

# ***An Analysis of Breakthrough Energy Ventures as an Impact Investing Platform***

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# Executive Summary

# Promise and Criticism

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The various praise and criticism of Breakthrough Energy Ventures (BEV), a roughly \$1 billion fund, prompts an analysis of its efficacy given its size and resources.

## PROMISE

- ✓ Scale and capital of BEV is unprecedented
- ✓ Coalition consists of high-influence individuals across sectors

## CRITICISM

- × Not enough funding for lofty objectives
- × Lack of investing expertise means other impact investing firms are more effective

**Goal: To analyze whether Breakthrough Energy Ventures is using its capital and resources effectively and optimizes its ability for impact more than standard impact investing firms.**

# Executive Summary



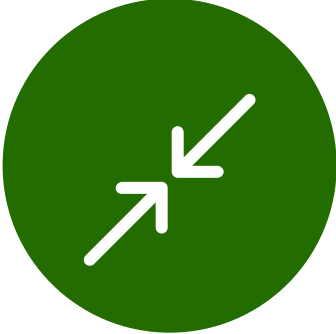
## INVESTOR COMMUNITY

The team looked into the key individuals, companies, and financial institutions which impact BEV’s decisions and actions. While there are many individuals and institutions with high capital, there is a lack of specific focus impact investing from parties involved.



## INVESTMENT STRATEGY

The team analyzed defining factors of BEV’s investment strategy to make predictions on its potential for impact and high returns. It was found BEV looks into the long term success of a company, sacrificing the difficulty to produce assets at scale for cutting edge scientific technology.



## COMPARISON TO SIMILAR INITIATIVES

The team compared BEV’s investment strategy and composition to the impact investing space as a whole and a similar initiative, OGCI. While OGCI is primarily focused on short term impacts and more standard technologies, BEV has a portfolio with more niche markets and long term impacts.



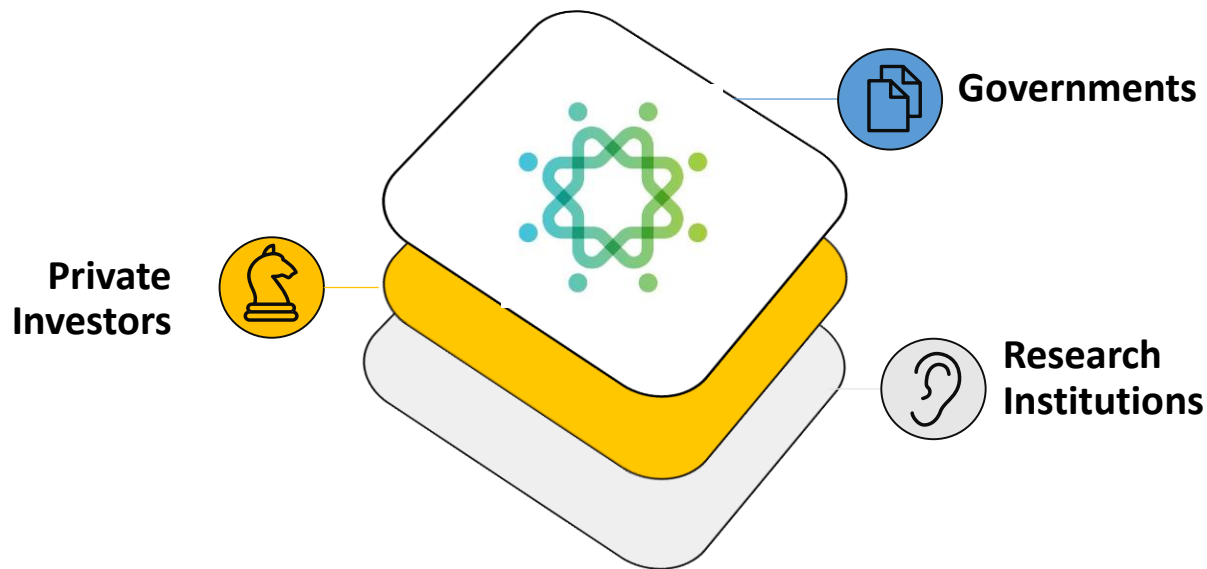
## PORTFOLIO ANALYSIS

The team conducted a comprehensive analysis of BEV’s portfolio over the past few years and found numerous companies with cutting edge technologies, namely Carbon Cure and Zero Mass Water.

# Investor Community

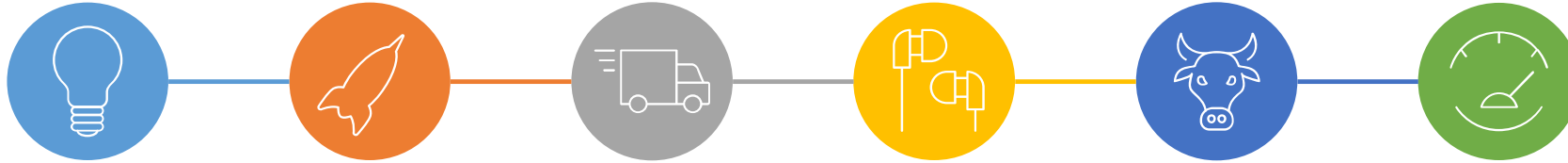
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# The Vision



“At the 2015 United Nations Climate Change Conference in Paris, the launch of BEC and Mission Innovation brought together **governments, research institutions, and nearly 30 leading private investors** to prioritize a **new model** for investing in energy innovation. In 2016, BEC created **Breakthrough Energy Ventures**, an investor-led fund to build new, cutting-edge energy companies that will help deliver on that promise.”

