

The Green Power

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Human Dominated

Human Beings are today the largest geological force in the planet

We are changing the planet's atmosphere, its body of waters, and the complex web of species that makes life on earth

Global Risks

- Climate Change
- Biodiversity Extinction
- Clean Water scarcity
- Life in the Seas going extinct

Avoiding

URGENCY

Why are we being called to respond to

The Climate Question

Catastrophic Risks

- **Global sea level raise** threatens the survival of 43 island nations
- **Polar Caps melt** – accelerating warming trend
- **Record breaking tornadoes, floods, droughts and devastating fires**
- **30 million climate migration in 2011**
- **National Security at Risk US Pentagon 2009**

Oceans – the origin of life – going extinct

Are Humans Next?

- Need Action Now
- Waited too long
- Industrial economies 20% of world population cause most of world's CO2 emissions

Energy from **fossil fuels**

is 45% of global emissions

Clean Energy is the Only

The

The change we are producing will be read in rock formations for thousands of years

A new geological era – the ‘Anthropocene’ – follows the Holocene –it started in 1945

**The Bretton Woods Institutions
after WWII led to
Globalization of Western**

A Brief History of Western Economics

How an individualistic frontier society
Grows Interconnections & the Global
Commons

Western Economics an

- **Lacks connections** with natural resources
- **Lacks connections** between present and future
- **Lacks connections** between people

Western Market Economics based on

- **Competitive Markets** – individualistic consumers trade private goods: no connection between people
- **Optimal Growth Theory** -- exponential growth of population and resource use – a frontier society without limits: no connection between the economy and ecological systems
- **Cost Benefit Analysis and Financial Models** Discount the Future – a short term vision: no connection between the present and the future

Western economics

- Lacks connections between people
- Lacks connections between economy and environment
- Lacks connections across generations

**Sustainable
Development**

requires building connections

Because humans dominate the planet

- For the first time in recorded history
- Following an era of rapid globalization

Humans dominate Planet Earth

- We are connecting and

This means natural resource

- As we reach natural resource and environmental limits

The survival of humankind is at stake

- Need connections with the ecology, between people and with the future of our species

Can Western Economics adjust?

Sustainable

How to do it

What to do

- Change International Law
- Change Economics

We just have to do it

- For the survival of our

Changing Economics is

HOW?

- Provide the Missing Connections
- Between people and the environment

Changing Economics

Requires Changing International Law

Change International

- In 1974 I created the Bariloche Model of the World Economy
- Based on my new concept of Basic Needs
- Basic Needs foundation of Sustainable Development voted by 150 nations at the 1992 UN Earth Summit in Rio Brazil
- Adopted by the G - 20 in 2009

Change International

- The Carbon Market I designed and wrote into the UN Kyoto Protocol in 1997 is international law since 2005
- Productive clean CDM transfers to developing nations \$50 Bn since 2005
- EU ETS Trades \$200 Bn/year, decreased 37% EU emissions since became law in 2005
- Makes profitable the use of clean energy for the production of all goods and services
- Changes the energy foundation of the Global Economy
- China ratified the Kyoto Protocol and since 2005

Change International Law

The Green Power

- \$200Bn/year Private/Public Fund for building Carbon Negative Power Plants in developing nations
- Funded by the CDM of the Kyoto Protocol = Carbon Market trading in 2011
- Created in Copenhagen CP15 December 2009 – I published and presented it to Pershing US State Dept, and Pizer US Treasury
- Announced two days later December 17 2009 by US Sec H. Clinton -- now accepted in Durban 2011

Where are We?

What comes Next?

Changes Articulated by the

United Nations

Kyoto

- What is it?
- What it is not

The Carbon

- EU-ETS Trades \$200 Bn/year
- Reduced 30% EU emissions
- CDM transferred \$50 Bn clean energy projects in poor nations
- Now in 4 continents
- Compulsory Carbon Market in California USA
- US Federal Law March 2012 limits power plant emissions
-

