomass and biofuels
- Improve thermal efficiency (= savings) and lowers GHGs









## **Strong links with India**

- Members of the Manchester India Business Partnership
- 9<sup>th</sup> Sept 2021 next Summit at Old Trafford then 5<sup>th</sup> test!
- Invited to host World CSR Day (18<sup>th</sup> Feb) in Mumbai 19 & 20
- Feb 18: Our first industry workshop (Kolkata Press Club)
- Launched special edition of Energy Ensemble magazine
- Then developing a Lithium Recycling Curriculum in W Bengal
- E&EF International Advisory Council Members since 2018
- Since 2018 (Energy) then 2019: (Renewable Energy & Water)
- Long term commitment to green energy transition in India









## **Strong Management Team**

- 3 directors
- Over 120 years of experience in business
- ServCo OpCo business model
- >63,000 employees worldwide to call on from our partners
- Agile to address fast moving green economy transformation
- Core skill sets in aftermarket automotive, combustion engineering, construction, mining, programme management and business operational delivery.
- Looking for partners *across* the Economy Solution Group









## **Fuel Economy Solution Limited**

- 2018 launch: USI- combustion catalyst range.
- To 2020 fuel tech only COVID changed all that
- May 20: The *Economy Solution Group* was formed
- Health Economy Solution launched in May 2020.
- Green ECOnomy Solution launched in June 2020
- Common focus: Green Economy Transformation

**Economy Solution Group** 

• FES = *founder* of the Economy Solution Group.







## Fuel Savings, Reduced Emission, Lower OPEX

- Liquid & solid combustion chamber catalysts.
- USI 1000 internal combustion engines only.
- USI 2000 open flame combustion boilers.
- USI 3000 marine application as a solute directly into day tanks.
- Organometallics from *sustainable* sources.
- Bespoke product design service available.









## **Key FES Sectors**

- Agri
- Power
- Marine
- Mining
- Land Transport.









#### Ultimate Systems Integrator (USI-) Range: Savings

- Euro I fuel (2000+ ppm sulphur) 10%+.
- Euro II fuels (500 ppm sulphur) 8-10%.
- Euro III fuels (350 ppm sulphur) 7.5-9%.
- Euro IV fuels (50 ppm sulphur) 6.5-8%.
- Euro V/VI ULS fuels (<10ppm) 5% or better.
- *Significant* black smoke reduction up to 75%.

**Economy Solution Group** 

• Healthy reductions across all GHGs.







## **Testing Provides the Proof**

- Road Transport 7-17% (6 countries).
- Mining & Civil Engineering 5-25% (2 countries).

- Power Generation 5-19% (7 countries).
- Shipping 5-14% (5 countries).







#### **First Step to Decarbonization:**

#### **Test Proposal or Concept Paper**









#### **First Step to Decarbonization:**

#### **Test Proposal or Concept Paper**







## First Step to Decarbonization: Test Proposal or Concept Paper







# First Step to Decarbonization:

**Test Proposal or Concept Paper** 





#### 2. Economy Solution Group

















SOCIETY ENERGY ECONOMY SOLUTION GROUP ENVIRONMENT

Shift from

traditional forms

of energy to

sustainable

energy from

environmentally

friendly sources







SOCIETY ENERGY ECONOMY SOLUTION GROUP ENVIRONMENT **Restore balance** 

Restore balance to earth's carbon (Currently c.550Gt deficit)

Shift from traditional forms of energy to *sustainable* energy from environmentally friendly sources







Shift from traditional forms of energy to sustainable energy from environmentally friendly sources



chains

# FUEL ECONOMY SOLUTION

Shift from traditional forms of energy to *sustainable* energy from environmentally friendly sources



Major progression in State-Citizen Ecosystems for Smart Cities

Improve the Biosphere and increase low carbon high resilience food chains





Behavioural change by Society to improve resilience and reduce brown carbon intensity



**Economy Solution Group** 

Shift from traditional forms of energy to sustainable energy from environmentally friendly sources