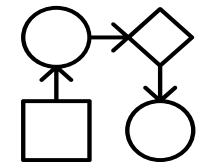
# Breakthrough Energy Coalition



Represents every link on the chain of energy innovation, from **discovery** through **development** to **deployment**



Operates in the space between **government funding** of basic science and **companies** deploying cost-competitive technologies at scale



Supports the refinement and validation of a **big idea** until it is ready to be **commercialized**



# Key Stakeholders

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**Private investors** who are patient and risk tolerant



**Global corporations** that produce or consume energy in vast quantities



**Financial institutions** with the capital necessary to finance the world's largest infrastructure projects



**An extensive network** that reaches every sector in the global economy, allowing us to tap into additional expertise as needed

# Summary – Investor evaluation

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**Private investors** are the most influential stakeholders in the coalition, and personal interests must be considered when evaluating their position



**Global corporations** that produce or consume vast quantities of energy are integral to ensuring that energy solutions are tenable for large corporations



**Financial institutions** are essential contributors to the financial sustainability of the coalition but do not likely have a vested interest in coalition outcomes



**An extensive network** is a key distinguishing characteristic of the coalition, as connecting diverse stakeholders is key to devising multifaceted solutions

# Private Investors

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“Energy transitions take a long time, but there’s more urgency than ever to prevent the worst impacts of climate change. We need **new models of investment** and **new partnerships** between governments and a broad network of investors, companies, and 3 energy customers. Breakthrough Energy is designed to help facilitate those partnerships and bring more energy products from the lab to the market more quickly.” - **Bill Gates, Chair of the Board**

The Breakthrough Energy Coalition is about collaboration, innovation and bringing people together to solve one of the world’s most important challenges. This is also what our company stands for, and we're proud to be part of shaping the future of energy.”

**Hans Kobler**  
Chief Executive Officer  
Energy Impact Partners

The world needs to take ambitious action on climate change and the Breakthrough Energy Coalition is an opportunity to do just that. We need to produce an abundance of clean, renewable energy and drive further innovation to make the next generation of energy more efficient...Tackling climate change will bring huge benefits for the environment, our society and the economy and by working together we can create a better future for all.”

**Sir Richard Branson**  
Founder, Virgin

# Global Corporations

## Energy Producers

- African Rainbow Minerals
- Total

## Energy Distributors

Engie

## Conglomerates

- General Electric
- Reliance Industries Limited
- Virgin

## Technology

- Microsoft
- SAP

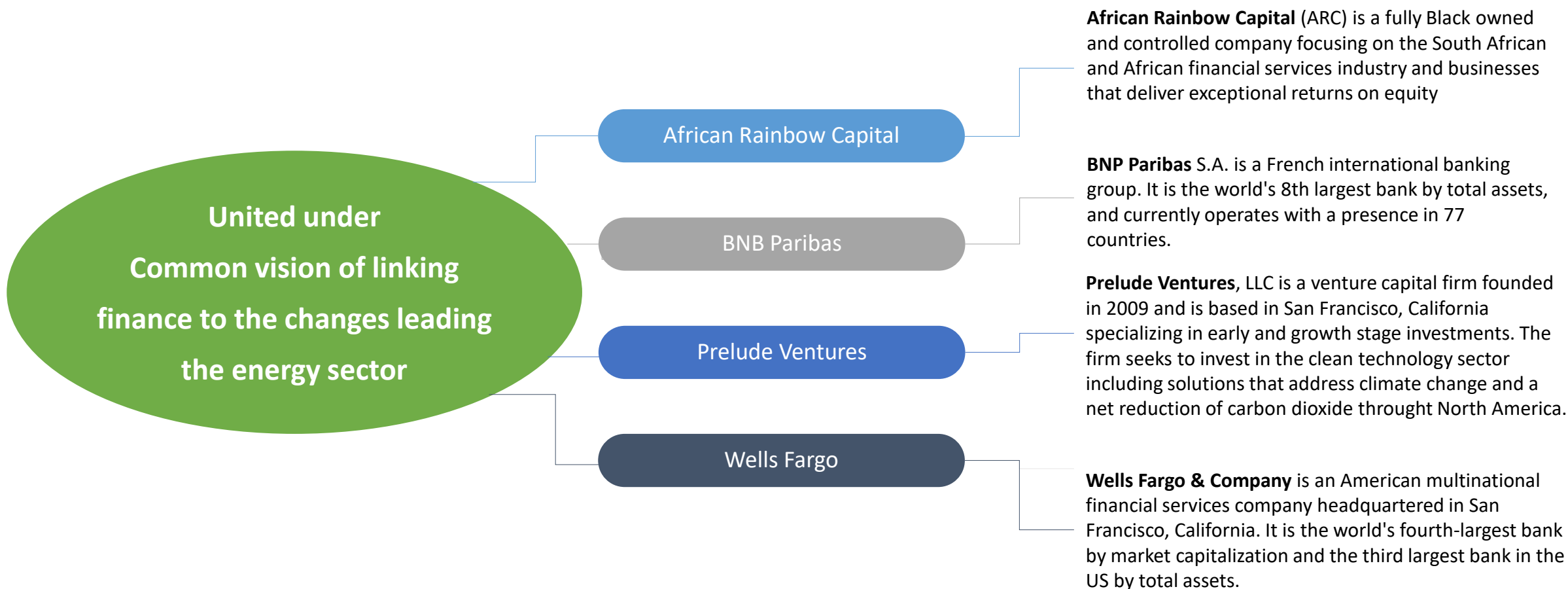
## Research institutions

University of California

“ENGIE and the Breakthrough Energy Coalition share a common purpose: fuel the world with clean, affordable, reliable energy, and we share the conviction that breakthrough innovation will help us attain this goal. Combining the expertise and financial means of ENGIE New Ventures and Breakthrough Energy Ventures will enable better scouting of disruptive technologies and the acceleration of time to market of cutting-edge innovation.”

“The University of California, with its 10 campuses and three national energy labs, is home to some of the best climate scientists in the world and as a public research institution we take the imperative to solve global climate change very seriously,” said UC President Janet Napolitano. “With access to the private capital represented by investors in the Breakthrough Energy Coalition we can more effectively integrate our public research pipeline to deliver new technology and insights that will revolutionize the way the world thinks about and uses energy.”