Emission Limits are the basis of Carbon

Dirty
pays
clean –
ZERO



Carbon
Makes
Clean
Energy



CARBON
PRICES
ARE THE
Missing



\$25/TON
EMITTED



CHANGES
THE
ENTIRE
GLOBAL

Carbon Market

Links to Global Economy

Everything is made with energy

Economic growth = Energy Use

Link to Energy

**Carbon Market provides Missing
Signal**

New Market Prices = New Values

From the Carbon
Market

to the

Green Power Fund

Power Plants Create

- Energy is the mother of all Markets

A US\$55 Trillion

Global Power Plant Infrastructure (IEA)

- They Power the World
- The World needs more energy
- But Power Plants today emit 45% of all Carbon emissions

The Green Power

- Mobilizes the World Energy Markets

Builds Carbon Negative Power Plants

- \$200bn/year to build carbon negative power plants
- Creating Rapid Development in Latin America Africa Small Island States

Funded by the Carbon

To Build Carbon Negative

- Capture More Carbon than Emitted
- Providing Rapid Development while
- Cleaning the Planet's Atmosphere
- Ideal for Low Income Developing Nations
- Low Emitting Nation can Reduce more Carbon than they emit
- Paid for by the \$200 Bn/trading of the
Carbon Market of the Kyoto

Copenhagen COP15: Two Seeds with Irresistible Growth

1. Green Power Fund
2. Carbon Negative Technologies in the CDM

Durban December 2011: Kyoto Protocol extended 3 years

- Existing KP limits valid until 2015
- New Carbon limits pledged for 2015
- **Green Climate Fund**

Sustainable

- Cost Benefit Analysis and Optimal Growth theory exist that do not discount the Future

A Formal Theory of Sustainable Development has been developed that provides

Equal treatment for future generations

Basic Needs, The Carbon Market and the Green Power Fund

- New types of markets that value the Global Commons
- The Atmosphere, Biodiversity, Water
Change the global economy

New Markets Change Capitalism

- Markets trading privately produced public goods are new
- They combine equity with efficiency

Connecting People

- They require limits on resource use

Connecting Economics with Ecological Systems

Green Capitalism in the 21st Century

- The basis exists: international law and economics
- Theoretically and in practice
- New markets for the global commons, new growth theory, new cost benefit analysis and new GDP measures, new international law

The Global **New Economics**

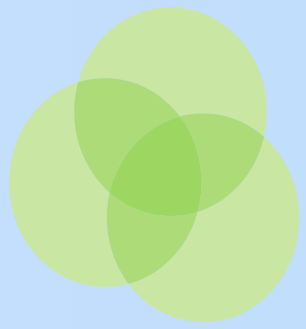
From maximizing profits to
economic progress
that ensures survival of our
species

Technology is Urgently

- To Reduce Carbon from the Atmosphere
- In a Profitable Way

The Word needs Energy

CLEAN ENERGY FOR



global thermostat

a carbon negative solution



Global Thermostat Pilot Plant, SRI International – Menlo Park
California

February 2011

Why a Carbon Negative

Carbon Neutral is not

- Neutralizing emissions does not prevent further increases in atmospheric CO₂
- Even the most aggressive efficiency improvements and renewables adoption are unlikely to keep CO₂ concentration at the generally agreed 450 ppm level, let alone 350 ppm

Negative Carbon is the solution¹

- Air capture enables direct and rapid reduction of CO₂ concentration
- GT allows for the capture of even more CO₂ than we are loading into the atmosphere or that the earth's systems can absorb – Negative Carbon

¹ United Nations Headquarters, New York, November 12, 2009. Presentation by G. Chichilnisky on "[The Rising Tide at Copenhagen: A Win-Win Solution for Industrialized and Developing Nations](#)"

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GT's technology directly reduces carbon concentration in the air, making carbon negative possible

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Closing the Carbon

- GT Technology Captures Carbon from Air
- Inexpensive: Uses Low Process Heat
- Cogenerates Power Production with Carbon Capture
- The More Power is Produced – the More Carbon is reduced
- Makes Coal Plants **Carbon Negative**
- Makes Solar Power Plants even more **Carbon Negative**

