DIMENSIONAL ENERGY

HI-LIGHT: Artificial Photosynthesis Reactor

Scale and Velocity

Reducing atmospheric carbon with Economic forces.

Problem: Industrial Carbon into Atmosphere

38 Billion Tons / year CO_2 Emissions
Projected tax of up to $50 / ton
Low Margins – *race to the bottom*
High CAPEX – *for economy of scale*

Technologies in Climate Models that keep warming below 2 degree C change. Source: IEA

38% Efficiency
32% Renewables
12% CC(U)S
11% Fuel Switching
7% Nuclear

Opportunity

15% CO_2 emissions = $800 billion to $1.2 Trillion opportunity.

Sources: Global CO_2 Initiative 2017.

Opportunity

Building material

- 1-5 GT/CO2/year
- $60-$500 Billion/year

Fuels

- 7- 2.1 GT/CO2/year
- $60-$500 Billion / year

Chem-icals

- 005- .06 GT/CO2/year
- $4-$40 billion/year

Sources: Styring etal 2015, Xprize Foundation,Circular Carbon Network 2017, Nature 2015,16, Techniche Universtat Berlin 2015, Global CO2 Initiative 2017.

Competition and Compatibility

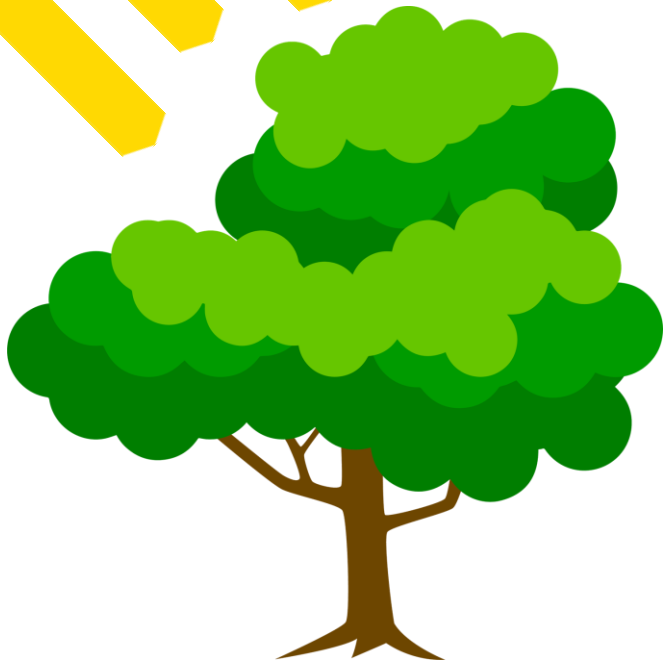
nrg | cosia CARBON XPRIZE

JCAP JOINT CENTER FOR ARTIFICIAL PHOTOSYNTHESIS

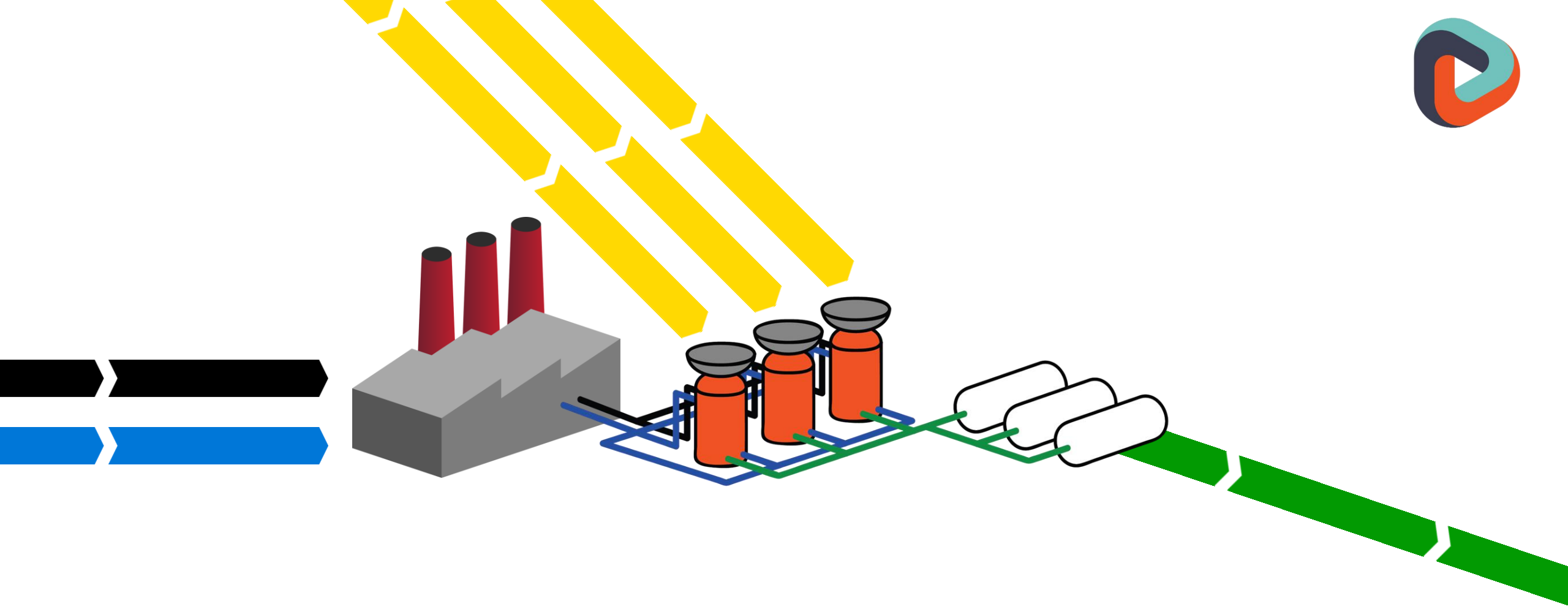
THE GLOBAL CO_2 INITIATIVE

Source: Global CO2 Initiative 2017.

How does nature complete the carbon cycle?