# Financial Institutions

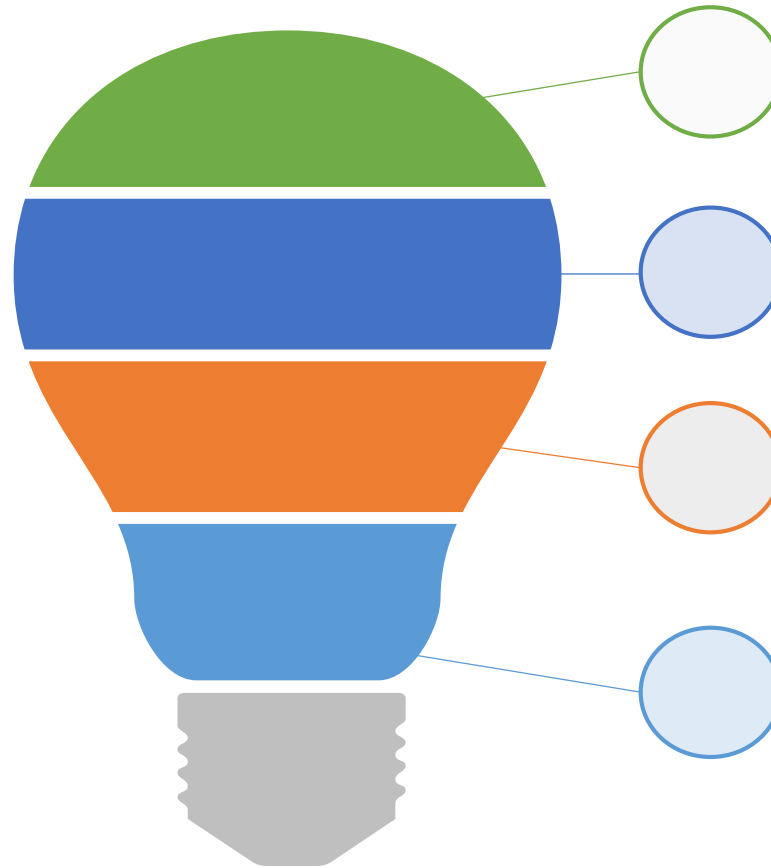


# Extensive Network



## Capitalizing on Existing Knowledge

Four of Breakthrough Energy Ventures' partners include coalitions which focus on various aspects of climate solutions



### Energy Impact Partners

A collaborative approach to innovation, bringing incumbents, capital and entrepreneurs together to shape the future of energy

### National Grid Ventures

NGV is home to a diverse portfolio of energy businesses that deliver competitive products and services for a broad range of customers.

### Oil and Gas Climate Initiatives

OGCI members leverage our collective strength to lower carbon footprints of energy, industry, transportation value chains via engagements, policies, investments and deployment

### Wheatsheaf

Wheatsheaf Group directly operates, invests in and helps to develop businesses in the food and agriculture sectors

# Investment Strategy

# Key Investment Takeaways

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Clean energy strategies that are cheap and driven by Science

- Fundamental purpose of investing is to **incentivise further investment** as well as **research and development** into cheap clean energy
  - The **generationally-long investment position** is taken given the generational effects of climate change
  - Willing to wait longer for returns as well as take on more **technical risk**
  - BEV is searching for scientific breakthroughs that have the potential to improve clean energy efficiency around the world
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# Leveraging Innovation

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Breakthrough Energy Ventures does not focus on the size of the business, specific regions or at what stage the green-tech project exists



Open to investing across geographies, business size and development phases.



The Development and demonstration phases are prioritised, but there is need for proof of concept before investing



Focused solely on the long-term potential of their investments, because of the generational impact of climate change

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# Investment Criteria

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Technology that has any indirect impact on energy consumption is excluded from investment.

- **Clean energy** is the primary application of the technologies
  - Technology that has any indirect impact on energy consumption is excluded
  - Climate Impact: technologies with the potential to reduce greenhouse gases by **half a gigaton per year** (1% of the global emissions by 2050)
  - The company is able to and already has attracted other investors
  - BEV technologists have concluded that the project is **scientifically viable** and scalable
  - The enterprise can have a **synergistic** role in BEV's global network
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# Investment Goals

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“Respond to today’s circumstances but also anticipate tomorrow’s urgent needs.”

- **Incentivise further investment** into developmentally difficult sectors with promising sustainability potential
  - Successfully improve the public-private partnership networks necessary to appropriately **scale-up cleantech infrastructure** globally
  - Further stimulate the movement towards a **clean energy zero-carbon global economy**
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# Five-Part Investment Strategy

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Breakthrough Energy Ventures is focused on developmentally difficult sectors with promising sustainability potential



## Affordable Grid-scale Storage

- Invest in cheap energy storage with a long calendar life
- Interest in lithium-ion batteries as they become cheap enough to fulfill energy demand at peak use times



## Fuel Production

- Air travel and long-haul shipping cannot be powered by electricity
  - There is a desire to expand past production of biofuels
  - Looking into the various ways liquid fuels can be made or biofuels can be made cheaper
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# Five-Part Investment Strategy

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Breakthrough Energy Ventures is focused on developmentally difficult sectors with promising sustainability potential



## Global Microgrid Development

- Investing in the expansion of micro and mini-grids in developing countries
- Interested in grids that are low-cost solar and low-cost energy storage



## Zero Carbon Building Materials

- Investing in companies that develop new building materials.
  - Particularly zero-carbon methods of producing engineered wood, fiber-reinforced composites, mass timber, concrete and steel
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# Five-Part Investment Strategy

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Breakthrough Energy Ventures is focused on developmentally difficult sectors with promising sustainability potential.



## Geothermal Energy

- Investing into companies that innovate the production of geothermal energy
  - Recent improvements in drilling technology hold the potential to improve geothermal energy production
  - Examples: Horizontal drilling, multilateral drilling, hydraulic fracturing or complex path drilling)
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# Similar Initiatives

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# Clean Energy Investment Space

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- Venture Capital participation has declined in recent years
  - Slow adoption of innovation
  - Regulatory complexity of energy innovation
- Private Investors focus
  - Low risk areas of demonstrated market demand
  - Later stages of innovation
- Gap in coverage of higher-risk, future-focused investment





# Initiatives Comparable to Breakthrough

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- Voluntary CEO led initiative taking practical actions on climate change
- Leverage collective strength to lower carbon footprint in various industries through engagement with policies, investments, and deployment
- \$1B+ Climate Investment fund to lower carbon footprint of the energy and industrial sectors

# Differences in Investors

## The Companies Behind OGCI



ExxonMobil



OGCI is backed by large oil companies in contrast to Breakthrough's influential billionaires