Major

progression in State-Citizen

**Smart Cities** 

Improve the

**Biosphere and** 

increase low

carbon high

resilience food

chains







































## **Market Ready Technologies**

- Ultimate Systems Integrator (USI-) fuel borne combustion catalyst range – fuel savings, reduced emissions & lower OPEX.
- ECOlysis our own marketing brand for WtE power generation through bespoke pyrolysis units, clean energy with biochar by product
- Sustaina-BEET an industry leading first bio sugar process powered by own biomass with green by products (e.g. Graphene) & biochar









#### **3. Bioenergy circular economy opportunities**






## The Challenge with Bioenergy from Biomass

- Carbon debt & payback times for biomass units
- Carbon payback time varies by supply chain
- Wood particularly challenging
- Better carbon accounting case to use waste only
- Is combustion the best method?
- Is combustion catalysis cost effective and helpful?







## **Biomass & Biofuels Catalysis Research**

- Palm oil biodiesel
- Algae fuels from harvesting parasitic knotweed
- Cleaner burning biomass e.g. Olive pomace
- Additive for more improved recycling in pyrolysis







## **Biomass & Biofuels Catalysis Research**

- Palm oil biodiesel Indonesia going from B20 up to B50 (Issues with oxidation stability and acid numbers)
   Benefit: Massively collapse transport CO<sub>2</sub> footprint
- Algae fuels from harvesting parasitic knotweeds (173 invasive alien plants recently studied in India)
   Benefit 1: Restore cleaner water bodies
   Benefit 2: Clean energy (algae fuel or pyrolysis + biochar)







### Human bioenergy – improving resilience

• Aloe Polymannose:

#### The Effect of an Aloe Polymannose Multinutrient Complex on Cognitive and Immune Functioning in Alzheimer's Disease

John E. Lewis<sup>a,\*</sup>, H. Reginald McDaniel<sup>b</sup>, Marc E. Agronin<sup>c</sup>, David A. Loewenstein<sup>a</sup>, Jorge Riveros<sup>c</sup>, Rafael Mestre<sup>c</sup>, Mairelys Martinez<sup>c</sup>, Niurka Colina<sup>c</sup>, Dahlia Abreu<sup>a</sup>, Janet Konefal<sup>a</sup>, Judi M. Woolger<sup>d</sup> and Karriem H. Ali<sup>e</sup> <sup>a</sup>Department of Psychiatry & Behavioral Sciences, Miami, FL, USA <sup>b</sup>Fisher Institute for Medical Research, Grand Prairie, TX, USA <sup>c</sup>Miami Jewish Health Systems, Miami, FL, USA <sup>d</sup>Department of Medicine at University of Miami Miller School of Medicine, Miami, FL, USA <sup>e</sup>Pharmacognosia, Rainier, WA, USA







#### Human bioenergy – improving resilience

#### • Conclusions: Positive (i.e. Better *Cognitive* Quality of Life)

Accepted 1 August 2012

Abstract. Alzheimer's disease (AD) is a leading killer of Americans, imparts a significant toll on the quality of life of the patient and primary caregiver, and results in inordinate costs in an already overburdened medical system. Prior studies on cholinesterase inhibitors among AD patients have shown minimal amelioration of disease symptoms and/or restoration of lost cognitive functioning. The effect of improved nutrition, particularly with dietary supplements, on cognitive functioning may offer an alternative strategy compared to standard treatment. The present pilot study investigated the effect of an aloe polymannose multinutrient complex (APMC) formula on cognitive and immune functioning over 12 months among adults diagnosed with AD. Subjects participated in an open-label trial and consumed 4 teaspoons per day of the APMC. The ADAS-cog, MMSE, ADCS-ADL, and SIB were administered at baseline and 2, 6, 9, and 12 months follow ap. Cytokines and lymphocyte and monocyte subsets were assessed at baseline and 12 months. The mean ADAS-cog cognition score significantly improved at 9 and 12 months. Participants showed clinically-significant improvement ( $\geq$ 4-point change) from baseline to 12 months. Participants showed clinically-significant improvement ( $\geq$ 4-point change) from baseline to 12 months. Participants showed cligatificant decreases in tumor necrosis factor- $\alpha$ , vascular endothelial growth factor and interlocume-2 and -4. CD90+, CD95+CD3+, CD95+CD90+, CD14+CD34+, CD14+CD90+, and CD14+CD95+ decreased significantly, whereas CD14+ significantly increased. Participants tolerated the APMC supplement with few, temporary adverse process. Our results showed improvements in both clinical and physiological outcomes for a disease that otherwise has no tandard ameliorative remedy.