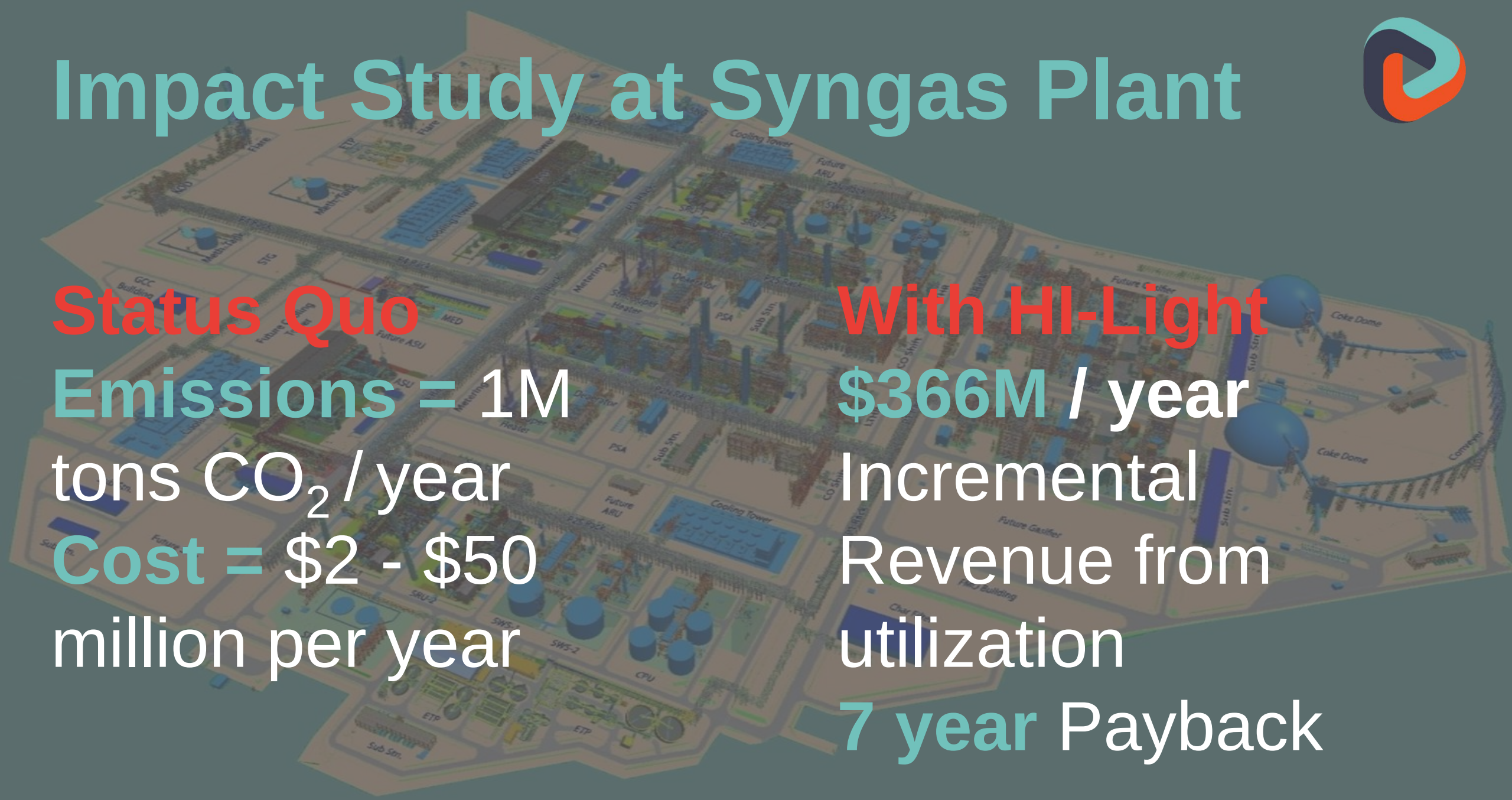


Photosynthesis



HI-LIGHT Reactor: Artificial Photosynthesis

Impact Study at Syngas Plant



Status Quo

Emissions = 1M tons CO_2 / year

Cost = $2 - $50 million per year

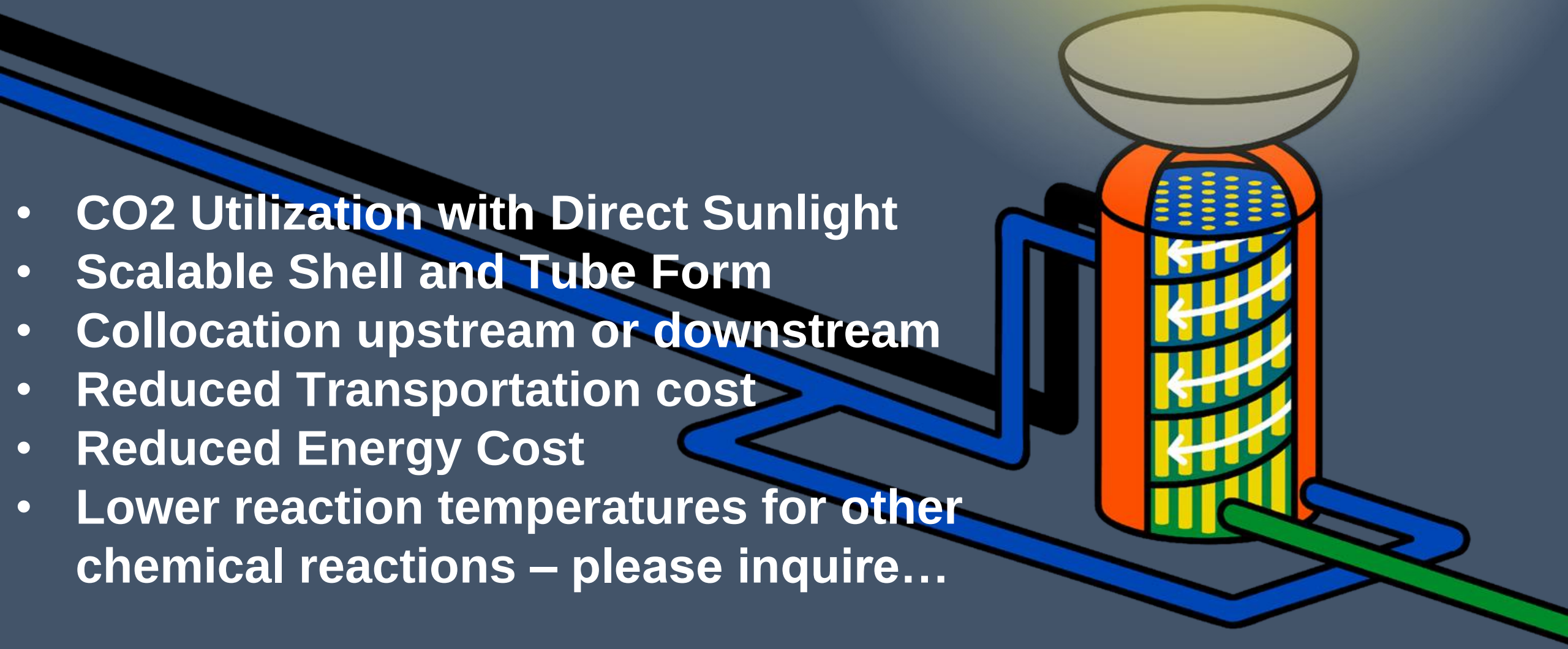
With HI-Light

$366M / year Incremental Revenue from utilization

7 year Payback

HI-LIGHT Photo Reactor

- CO2 Utilization with Direct Sunlight
- Scalable Shell and Tube Form
- Collocation upstream or downstream
- Reduced Transportation cost
- Reduced Energy Cost
- Lower reaction temperatures for other chemical reactions – please inquire…

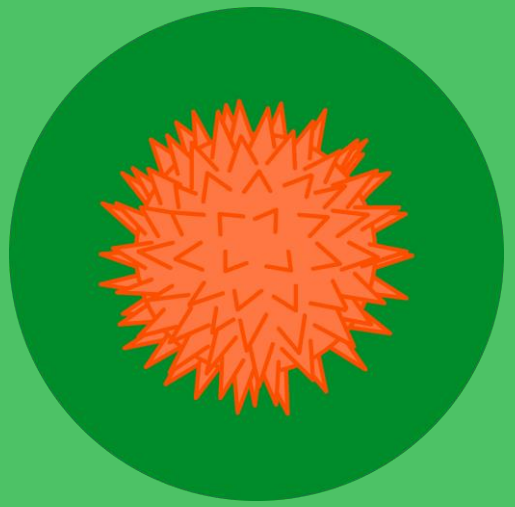


How HI-Light works

Concentrate and Bend CO_2 Molecules on catalyst.