GT's Air Capture

Three-Step Process Produces Concentrated
CO₂ Stream

Step 1
Air Input

GT's Air Capture

Three-Step Process Produces Concentrated CO₂ Stream

Step 1
Air Input



Step 2
CO₂ Capture

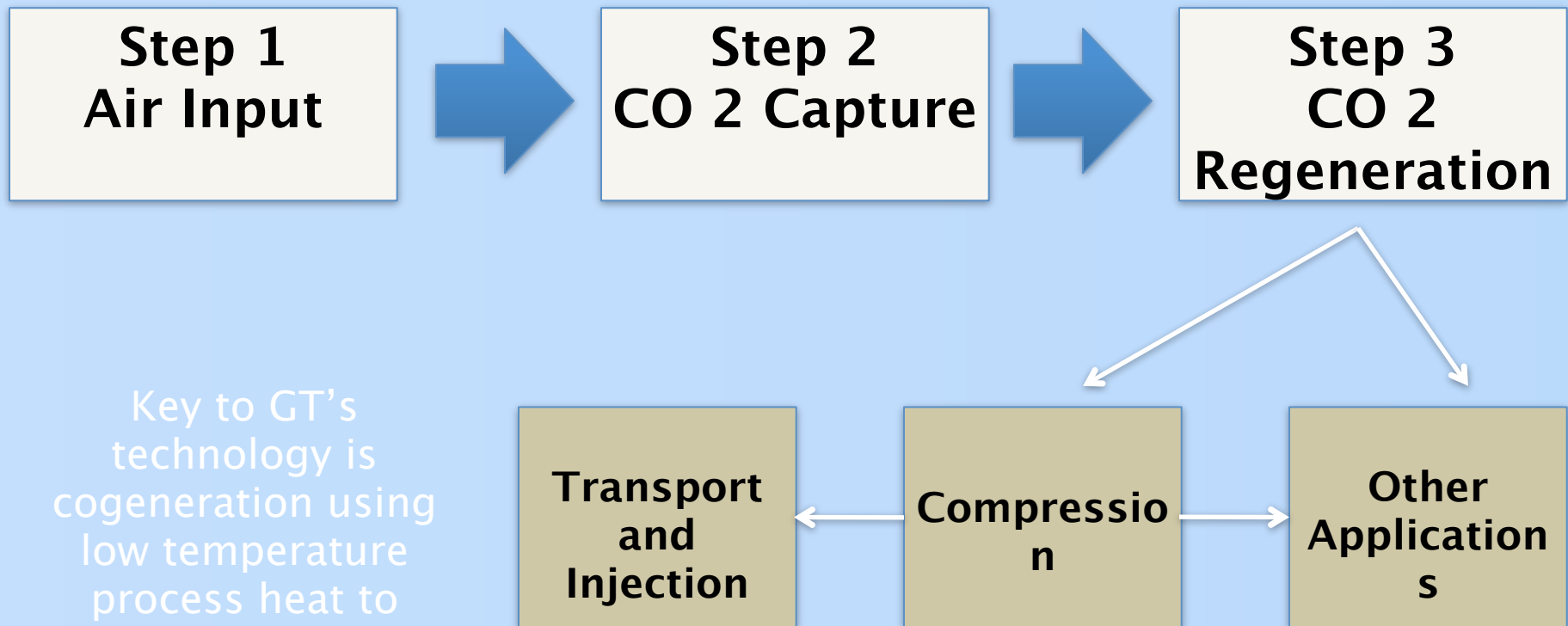
GT's Air Capture