Keywords: Aloe, Alzheimer's disease, B-lymphocyte subsets, cognition, cytokines, dietary supplementation, growth factors, oligosaccharides, T-cell subsets







#### 4. Combustion vs Pyrolysis

- Thermal combustion is currently necessary
- FES has a 6 stage combustion technology partner ready
- If combustion can be avoided this is preferable
- However in transition this is not always possible
- Catalysis can help optimize combustion and lower GHGs
- Heating by pyrolysis for complex waste streams is better
- Simplifies and separates complex molecular structures
- Outputs yielded are the simple core elements









## **Pyrolysis Benefits**

• Significant reduction of waste volume by up to 85%

- Release of energy (i.e. generation of heat)
- Retrieval of metals oils and by products





# FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: Technology

Pyrolysis is the thermal decomposition of matter into:

- Gas
- Bio oil
- Carbon solids

In the absence of oxygen at temperatures between 600 and 900 degrees C.





#### FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: Process









# FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling:

- Good Waste to Energy solution for various feed stocks
- But greatest bio-restoration opportunity is with *biomass*
- FES currently in discussions with new IP owner
- Using recent technology developments in pyrolysis
- Technology is being deployed now in sub-saharan Africa
- Also in use as part of carbon capture in Latin America
- Plan to 2022 is to develop finance and roll out projects
- Market focus for FES is India, ASEAN, N Africa & Europe







## FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: Market Applications: Solid Waste Recycling

#### In Solid Waste Recycling:

- Diverts biomass, municipal waste & plastics from landfills
- This avoids GHG emissions
- Creates energy and valuable products

#### **Other Applications:**

- Renewable Energy Generation
- Bio Carbon Production







## FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: Addressable Markets









# FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: Products

• Renewable electricity & bio fuels (including green H<sub>2</sub>)

- Biochar
- Activated carbon





# FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: Biochar Market Applications

Biochar is a carbon-rich, stable solid derived by pyrolysis of agricultural waste, wood waste, and forest waste:

- Carbon sequestration and offset
- Regenerative agriculture
- Remediation
- Livestock







# **FUEL ECONOMY SOLUTION** Advanced Thermal Carbon Recycling: Biochar Sequestration and Offset

- Sequesters carbon in soil
- Offsets 3 tons CO<sub>2</sub> emissions/tonne of biochar
- Could avoid 4 Gigatons of CO<sub>2</sub> emissions by 2050

**Economy Solution Group** 

• Why is this important to focus on?





# FUEL ECONOMY SOLUTION Advanced Thermal Carbon Recycling: IPCC Report

intergovernmental panel on climate change Climate Change 2021 The Physical Science Basis Summary for Policymakers

• 7<sup>th</sup> August 2021 – 42 pg summary of findings AR06 report







## FUEL ECONOMY SOLUTION IPCC Report – 7<sup>tn</sup> August 2021

Approved Version

Summary for Policymakers

IPCC AR6 WGI

#### Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling





Figure SPM.2: Assessed contributions to observed warming in 2010–2019 relative to 1850–1900.







#### **IPCC Report Summary Report:Figure SPM02**

- The SO<sub>2</sub> indicated as one of few factors slowing CC
- This has come from coal and other fossil fuels (transport)
- 100% fossil fuel cessation now would increase warming
- Due to less SO<sub>2</sub> reflected light and heat
- Before coal phase ot we need massive bio-restoration

**Economy Solution Group** 

• Biochar production and re-sequestration into soils







## 5. Biofuels – key market challenges

- Sustainability of feedstock production e.g. Palm oil
- Additional use of land urgently needed for agriculture