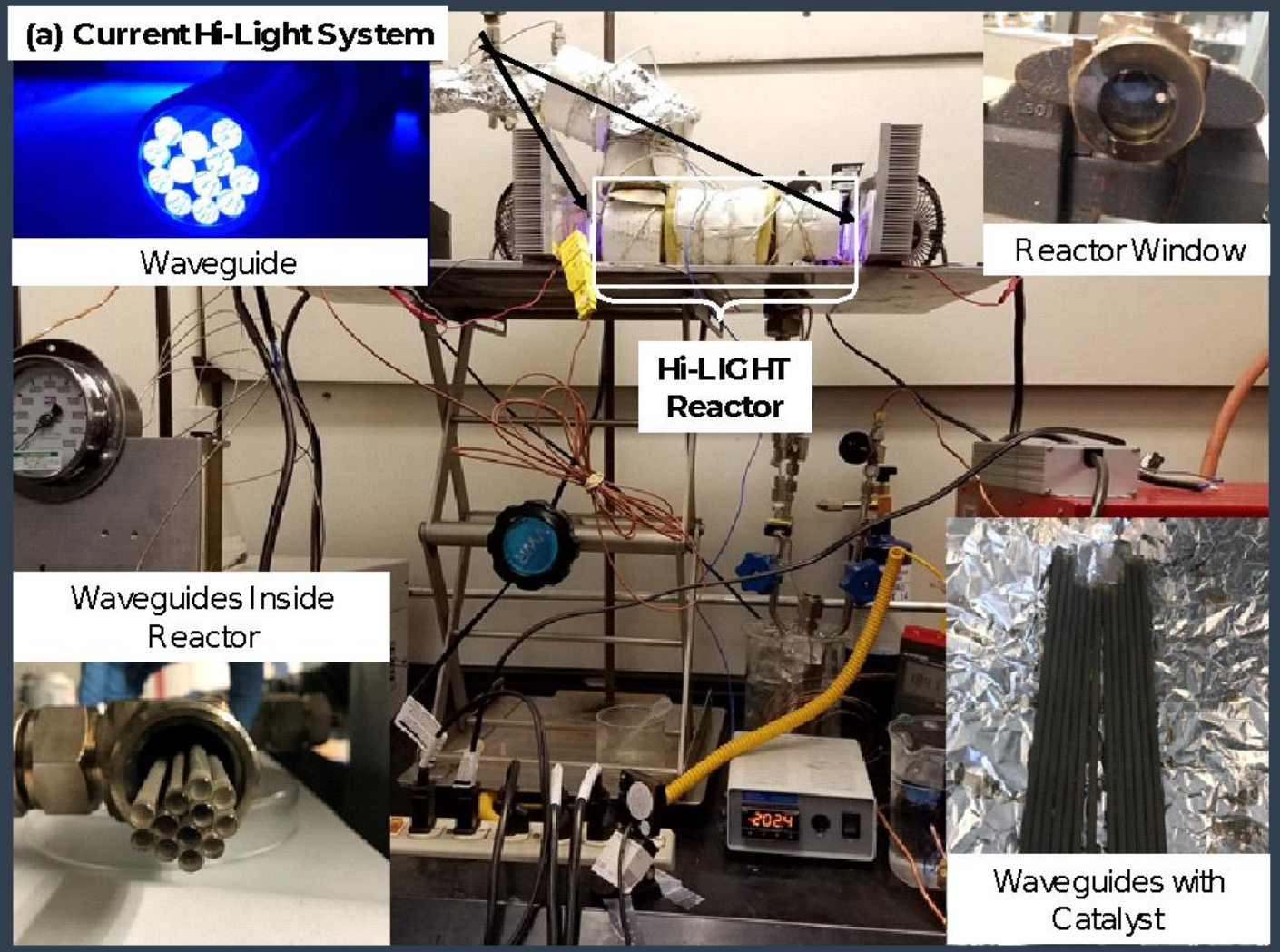
Deliver sunlight evenly throughout the reactor

Photochemical reduction of CO_2 and and other molecules to solar fuels.

