



# **The Crucial Need to Establish Links Between Environmental Performance and Emerging Innovations**

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# Emerging Innovations Types

## Incremental

- **Modifications Made to Existing Products**
- Unsustainable in the Long Run
- Low Profit Margins



**Increase Camera Resolution of Cell Phone**

## Game Changers

- **Introduces New Products Into Existing Markets**
- Potentially Sustainable
- Significant Revenue Margins
- Face Tough Technology Death Valley Challenge
- Majority of them Originate from Academia



**Fossil**



**Renewable**

## Breakthrough

- **Create New Products for New Markets**
- Occasional & Highly Uncertain

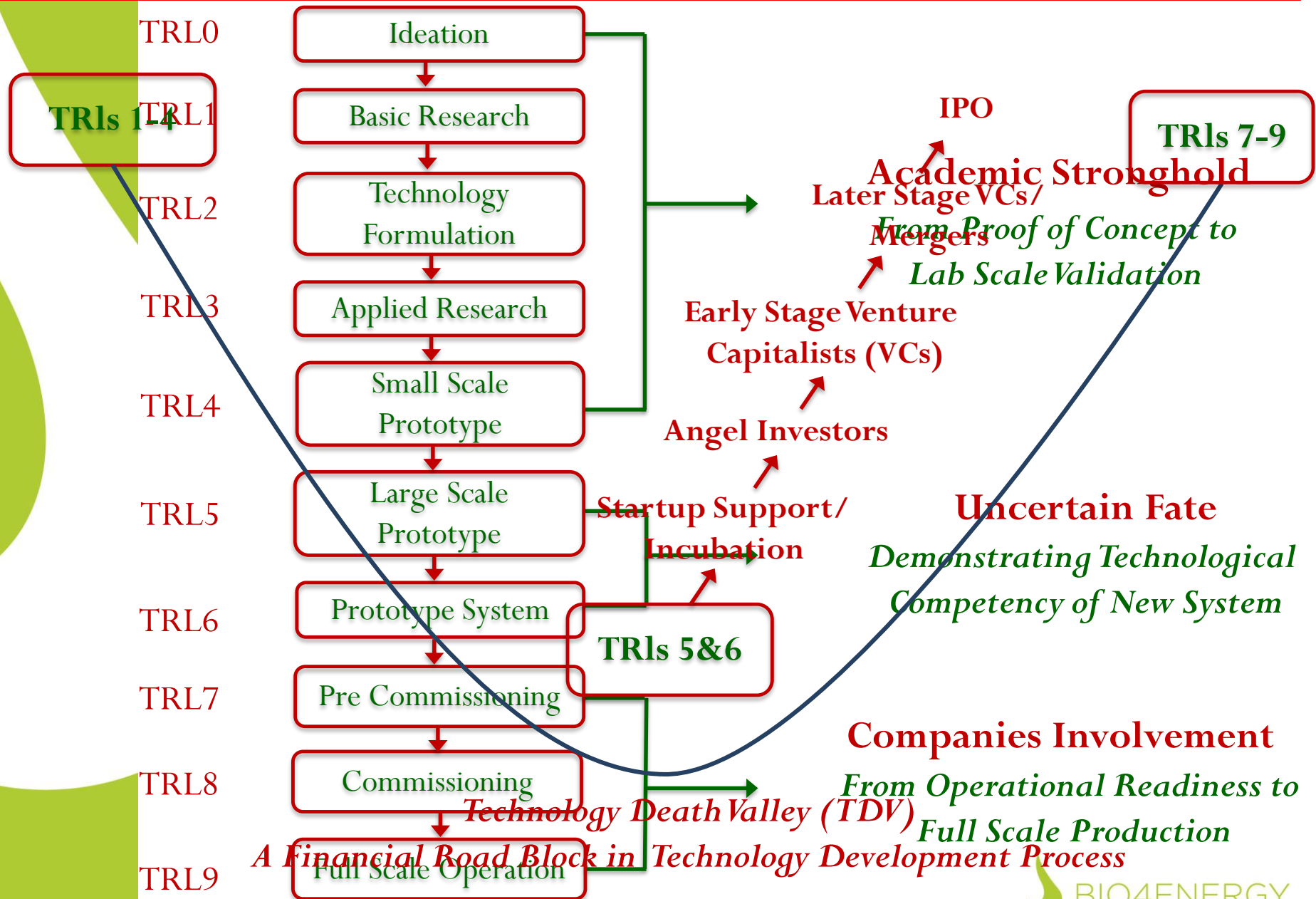


**Normal**

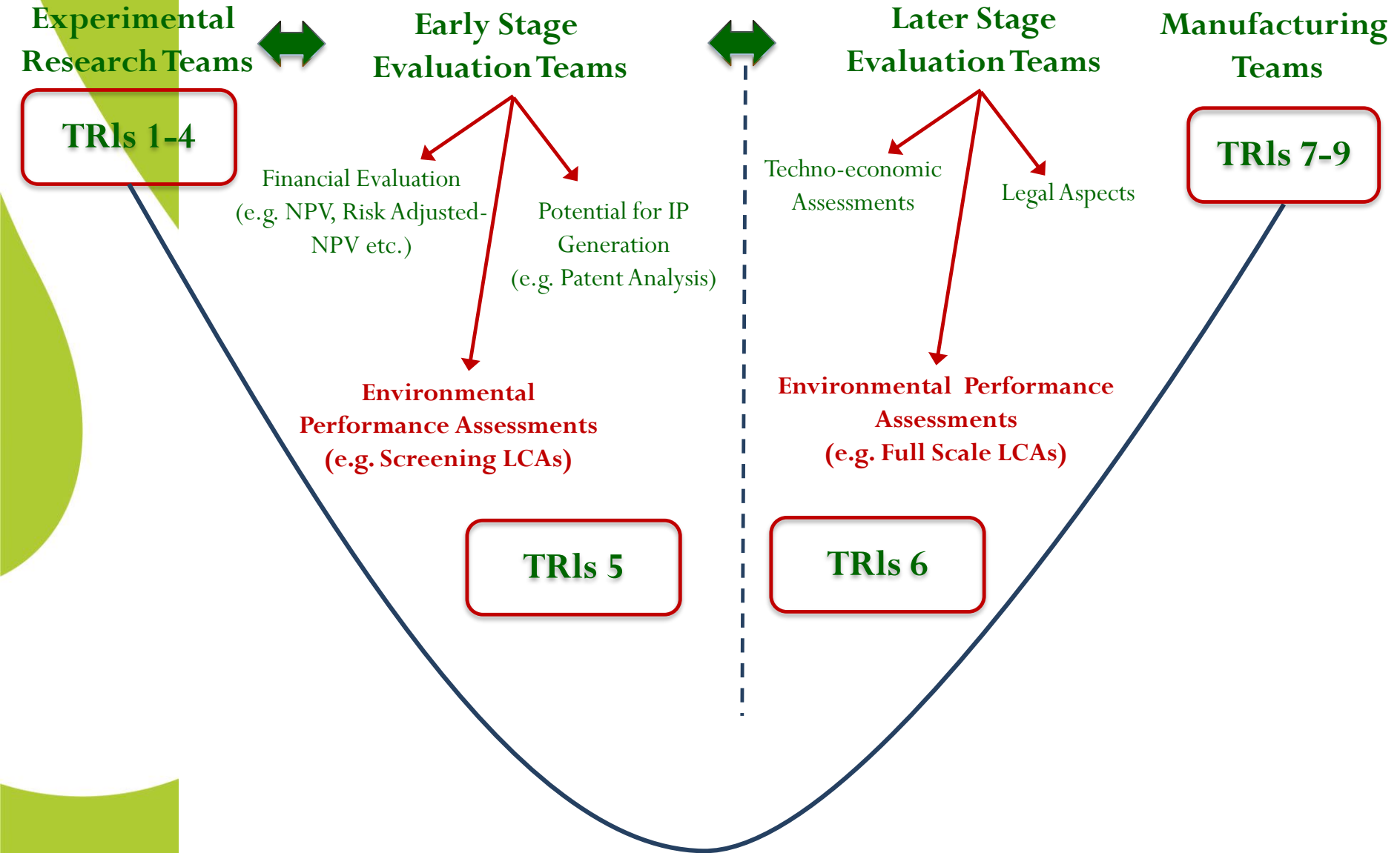


**Smart**

# Innovations & Technology Readiness Levels (TRL)



# How Death Valley Challenge is Handled in Large Companies



# Research Portofolio in Large Companies & Env. Performance

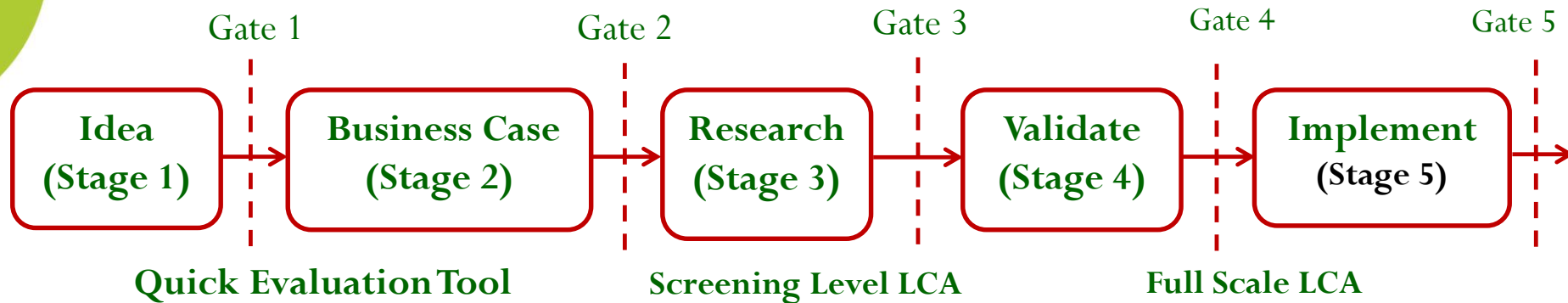


## Ecoefficiency Analysis

Innovations with Improved Product Performance @ Low Environmental Impact & Low Cost to Customers are Ranked High



## Stage Gate Evaluation



- Environmental Performance Scores from LCA.
- Project with CO<sub>2</sub> Utilization Potential Given Utmost Importance

# Why Measure Env. Performance of Emerging Innovations

- Measures Env. Impacts of Innovation Considering Entire Life Cycle
- Allows to Compare Env. Impacts with Existing Market Incumbents



Biofuel Feedstock



Biofuel Production



Biofuel Storage



Biofuel Use

What are Environmental Impacts of Driving a Car Operating on Biofuel?