- Consistency of product quality from plantations
- Stability in transport from plantation to refinery
- Oxidation stability affects quality and shelf life
- Raised total acid numbers corrosion?
- <u>https://www.jstor.org/stable/26554703</u>:







#### Is Palm Biodiesel corrosive to auto materials?

- Study from 2018 may allay these concerns
- SAE International Journal of Fuels and Lubricants
- Vol. 11, No. 2 (May 2018), pp. 147-162 (16 pages)
- Published By: SAE International



#### Corrosion Behavior of Automotive Materials with Biodiesel: A Different Approach

Kamalesh A. Sorate and Purnanand V. Bhale, Sardar Vallabhbhai National Institute of Technology







#### **FES Proposition: For Sustainable Biofuels**

#### Refinery end additive package proposals:

- Look in details at each feed stock and application
- This will vary by market
- Finance for R&D will need to be raised
- We offer bespoke fuel stability additive packages
- Help to maximise production volume
- But also minimize emissions of volatiles combustion
- Improved product performance for all sector customers









### 6. Fuel Cells: Challenges, risks & opportunities

 <u>https://greenauthority.com/</u> <u>10-alternatives-to-lithium-</u> <u>ion-batteries-</u> <u>79/?fbclid=IwAR3II1AbVG2Z</u> <u>qQMkuzUgwijBZpky3jOunVo</u> <u>RYAWK5Fj8fL4SEDUImZE6Cc</u> A Green Authority > News > 10 alternatives to lithium-ion batteries: Which new tech will power the future?

#### 10 alternatives to lithiumion batteries: Which new tech will power the future?

April 28, 2021 by Bogdan Petrovan





© April 21<sup>st</sup> 2021 Green Authority News







# 7. Fuel Cells: Challenges, risks & opportunities

So what are the likely contenders for the title of power source of the future? Here are our picks for the top lithium-ion alternatives, but bear in mind it could be a combination or a development of any one of these technologies that could eventually win the race to replace lithium-ion.

# 10 lithium-ion battery alternatives

- Hydrogen fuel cells
- Lithium-sulfur batteries
- Graphene supercapacitors
- Redox flow batteries
- Aluminum-graphite batteries
- Bioelectrochemical batteries
- Solar panels
- Powered roads
- Thin-film batteries
- Solid-state batteries



#### © April 21<sup>st</sup> 2021 Green Authority News





#### **Supercapacitors**

- Graphene and basalt fibre energy storage technology
- Not really a battery no chemicals involved
- 1 million charges capability unlike Lithium ion
- Lithium ion 10 year max guarantee
- Lithium ion cell change every 4 years
- Market leaders already in production
- FES & ESG partners can help integrate supercap solutions
- This will transform the future demands of global mining









#### **Resonant Control Electrolysis Hydrogen**

- Significantly reduces the bond strength between H and O
- IP to treat water to re-structure covalent bond strengths
- 3-10x more efficient using existing electrolyzers
- Current R&D phase will take RCE Hydrogen to the next level
- Huge investment opportunity for giga factory H<sub>2</sub> production







#### 7. ESG Forecast Trends & Investment Opportunities

- Fluid oscillation CC in power generation
- Carbon neutral coal buy time and South-south energy security
- Solid state supercapacitors using graphene and basalt fibre
- Hydrogen (RCE & Fuel Cells) vs Lithium battery EVs -who will win?
- Scaling of retrofitting existing ICEs for hydrogen
- Graphene economy will explode with many circular opportunities
- Graphene sand composites as low cost water filtration material
- Vertical farming high volume, quality & efficient food production
- Growth in advanced thermal carbon recycling in the South-south
- Sequestration of pyrolised biochar back into the biosphere









### **Green Economy Solution Consulting**

- Fuel and Energy use audit across operations
- Identify potential fuel efficiency OPEX savings
- Propose potential emissions reduction plan
- Validate entire project lifecycle benefits
- Underpinned by fuel efficiency testing
- Investors welcome to inquire re. current raises







#### **Thank You**

Contact: <a href="mailto:ceo@fueleconomysolution.com">ceo@fueleconomysolution.com</a>