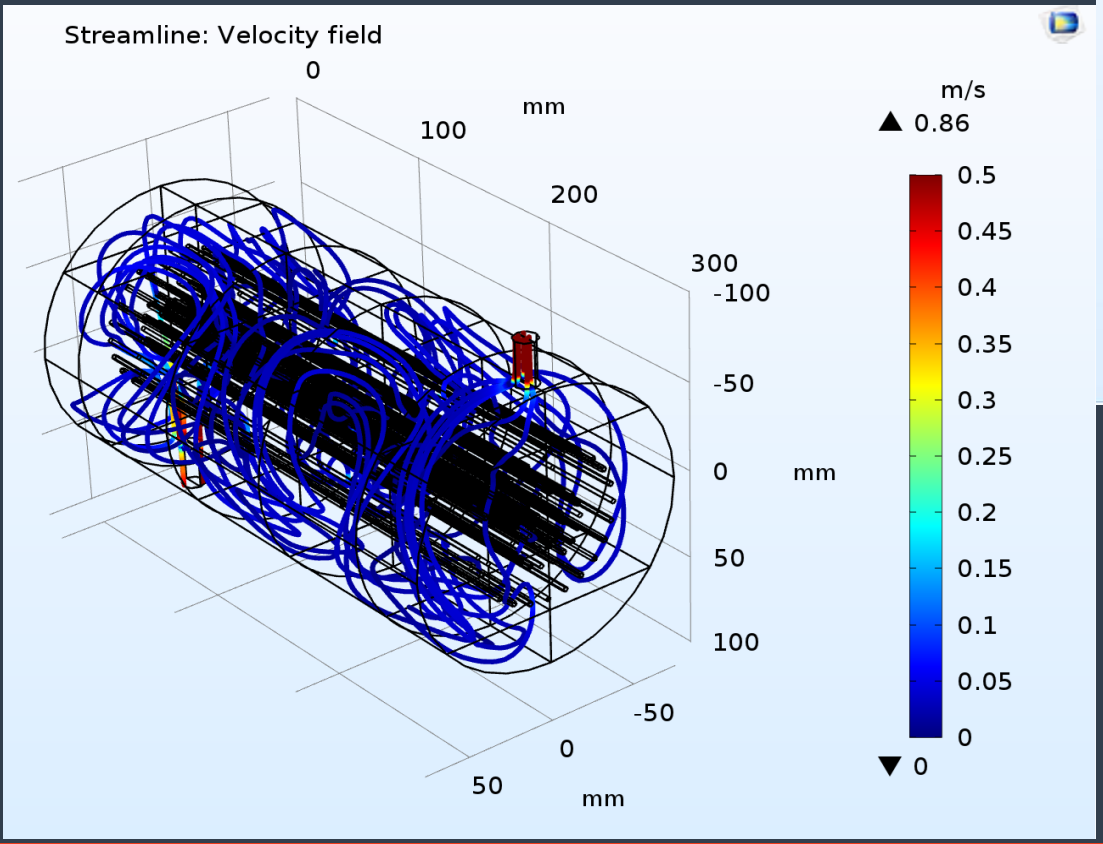


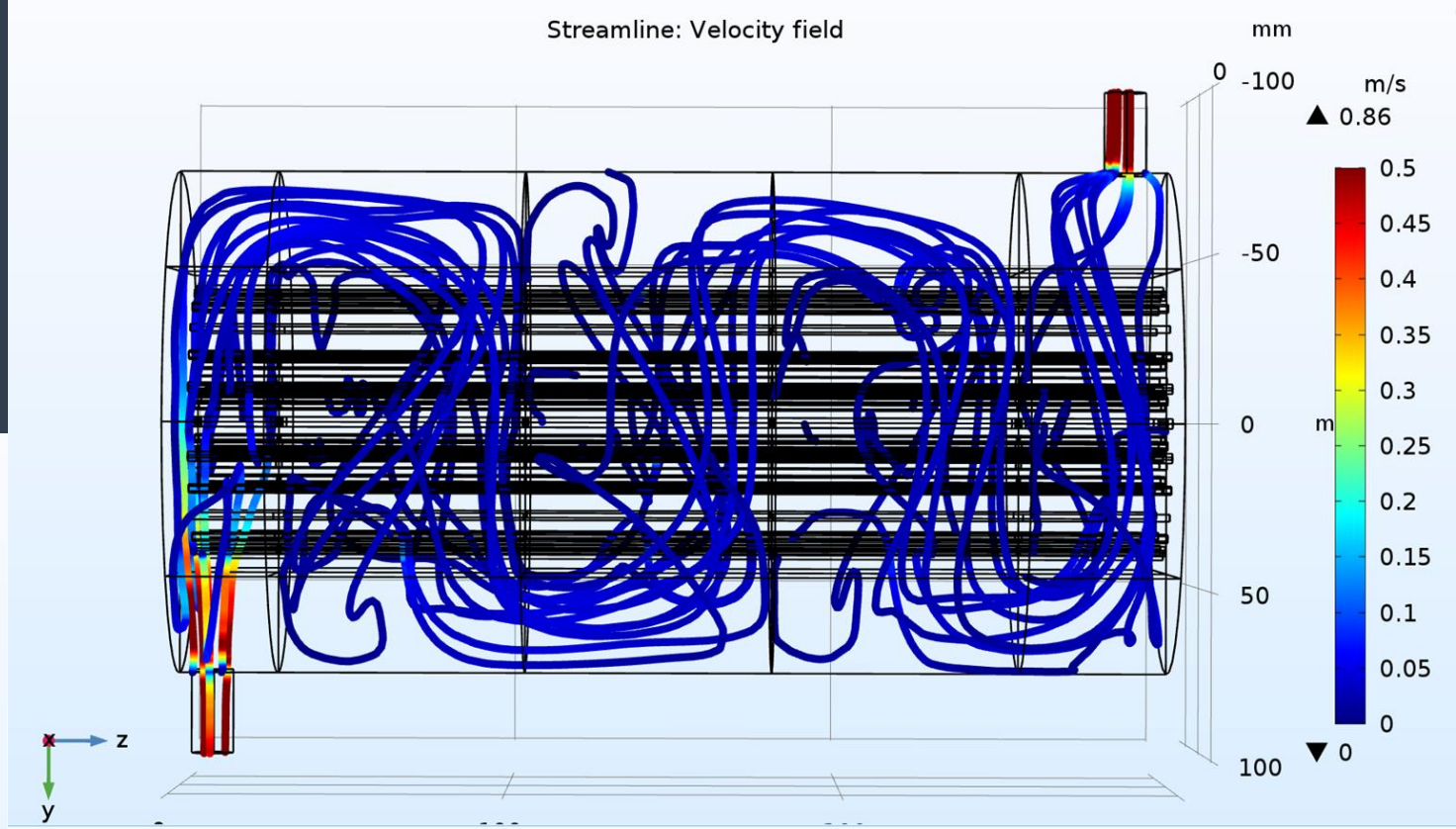
Inside the HI-LIGHT Reactor