# Differences in Focus Areas

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## Goals of OGCI

Reducing Methane Leakage



Reducing Carbon Dioxide



Recycling Carbon Dioxide (CCUS)



OGCI is less focused on new methods of energy production

# Comparison of Investments

## Reduce Methane Leakage



May 2018



September 2018



September 2018

## Reduce Carbon Dioxide

**achates**POWER

September 2017

Lower-Risk, shorter-sighted investments than Breakthrough Ventures

## Recycle Carbon Dioxide

**inventys**

October 2017



October 2017

**ECONIC**

February 2018

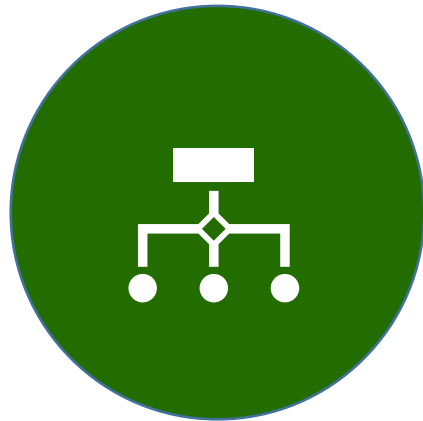


August 2017

# Portfolio Analysis

# Summary – Portfolio Attributes

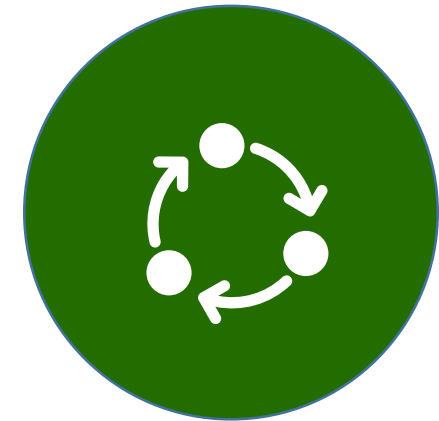
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**DIVERSE INDUSTRIES**



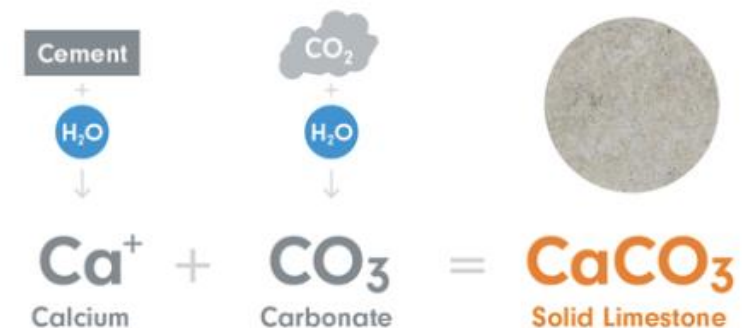
**TECHNOLOGICALLY  
ADVANCED**



**DIFFERENT STAGES IN  
ENTREPRENEURSHIP**

# Case Study — Carbon Cure

- Mission: Reduce the carbon footprint of the built environment
- Product: Manufactures technology of CO<sub>2</sub> chemically mineralization that introduces recycled CO<sub>2</sub> sourced from industrial emitters into fresh concrete (both masonry and ready mix)
- Impact: 59.9M pounds CO<sub>2</sub> savings to date, equivalent to 32,588 acres of forestland absorbing CO<sub>2</sub> for a year; Save up to 500 megatons of CO<sub>2</sub> emissions
- Target Clients: Cement manufacturers



# Carbon Cure Technologies

Carbon Cure, in a corporate round led by BEV, raised \$100 million; they've commercialized a product that turns CO<sub>2</sub> (typically emitted) into a mineral in concrete production .

Mission to save 500 megatonnes of CO<sub>2</sub> per year

- Since founding in 2007, Carbon Cure is used in more than 100 concrete plants in Canada and the US, currently reducing 24,000 tonnes of CO<sub>2</sub> yearly.
- Global cement production accounts for 8% of global emissions and production is set to rise 12-23% by 2050, contributing more than aviation (2.5%).
- Concrete is the most widely-used manmade material and, second to water, most-consumed resource on the planet.
- The funding round allowed BEV to join Carbon Cure's board of directors.
- A deal with PanUnited in Singapore has opened the doors to Asia; Carbon Cure is pursuing deals in Europe next.

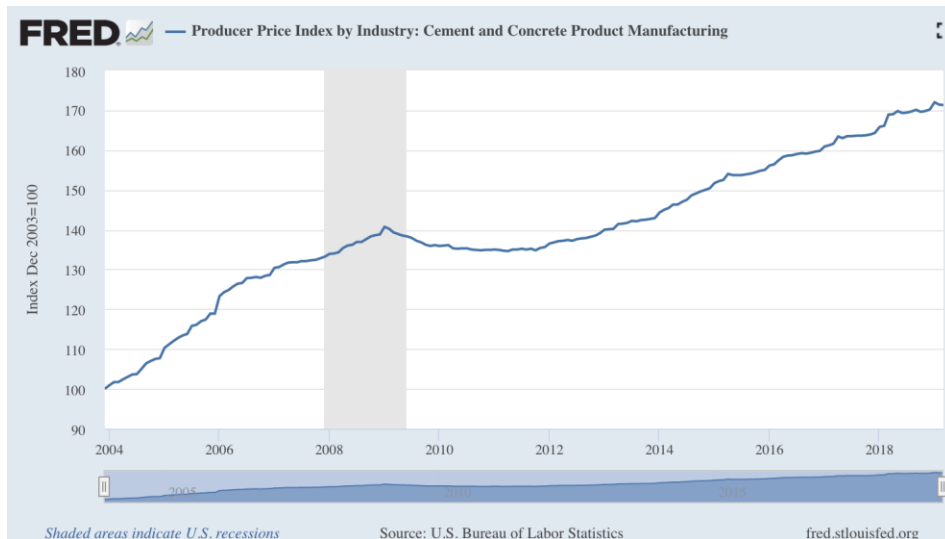
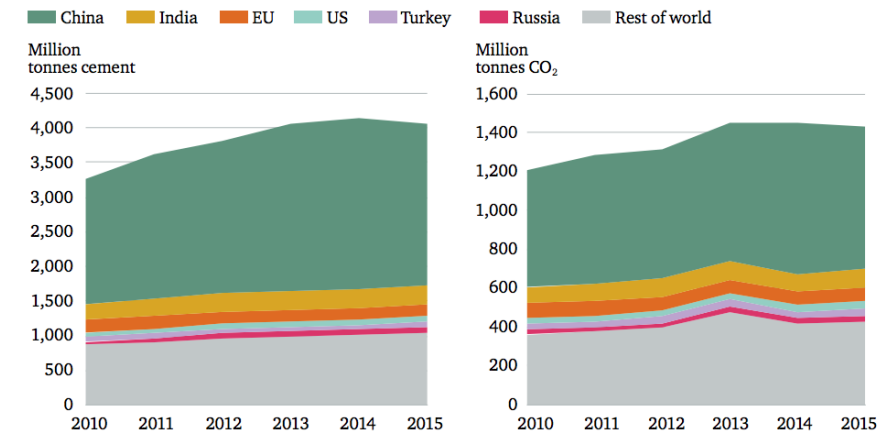