For all technology or financial investment inquiries







#### **BACK UP SLIDES**







#### TCFD Press Release Weds Feb 12<sup>th</sup> 2020

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

FOR IMMEDIATE RELEASE: WEDNESDAY, FEBRUARY 12, 2020 7AM ET, 12PM GMT, 1PM CET, 8PM HKT

#### More than 1,000 Global Organizations Declare Support for the Task Force on Climate-related Financial Disclosures and its Recommendations

New York, February 12, 2020 – The Task Force on Climate-related Financial Disclosures (TCFD) announced today that it has officially reached more than 1,000 supporters globally for its recommendations, signifying a major shift among market participants in acknowledging that climate change presents a financial risk. Together, the private sector organizations that are supporters have a market capitalization of nearly \$12 trillion. The Task Force, which is chaired by Michael R. Bloomberg, provides recommendations to enable markets to address the financial impact of climate change by increasing transparency on climate-related risks and opportunities to promote more informed financial decision-making. By publicly declaring their support for the TCFD and its recommendations, the supporting organizations are demonstrating that they are taking action to build a more resilient financial system through climate-related disclosure.

(https://assets.bbhub.io/company/sites/60/2020/02/PR-TCFD-1000-Supporters\_FINAL.pdf)







## Integrated Approach – Multi Sector/Modal

- Society growth is supported by food & minerals.
- Food & minerals flow between key nodes.
- Farms, factories, mines, ports and cities.
- Multi-modal transport KEY (road/rail/agri).
- Higher energy intensity needed but *lower* carbon.
- Combustion efficiency is key to low carbon shift.
- Many of our technologies are *h o r i z o n t a l...*







#### 10<sup>th</sup> World Renewable Energy Technology Congress-2019 3<sup>rd</sup> World Water Summit 2019

#### DECLARATION

The 10<sup>th</sup> World Renewable Energy Technology Congress-2019, the 3<sup>rd</sup> World Water Summit 2019 and the 22<sup>nd</sup> ISA SUN Meet of the International Solar Alliance (ISA) were held in New Delhi, India during August 21-23, 2019 and attended by delegates from India and many countries. There were extensive discussions on various facets of Renewable Energy and Water Management, including policies, regulations, financing and effective project implementation. The assembly took serious note of global priorities, emergencies, and the need to address the challenges. The following declaration was made:

- Renewable energy and new fuels have continued their robust and promising growth across developing and developed countries. The share of green energy has increased in the electricitymix through increasing policy support of almost all governments. The significant drop in the prices of solar power in recent years will help in global electrification through clean and affordable power.
- The need for consistent, stable and sustained government policies and financing would have a
  favorable impact on technology development, greater market penetration, cost reductions through
  economies of scale, and creation of an enabling ecosystem.
- For various end-use applications, technologies are required to be fine tuned, and appropriate policy and regulatory measures adopted at national, regional, and local levels.
- Appropriate integration of environmental and social externalities in energy pricing will help develop a level playing field among conventional and renewable energy sources.

New energy technologies need to be appropriately benchmarked with international standards, both in terms of quality and safety; or new standard developed.

Emerging grid technologies and operational strategy need to be adopted to enable national
electricity grids to host the increasing quantum of stochastic inputs from renewable energy
sources.

cleaner and intermittent new sources of electricity will necessitate time-of-day tariff, distributed charging facilities for electric vehicles, and accelerated energy efficiency programs. Storage and lithium recycling need emphasis.









- Cleaner and intermittent new sources of electricity will necessitate time-of-day tariff, distributed charging facilities for electric vehicles, and accelerated energy efficiency programs. Storage and lithium recycling need emphasis.
- The large scale integration of renewable energy in the coming decade will depend on the robust financial health of power distribution companies and their ability to provide payment guarantee mechanism.
- The growth of the renewable energy sector in the hinterland will depend on its ability to provide energy services such as drinking and irrigation water to users, and for meeting electricity loads beyond household needs.
- The development of rooftop solar and grid-interactive distribution microgrids which could witness large scale growth will necessitate policies for development of renewable energy service companies.
- The introduction of the KUSUM scheme in India for diversification for farmers' income through
   solar energy was appreciated.