Three-Step Process Produces Concentrated CO₂ Stream



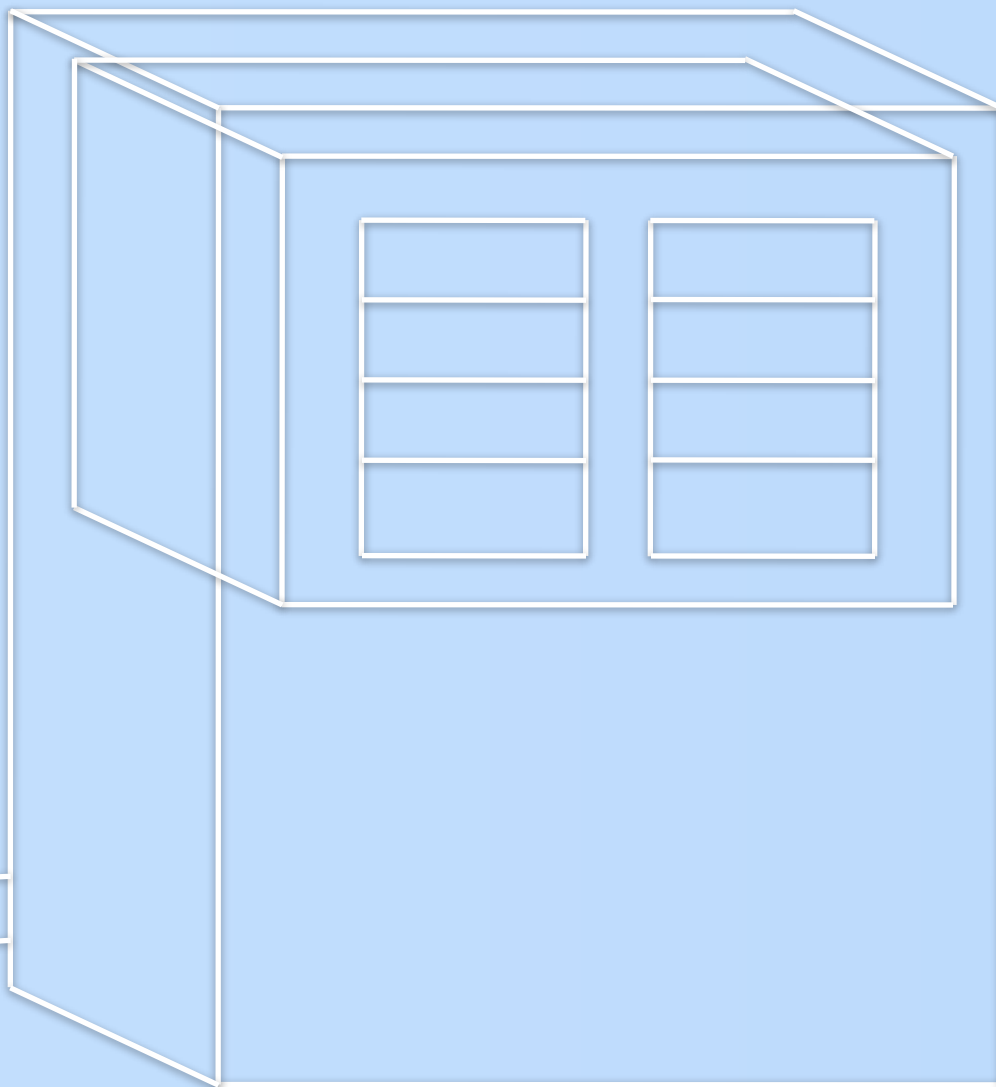
GT's Air Capture

Three-Step Process Produces Concentrated CO₂ Stream



Key to GT's technology is cogeneration using low temperature process heat to capture CO₂