Figure 2: Cement production and emissions, 2010–15



Source: Authors' analysis of data from Olivier et al. (2016), *Trends in global CO<sub>2</sub> emissions: 2016 Report*.





# Case Study — Sustainable Bioproducts

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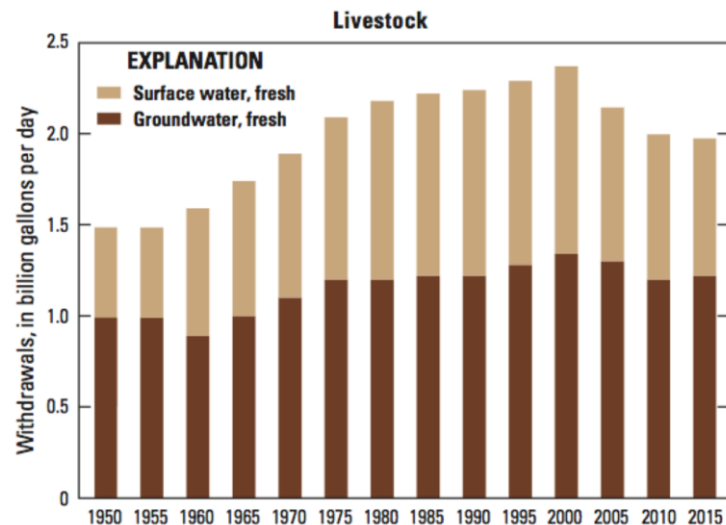
- Mission: Sustainable, edible protein
  - Funded by NASA, EPA, USDA, and National Science Foundation
- Product: Innovative fermentation technology that grows protein in labs with nutritional value and minimal environmental detriment
  - Simulates extremophile organisms in Yellowstone's volcanic springs; Feeds common components of food such as starches or glycerin to high-protein microbes, which quickly multiply. Resulting protein doesn't resemble meat but contains the nine amino acids essential to the human diet.
- Impact: Company the research and development phase
- Target Clients: agriculture and food companies
- Potential challenges: stigma surrounding artificial nutrition like lab-grown protein

# Sustainable Bioproducts

Sustainable Bioproducts raised \$33 million in Series A financing, led by 1955 Capital with participation from BEV; the company is developing a new way to grow edible protein.

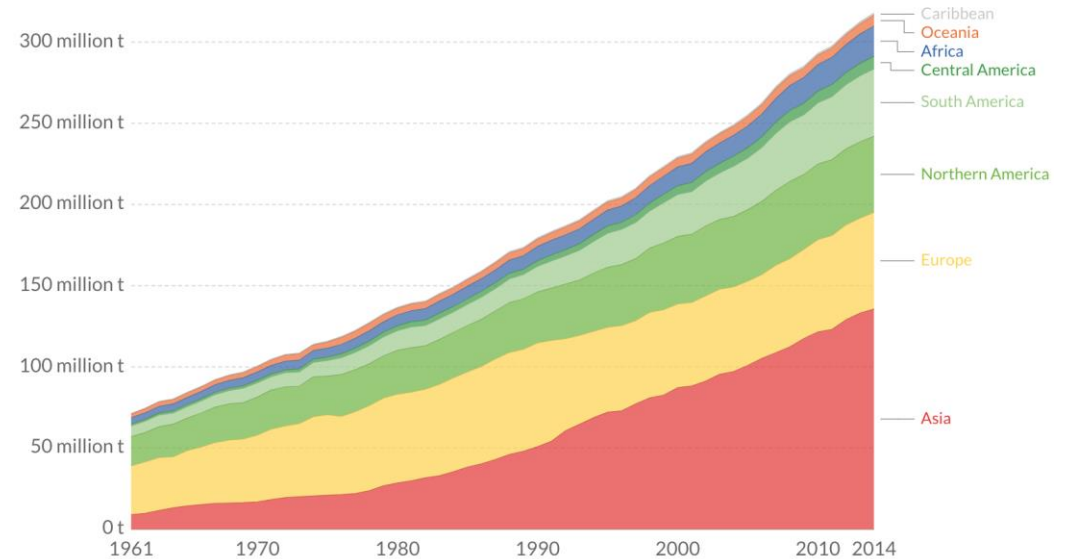
## Extremophiles

- Sustainable Bioproducts have turned to extremophiles, microbes capable of surviving in harsh conditions, in Yellowstone as a potential to grow edible protein.
- They are still a few years away from commercialization.
- The technology uses a fraction of the water needed for animal or plant-based protein.



## Meat production, tonnes

Total meat production, measured in tonnes. Meat includes cattle, poultry, sheep/mutton, goat, pigmeat, and wild game. Figures are given in terms of dressed carcass weight, excluding offal and slaughter fats.



Source: UN Food and Agricultural Organization (FAO)

CC BY

# Conclusion

# Defining Trends of BEV

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BEV is distinguished in the high levels of scientific innovation in companies it invests in, its prioritization of long term goals, and its broad domain of impact areas.



## SCIENTIFIC FOUNDATION

Companies are generally small scale but have **cutting-edge technologies**, rendering them **leaders in their fields** as opposed to generic impact oriented companies.