HI-LIGHT Photo Reactor



Optimize Residence Time

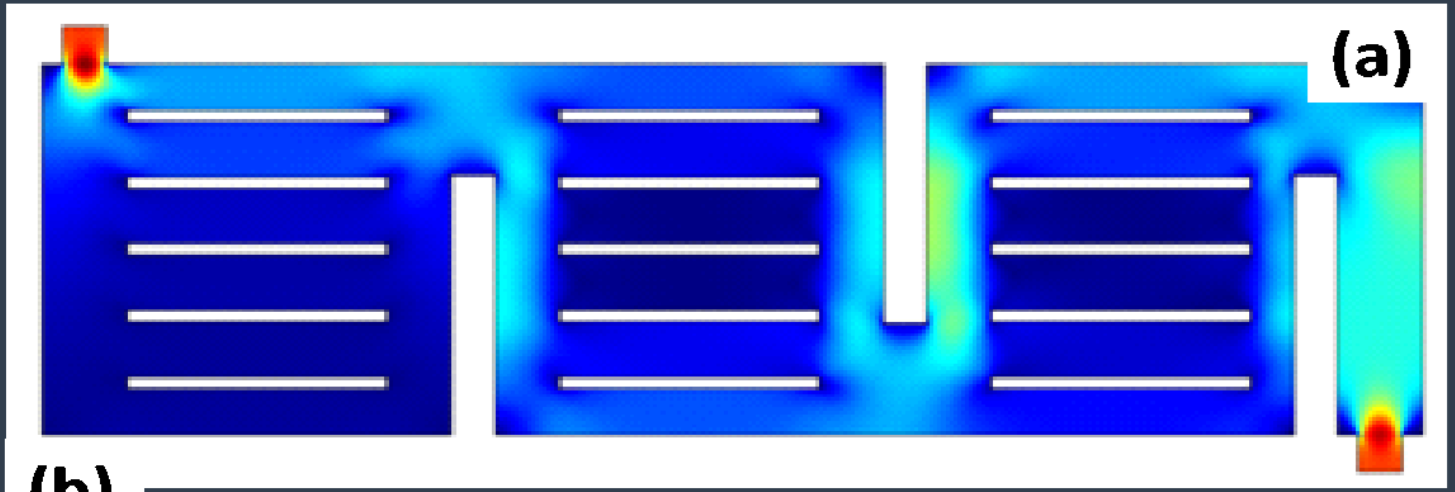