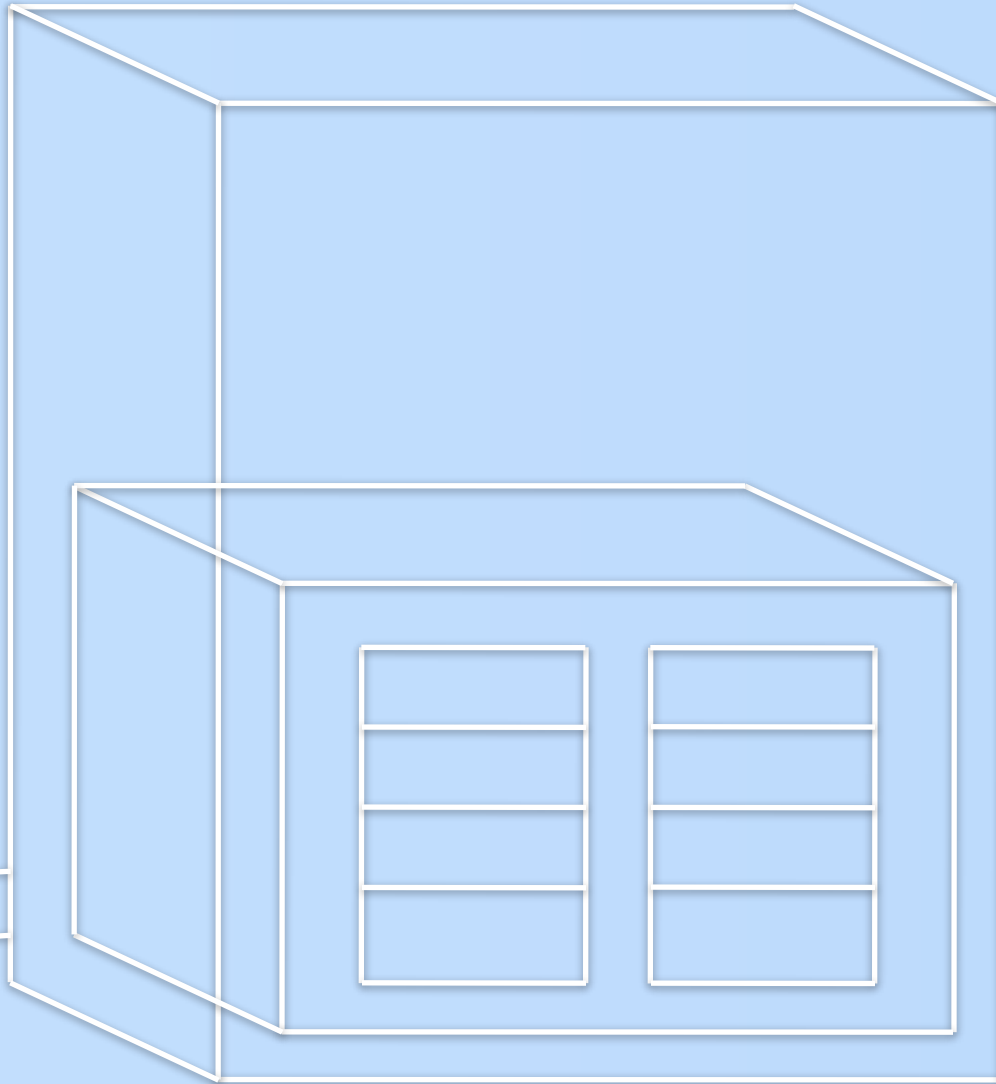
Subsequent steps are shared by all CO₂ capture methods though pipelining costs can be reduced by co-locating where CO₂ is stored or used



UP

Absorbing CO²

Pipes to oil well or algae

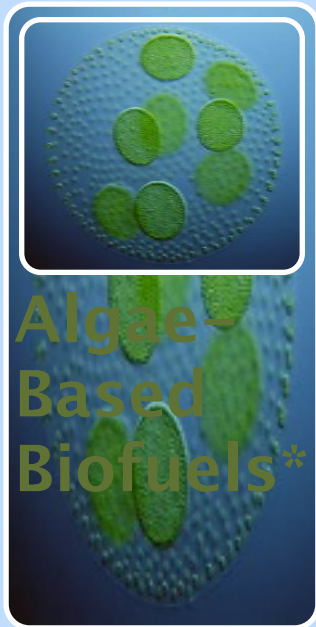
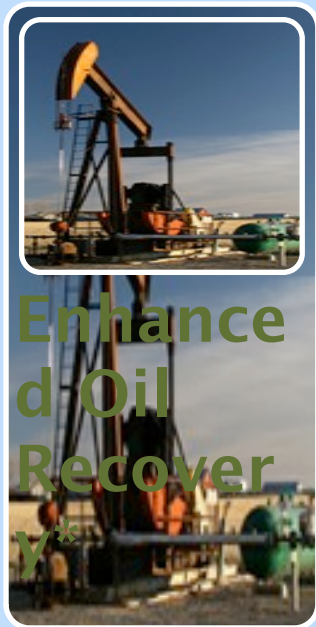


DOWN



Pipes to oil well or algae ponds

Applications & Markets for



*EOR and Algae-based biofuels represent most significant opportunities for commercial applications of CO2 captured using GT's technology

Unique Advantages of GT's Technology



Measurable advantages over other forms of
carbon capture

Unique Advantages of GT's Technology



Measurable advantages over other forms of carbon capture



Unique Advantages of GT's Technology



Measurable advantages over other forms of carbon capture

Low-Cost Provider

- Powered by low cost & widely available process heat



Unique Advantages of GT's Technology



Measurable advantages over other forms of carbon capture

Low-Cost Provider

- Powered by low cost & widely available process heat

Scalable Design

- Modular design adapts to different sized applications



Unique Advantages of GT's Technology



Measurable advantages over other forms of carbon capture

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Scalable Design

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Carbon Negative Solution

- An energy or industrial plant can capture even more CO₂ than is emitted – a carbon negative solution