Hydrogen as a fuel source through fuel cells and other means, and its accelerated development in some countries was very encouraging. Its potential in intensive energy use is promising.

The inevitable energy transition demands that governments should pay urgent attention to skill development globally. It has to be reoriented to aligned to new technologies and adaptation. This would involve re-skilling, up-skilling and life-long learning programs to ensure minimum job loss and resistance to new technologies.

 Entrepreneurial development programs for new technologies and their applications should be pursued simultaneously.









- The chrinking per capita water availability, in developing and densely populated countries was noted with great concern.
- · Urbanization has to be commensurate with water availability and sustainability.
- Contamination and pollution of water sources and water bodies should invoke stringent punishment.
- The importance of ground water recharge demands protection of wetlands and floodplains of rivers.
- Appropriate pricing and measurement of water and electricity is necessary to ensure efficient use.
- Comparsory metering and digitalisation of all electricity and water production, distribution, and consumption will help in conservation of resources and their efficient and economic deployment and use.
- Water pollution and water quality indicators need to be prominently displayed online for greater public awareness and involvement.
- Smart Cities could incorporate decentralized renewable energy generation, energy conservation and efficiency, water conservation, environmental conservation and environment friendly transportation in new habitats.







The WRETC and WWS invite the global green renewable energy and water communities to assemble again at New Delhi, India for the 11th World Renewable Energy Technology Congress and 4<sup>th</sup> World Water Summit in August 2020.

ut Ryper

Anil Razdan Former Secretary Power, Government of India Chairman, Energy And Environment Foundation

Former CMD

Power Finance Corporation

Partner-Research, Advisory, Litigation Infinity Legal

Ryriakos MANIATIS Principal Administrator, New Energy Technologies, Innovation and Clean Coal, European Commission

C. T. Coulion Thousand

Professor Colin Coulson-Thomas President Institute of Management Services, UK

Dr. Bibek Bandyopadhyay Senior Advisor, Ernst & Young Former Advisor MNRE, Govt. of India

Pradeep Chaturvedi Vice President World Environment Foundation

Tim Patterson CEO, Fuel Economy Solution Limited, UK

Anti K. Garg President

World Renewable Energy Technology Congress World Water Summit



EWABLE ENERGY

22 AUGUST 2021

www.wretc.in

# We Work Within the SDGs

Goal No.	Sustainable Development Goal
1	No Poverty
2	Zero Hunger
3	Good Health and Well Being
4	Quality Education
5	Gender Equality
6	Clean Water and Sanitation
7	Affordable and Clean Energy
8	Decent Work and Economic Growth
9	Industry, Innovation and Infrastructure
10	Reduced Inequalities
11	Sustainable Cities and Communities
12	Responsible, Consumption and Production
13	Climate Action
14	Life Below Water
15	Life on Land
16	Peace, Justice and Strong Institutions
17	Partnerships for the Goals




## Industrial Sectors – R&D and targets

USI 1000 - Liquid combustion catalyst:

- Rail (freight) transport BSIV HSD India
  USI 2000 98% pure solid catalyst powder:
- Cleaner coal combustion test project Poland
- Waste to Energy alternative fuel source pilot
- Mining CFPP retrofits, coal slurry & CC@stack







### **Our Innovative Combustion Technology**







# **Understanding Area of Impact**



Source for this diagram is : *Multi-Objective Optimization of Diesel Engine Emissions and Fuel Economy using Genetic Algorithms and Phenomenological Model (slide 16)* by Tomoyuki Hiroyasu et al, Doshisha University Intelligent Systems Design Laboratory (with "Area of Impact" note added)







# **Hydrogen Fusing**



Improved combustion efficiency through earlier *speed to ignition* and a hotter burn.







## **Heat Transfer Control**



Focus reduce fuel, CO, CO2 NOx SOx and HCs.

Higher (ave) instantaneous torque yielding more power (up to 11%) earlier in the stroke

= a leaner, longer, hotter burn.