*Versus*

What are Environmental Impacts of Driving a Car Operating on Diesel

# Why Measure Env. Performance of Emerging Innovations

- Reduction of GHGs is one of the Key Focus Areas

4.5 bn. years ago  
Formation of Earth

1750  
Industrial Revolution

Today



280 ppm  
CO<sub>2</sub>

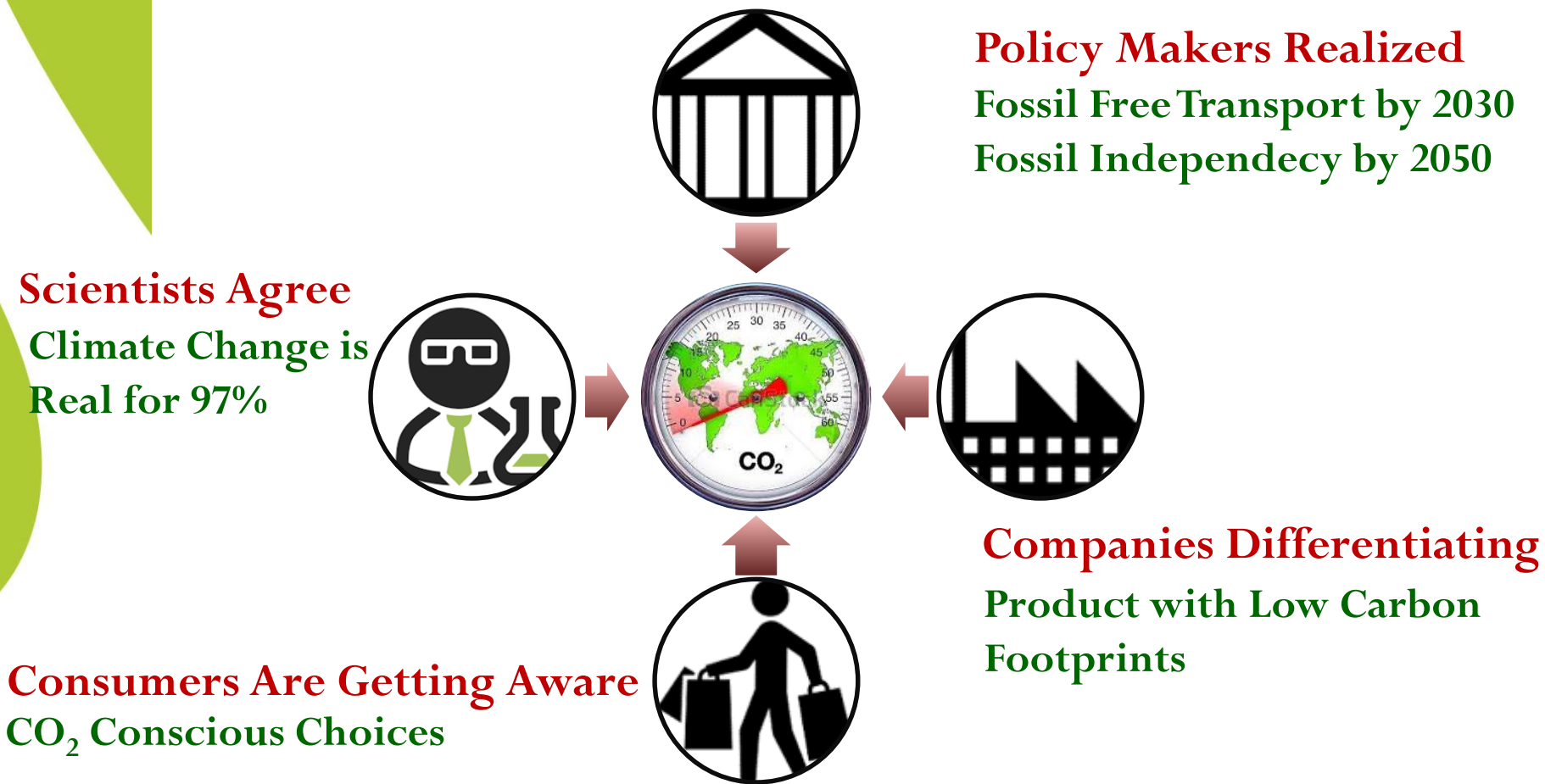
400 ppm  
CO<sub>2</sub>

0.6 Trillion Tons of Atmospheric CO<sub>2</sub> -2016

2 Deg. C. Temp Rise & Trillion Ton Cap by 2040



# Why Measure Env. Performance of Emerging Innovations



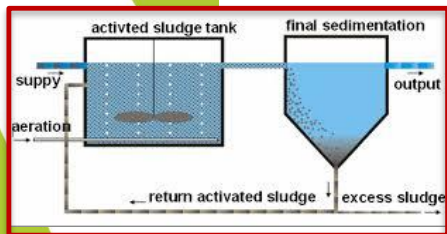
*CO<sub>2</sub> Reduction- A Key Driver for Majority of Innovations  
Directly or Indirectly*



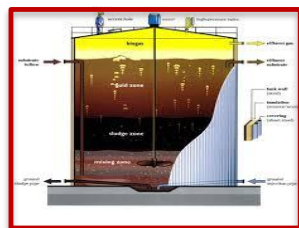
# Why Measure Env. Performance of Emerging Innovations

- Resource Conservation is a Another Key Focus Area

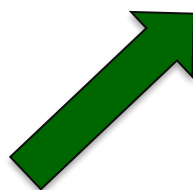
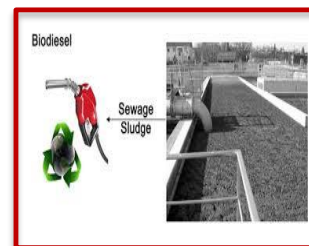
## Activated Sludge