## LONG TERM VISION

Instead of emphasis on short term quantifiable impact, BEV has amassed capital to take a more **long term investment strategy**, creating more **potential for impact**.



## HOLISTIC VISION

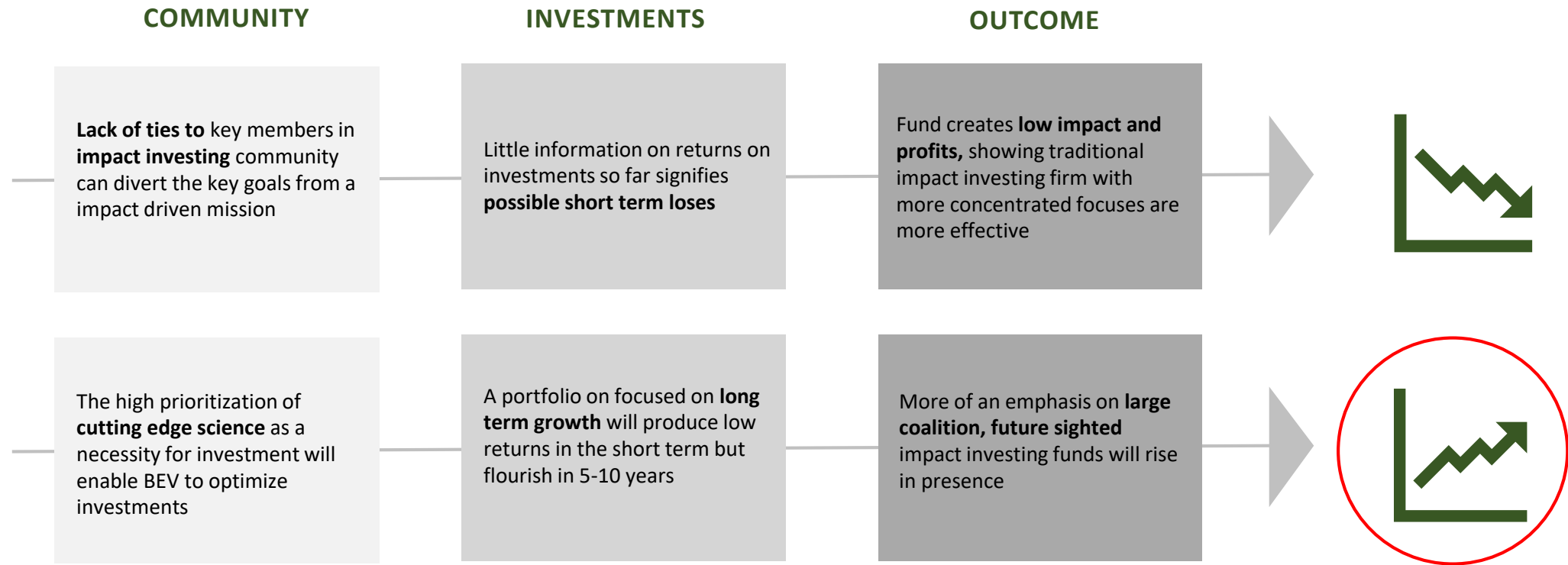
With investors in various aspects of sustainability, BEV has a unique leverage to pursue a **broad analysis** of possible investments and **further diversify**.



## LIMITED DATA

**Limited released information** regarding specific returns on investment or structure of the venture raises potential issues

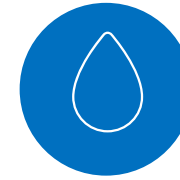
# Forecasting



**BEV's success could change the perception of long term impact investing from an incredibly risky platform to one capable of larger scale impact than before.**

# Appendix - Portfolio Analysis

# Case Studies — Zero Mass Water



TOTAL ECONOMIC OFFSET

**129,430**

TOTAL CARBON OFFSET

**61.24**

TOTAL WATER PRODUCED

**369,800**

- Mission: Making drinking water an unlimited resource

- Guiding Principles:

- Water independence
- Truly Renewable Water
- Every Person, Every Place
- Perfecting Your Water



- Product: SOURCE, off-grid, self-contained, solar-powered, infrastructure-free, utilizes solar photovoltaics and high efficiency solar thermal to produce purified water in a psychrometric cycle.

- Impact:

- Installed in 20 countries on 5 continents, exceeds water standards in each place
- Each array averages 4-10 liters each day = 8-20 16.9oz standard water bottles.

- Target Clients: Diverse entities, ranging from homes to schools

# Baseload Capital

Baseload Capital, 15.7% owned by Climeon, raised \$12.5 million in a May 4, 2019 venture round (total capital to date) and has invested in geothermal energy.

## Climeon

- Climeon is working on **low-heat affordable geothermal units** that aims to be as economically viable as wind and solar. It was founded in 2011 and went public in 2017 (stk: \$10.16); it's currently **valued at \$450 million**, has **executed \$68 million** in projects, with **\$80 million confirmed** for future orders.
- Cubic modules can generate **150 kW** of electricity, enough to **power 250 households as small-scale power plants** that are easy to scale up or decommission. Breakthrough made their second investment in Baseload Capital, a **project investment firm** that funds Climeon's modules.
- Modules can generate electricity, in some cases, **for \$45 MWh**, near the low end of bids for wind or solar power in Europe and with only **194 degrees F** (90 C) have even been **deployed in steel factories opening up a new cost-less revenue source for industry** in clean power production.
- Currently, at the geysers geothermal is sold for \$30-\$35 per MWh and in powerplants is sold for **\$50 per MWh**, Climeon holds a potential to open up geothermal energy to **previously unreached places**; geothermal is just **0.4% of clean tech VC investment**.
- Cubic modules can generate **150 kW** of electricity, enough to **power 250 households as small-scale power plants** that are easy to scale up or decommission. Baseload Capital, a **project investment firm** that funds Climeon's modules, received their second investment from Breakthrough.
- Modules can generate electricity, in some cases, for \$45 MWh, near the low end of bids for wind or solar power in Europe and with only 194 degrees F (90 C) have even been deployed in steel factories opening up a new revenue source for industry in clean power production.

## Baseload Capital

- Subsidiary investment firm of Climeon founded in January 2018 which on Feb 4, 2019 received a loan from Nordic Environment Finance Corp and on March 15, 2019 received its first green bond (\$55 million).