Unique Advantages of GT's Technology



Measurable advantages over other forms of carbon capture

Low-Cost Provider

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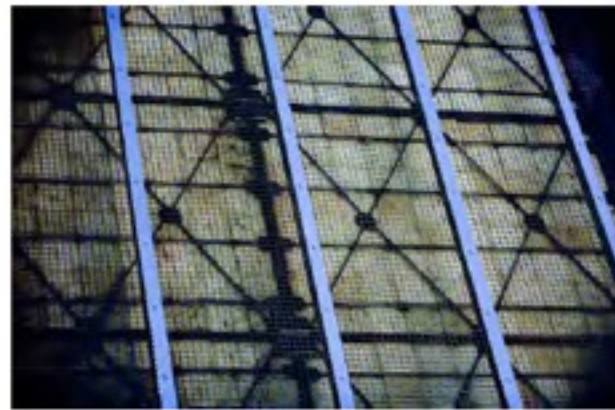
Carbon Negative Solution

- An energy or industrial plant can capture even more CO₂ than is emitted – a carbon negative solution

Flexible Integration

- Fossil, renewable, nuclear plants, industrial plants, (cement, steel) – anywhere heat is available

GT Pilot Plant at SRI – October 1, 2010



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Strategic Partners

 **BASF**

The Chemical Company



CORNING



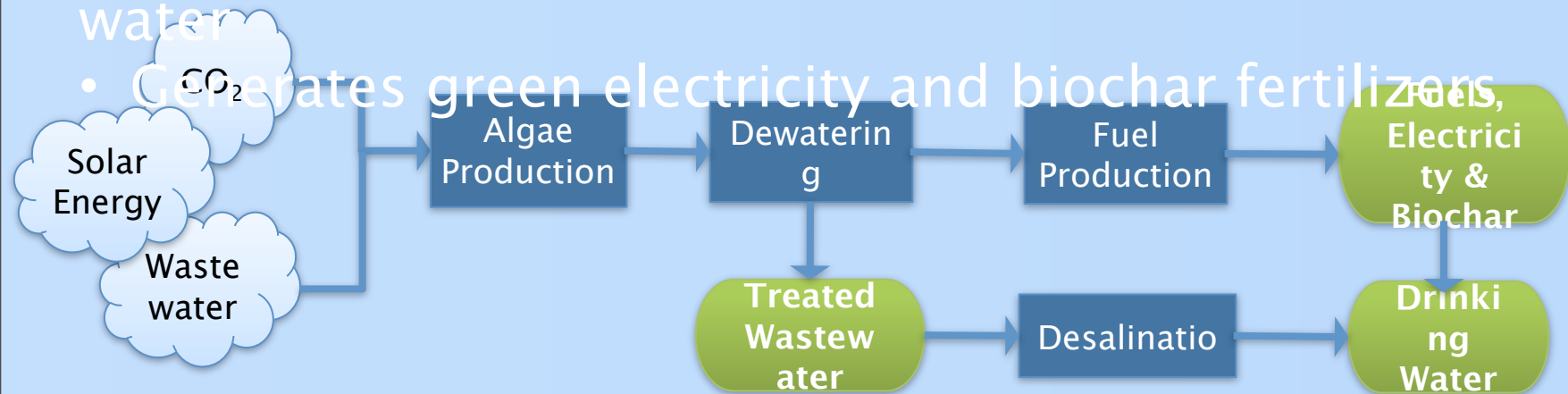
SUMMIT POWER

 **Nexant**

GT Producing Carbon Negative

GT isloping fully-integrated biorefinery in partnership with Algae Systems

- Produces carbon negative transportation fuels (gasoline diesel)
- Treats municipal wastewater and produces drinking water
- Generates green electricity and biochar fertilizers,



Provides critical municipal services while producing energy

As Green As It Gets

The Green Power Fund Creates a Carbon Negative

- To fund Carbon Negative Power plants in island nations AOSIS Latin America & Africa
- The **ONLY WAY** that low emitting developing nations can benefit from the