## Digestion

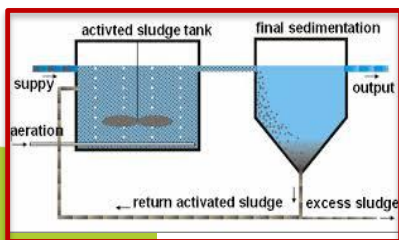


## Sludge to Biodiesel Nutrient Recovery

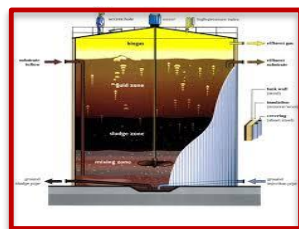


*Forest Resources are Precious..  
But Wastewater is Also Precious.*

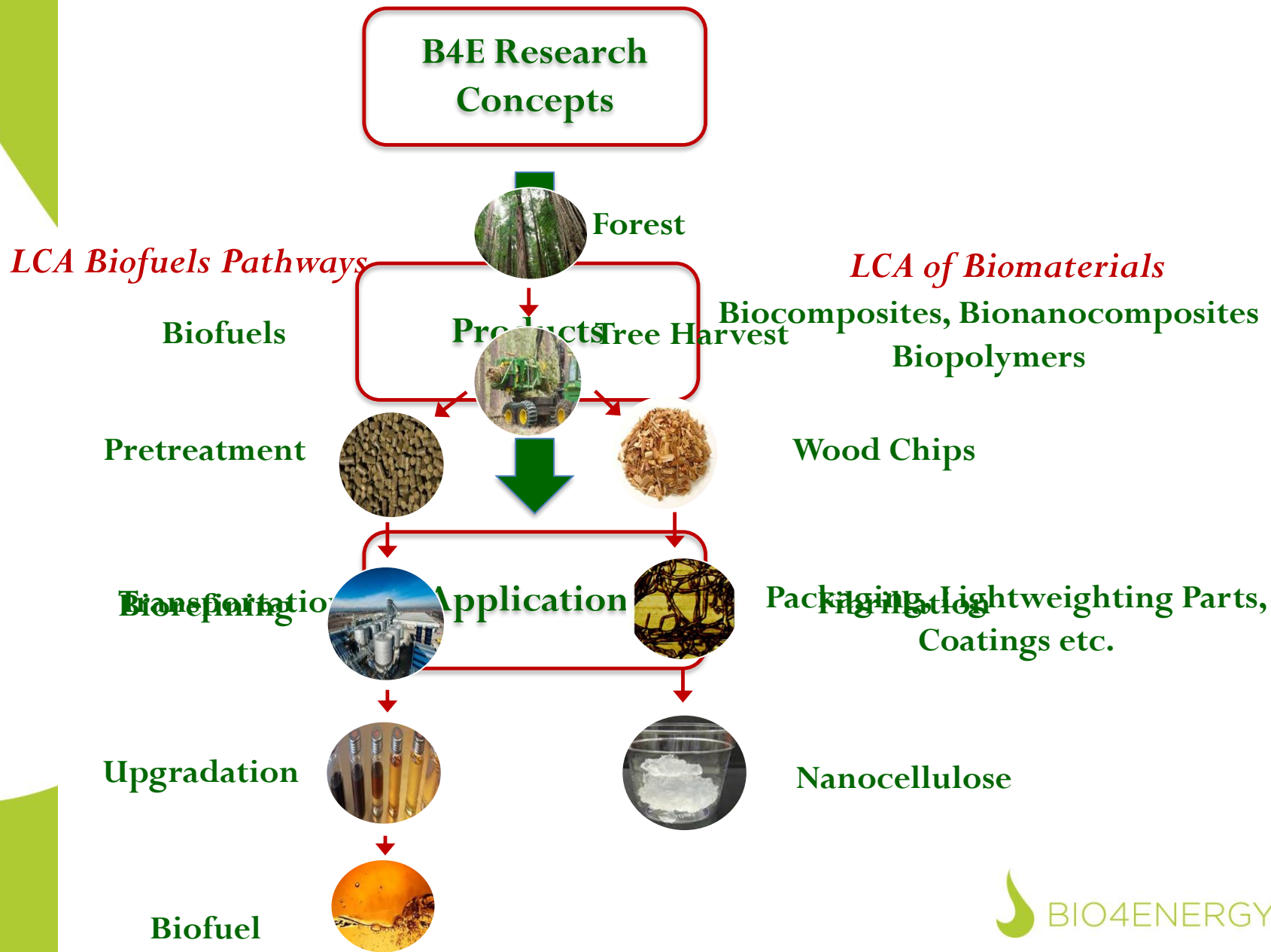
## Activated Sludge



## Sludge Digestion



# Env. Performance of Products Developed by B4E Innovations



# Env. Performance of Products Developed by B4E Researchers

**B4E  
Research  
Concept**

Nanocellulose  
Composites



Application as  