## Risks

- Lowest sell price is only available in ideal conditions and barely edges out typical renewable prices in Europe, barring too many factories from taking up modules and bidding their electricity.

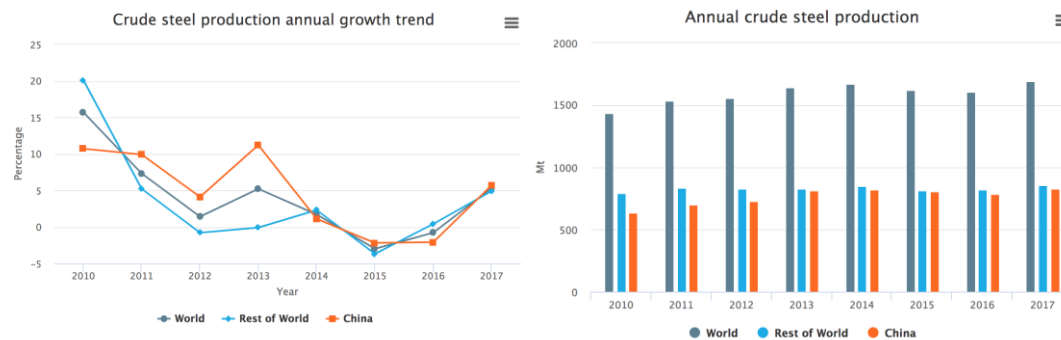


# Boston Metal

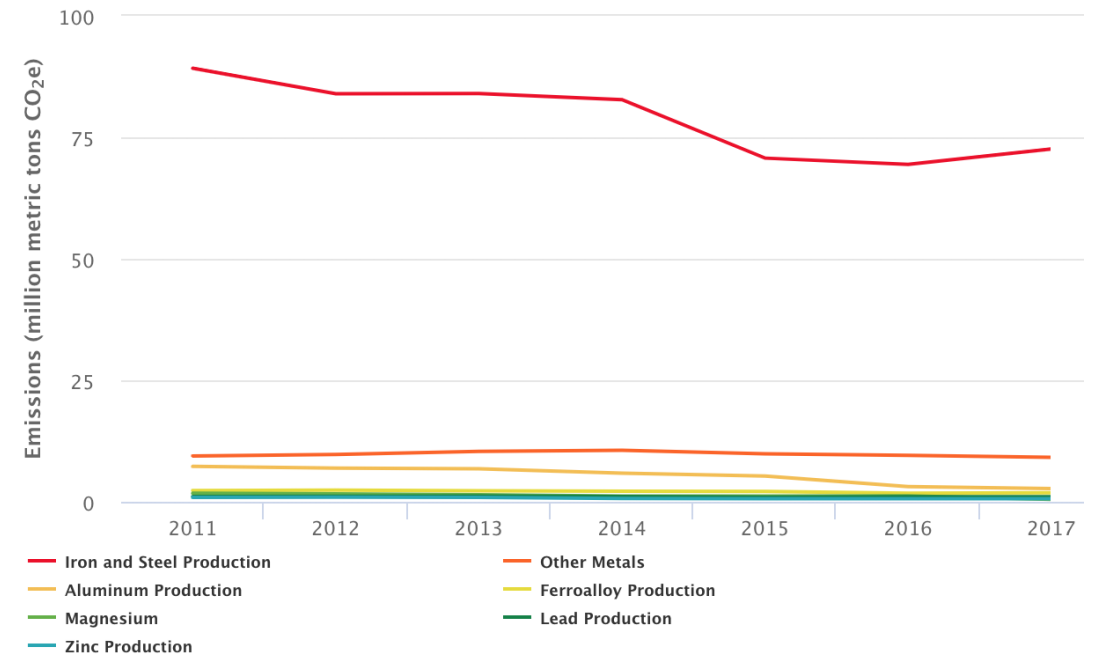
Boston Metal raised \$20 million in Series A financing, led by BEV; the company is born from developing MIT technology to produce a variety of steel and metal with low-emissions.

## Molten Oxide Electrolysis (MOE) Process

- The technology uses electricity to transform metals from their raw oxide form into molten metal products. This allows metal production to avoid traditional coal-burning.
- The MOE process was invented at MIT and spun into Boston Metal in 2012. Since then Boston Metal has scaled the technology by 1,000x.
- The MOE process could provide the steel industry a capital-efficient means of adding production capacity.
- Boston Metal aims to “decarbonize” the steel production process.
- Boston Metal will first commercialize production of ferroalloys (iron composites) before hopefully rolling out steel later.



Trend from the Metals Sector, by Subsector

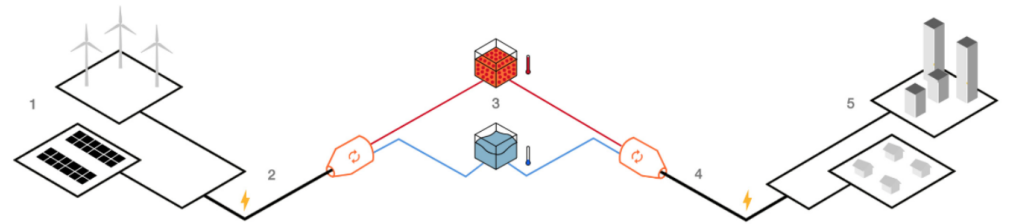


# Malta

Spun out of Alphabet's Moonshot Factory, Malta raised \$26 million in Series A financing, led by BEV; Malta is using molten salts to develop inexpensive energy storage.

## Huge Potentials

- Malta's technology could be applied to various energy storage markets:
  - Renewable energy intermittency
  - Grid peak load shifting
  - Distributed energy services
  - Business and industrial parks
  - Auxiliary services



### 1. Collects

Energy is gathered from wind, solar, or fossil generators on the grid as electrical energy and sent to Malta's energy storage system.

### 2. Converts

The electricity drives a heat pump, which converts electrical energy into thermal energy by creating a temperature difference.