# **Best Results: Large Diesel Gensets**

Appendix F: Case Study 2: Wal-Mart Test, Mexico City – Power Generation (1 MW)

**Electrical Power Generation Engine** 

Cummins 1 MW Engine, model: QS-T30-G3

Wal-Mart Corporation, Mexico City, Mexico

2,500,000 Litres of Fuel per Month

- Achieved statistically significant improvement in fuel consumption of 9% (95% CI)
- Fuel consumption measured in L/Hr & kWh/L









#### **Transportation Testing**

#### Worldwide Testing by Application

Some examples of USI 1000 testing from around the world include but are not limited to the following:

				Change in
				Fuel
Application	Equipment Type	Manufacturer	Country	Efficiency
Transportation	FH 460	Volvo	Mexico	7.35%
Transportation	CF (2008)	DAF	UK	8.01%
<b>Transportation</b>	18 tonne rigid	Scania	UK	8.35%
Transportation	7.5 tonne rigid	Isuzu	UK	10.47%
Transportation	Date not reported - ACTROS 1840L	Mercedes Benz	Estonia	12.30%
Transportation	1998 ACTROS 1840L	Mercedes Benz	Estonia	13.60%
Transportation	7.9 litre Diesel Engine	Hino	Philippines	14.00%
Transportation	2007 ACTROS 1840L	Mercedes Benz	Estonia	16.90%
	2000/2007 Volvo trucks with			
Transportation	Detroit Deisel Engines	Detroit Diesel	Canada	17.00%







## **Mining and Civil Engineering Testing**

				Change in
Application	Equipment Type	Manufacturer	Country	Efficiency
Mining & Civil Engineering	2008 MPR 669 4-cylinder	Isuzu	Nicaragua	5.97%
Mining & Civil Engineering	320C Excavator	Caterpillar	Colombia	13.40%
Mining & Civil Engineering	Volqueta 2012 muck wagon	Kenworth	Colombia	17.70%
Mining & Civil Engineering	Volqueta internacionale 2008 muc	Kenworth	Colombia	25.00%







#### **Power Generation Testing**

Application	Equipment Type	Manufacturer	Country	Change in Fuel Efficiency
Power Generation	Loos Boiler	Loos	Indonesia	5.00%
Power Generation	80 kW Engine	Cummins	Philippines	6.00%
Power Generation	6.5 MW Generator Engine	Wärtsilä	Indonesia	8.00%
Power Generation	QST30-G3 1 MW	Cummins	Mexico	9.90%
Power Generation	Boiler	York-Shipley	Guatemala	10.00%
Power Generation	1979 CE1400 Boiler	Cyclotherm	South Africa	12.80%
Power Generation	1979 CE1400 Boiler	Cyclotherm	South Africa	13.00%
Power Generation	DFHC 60 Hz 900 kW Generator	Cummins	Ecuador	19.00%
Power Generation	4045T 60 kV	John Deere	Mexico	19.00%







#### **Marine Testing**

				Change in
				Fuel
Application	Equipment Type	Manufacturer	Country	Efficiency
Marine	1995 10L80 MC	Mitsui-Man	Taiwan	5.00%
Marine	6R32	Wärtsilä	Belgium	7.00%
Marine	8L20	Wärtsilä	Germany	7.00%
Marine	8L20	Wärtsilä	Holland	7.00%
Marine	6R32	Wärtsilä	UK	7.00%
Marine	8L20	Wärtsilä	Holland	7.50%
Marine	6L38B	Wärtsilä	Belgium	8.00%
Marine	38A	Wärtsilä	Holland	8.00%
Marine	38A	Wärtsilä	Holland	8.00%
Marine	16V32	Wärtsilä	Holland	8.50%
Marine	Penta Engine	Volvo	Belgium	9.00%
Marine	3512B Engine	Caterpillar	Belgium	11.00%
Marine	Model not reported	Cummins	Belgium	12.00%
Marine	Detroit Engines (2)	GM	Belgium	12.00%
Marine	1999 PK	Wärtsilä	Belgium	12.00%
Marine	6-Cylinder Engine	Wärtsilä	Belgium	12.00%
Marine	6Z-ST Engines	Yanmar	Belgium	14.00%