Auto Parts

Early Stage  
Venture  
Capitalists

Later Stage  
VCs, Mergers/  
Acquisitions

IPO

**Market  
Entry**

Sustainable Return on  
Investment (ROI)?

Life Cycle Assessment

*Factor Env. Performance  
Assessments Into Investment  
Decision Making*

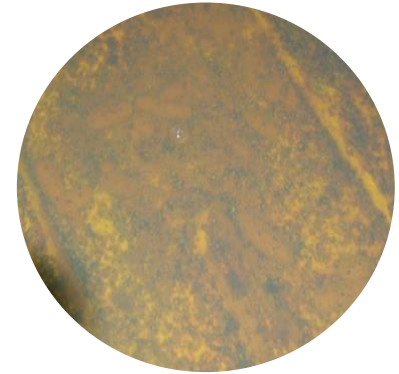
# Our Recent Success Story-Env. Performance of Graphene Coatings



BioDiesel Storage Tank

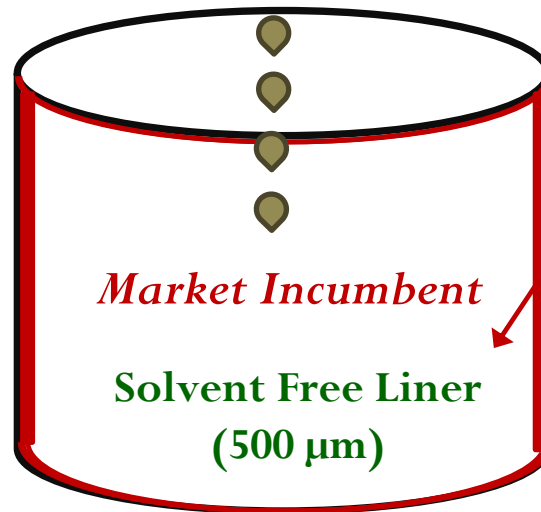
- Biodiesel Hygroscopicity
- Hydrolysis Reactions a Labile Carbon Source