### 3. Stores

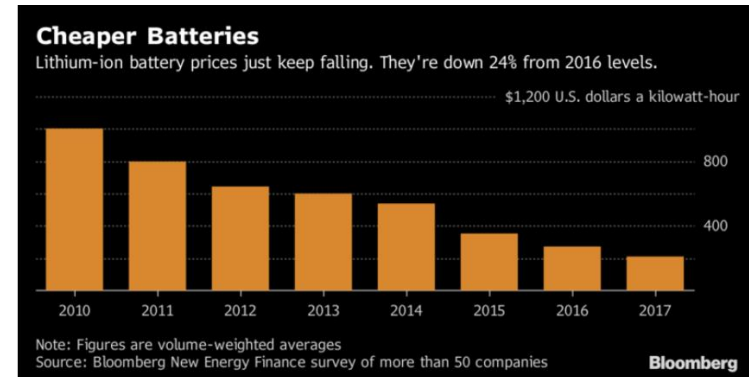
The heat is then stored in molten salt, while the cold is stored in a chilled liquid.

### 4. Reconverts

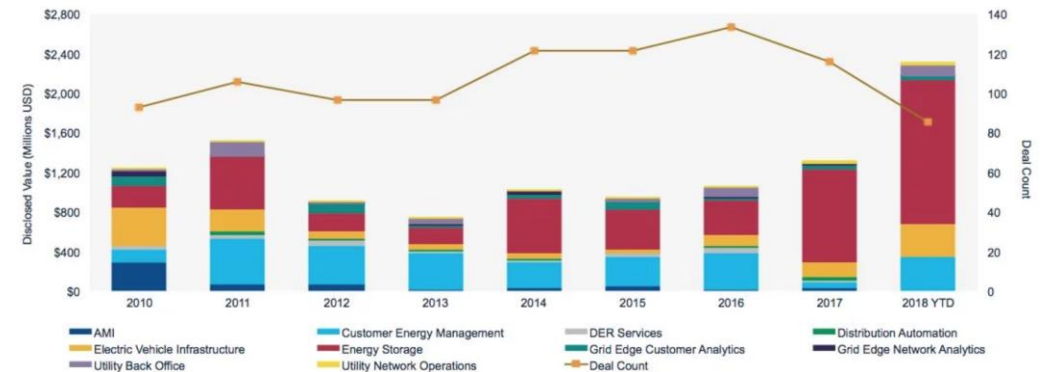
The temperature difference is converted back to electrical energy with a heat engine.

### 5. Distributes

Electricity is sent back to the grid when it is needed.



VC & Private Equity: \$2.4 billion, 85 deals in 2018 to date for storage technology



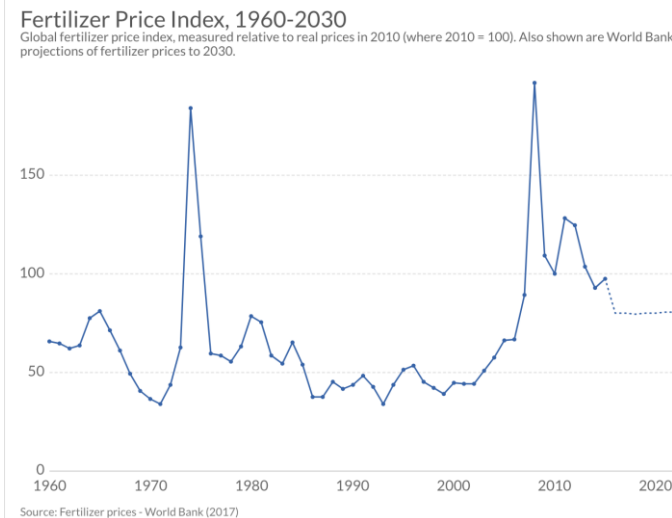
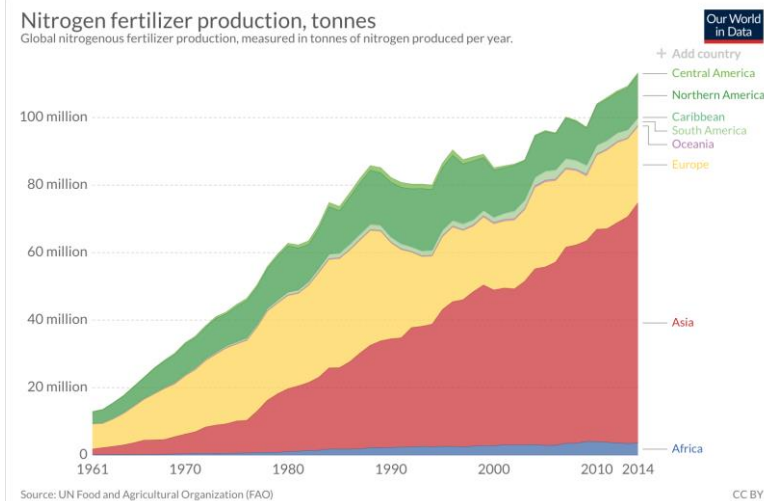


# Pivot Bio

Pivot Bio raised \$70 billion in Series B financing led by BEV; the company has commercialized the first and only nitrogen-producing microbes for US corn farmers.

## Nitrogen-Producing Microbes

- Supplies a clean alternative to synthetic nitrogen for corn agriculture
- New funding supports commercial launch, research to develop a seed treatment option, and expansion to new markets such as Brazil, Argentina, and Canada
- Fertilizer market is worth \$200 billion.
- Nitrogen is 300x more potent than CO2 and responsible for 5% of global warming



**SOIL TYPES MAP OF FIELD**  
PIVOT BIO PROVEN™  
**12 bu/A**  
IN LIGHTEST SOILS

**SATELLITE MAP OF FIELD**  
**10.6 bu/A**  
ACROSS ALL SOIL TYPES

**NO LEACHING  
NO LOSS  
FOR A STRONG ROI**

Based on conservative calculations, when the use of Pivot Bio PROVEN™ expands to 30 million acres, nearly **20,000 metric tons of nitrous oxide emissions will be reduced or prevented**, which is equivalent to taking almost **1.5 million cars off the road**.

**AND WILL PREVENT  
500,000 METRIC TONS  
OF NITRATES  
LEACHING INTO WATERWAYS**

# Form Energy

Form Energy raised \$9 million in Series A financing, led by BEV; the company is developing ultra low cost, long duration energy storage system to be commercialized in the next decade.

Climeon