*More Susceptible to Microbial Induced Corrosion*

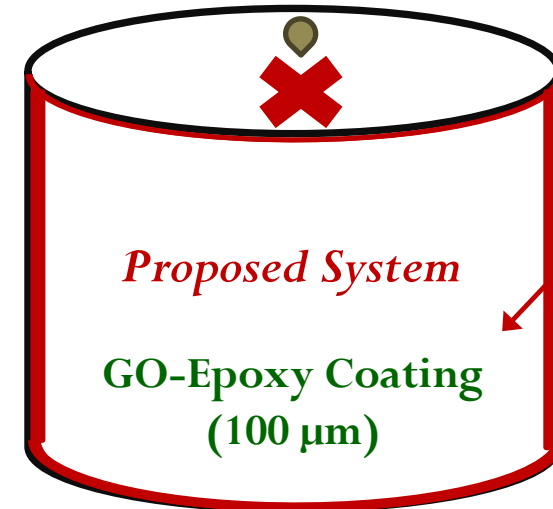


Tank Interior

Biocide as Fuel Additive



Biocide as Fuel Additive



# Our Recent Success Story-Env. Performance of Graphene Coatings

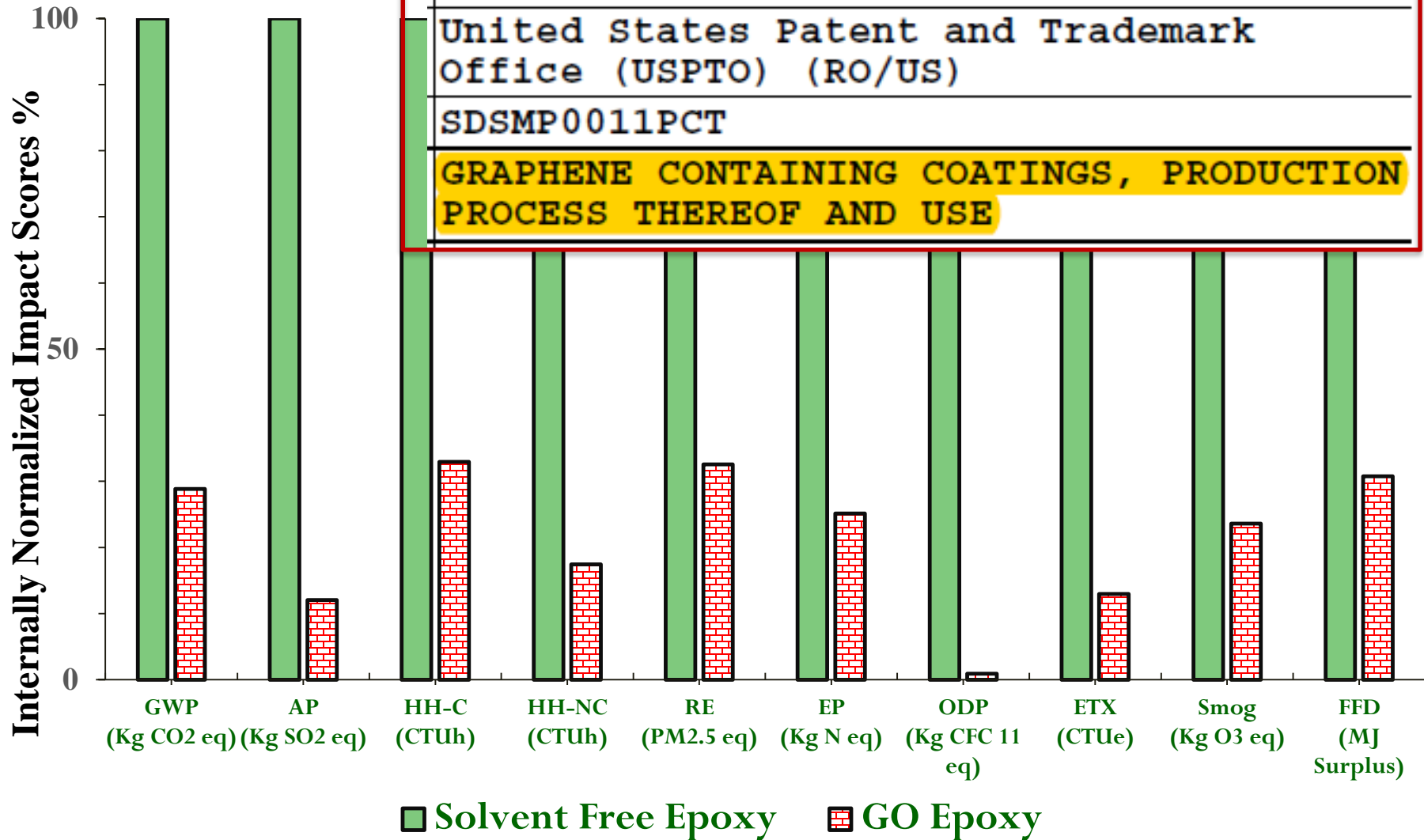
*From LCA Results to Patent Application*

## US Patent Application Filed

United States Patent and Trademark Office (USPTO) (RO/US)

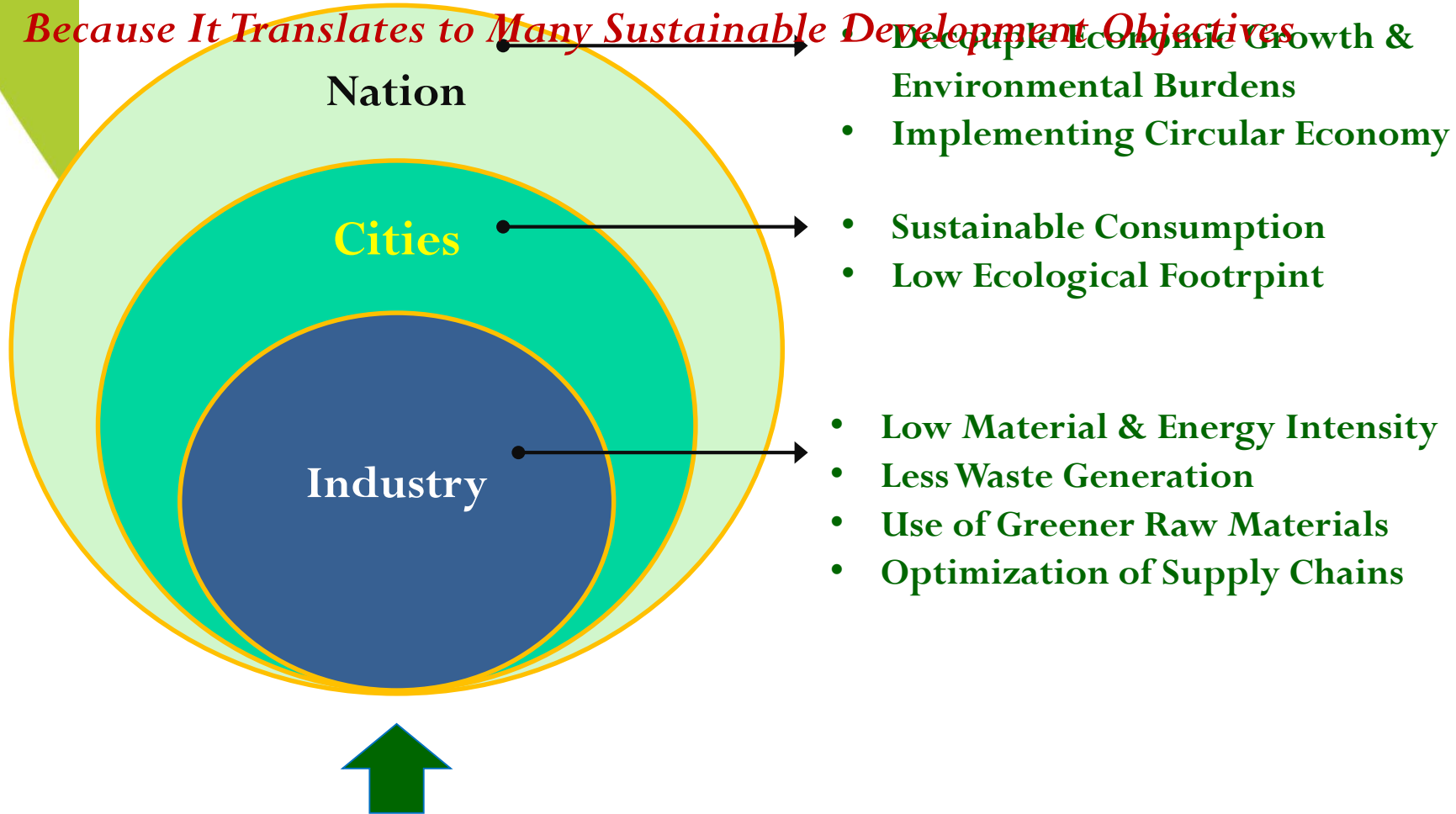
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**GRAPHENE CONTAINING COATINGS, PRODUCTION PROCESS THEREOF AND USE**



## To Conclude...

*Measuring Environmental Performance of Emerging Innovations is Important Because It Translates to Many Sustainable Development Objectives*



*Thankyou for Your Attention*

# Measuring Environmental Performance of Emerging Innovations

Innovations Appear to be Climate Change Effect But They May Not....