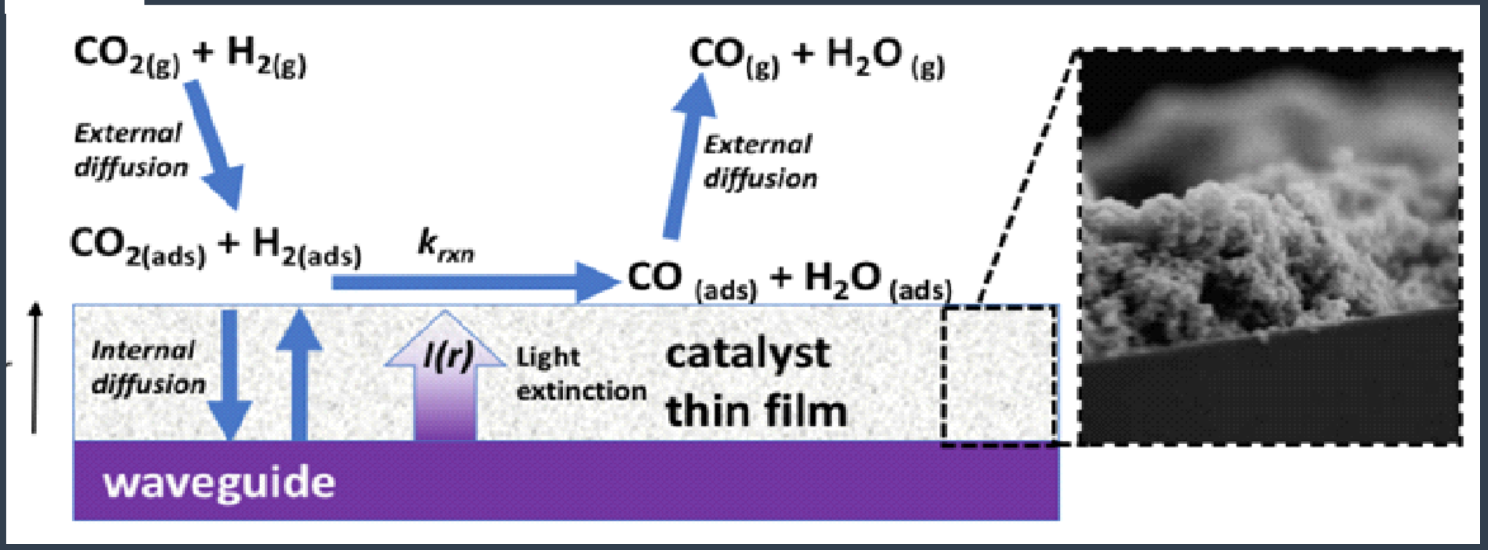


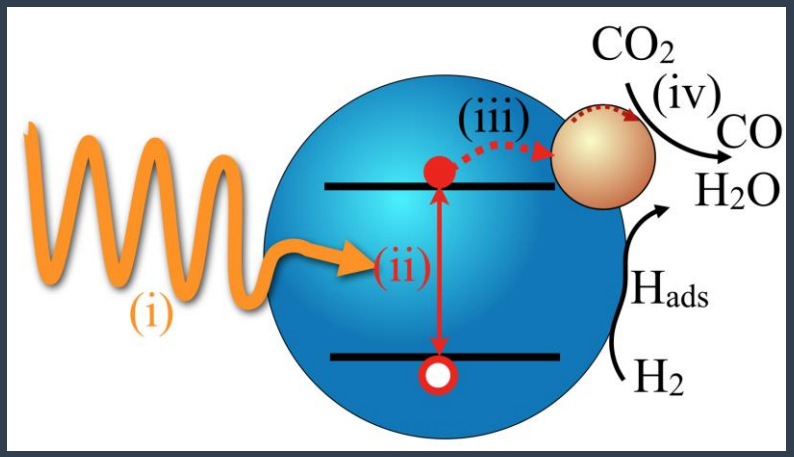
CO_2 Mixing with Catalysts & Light

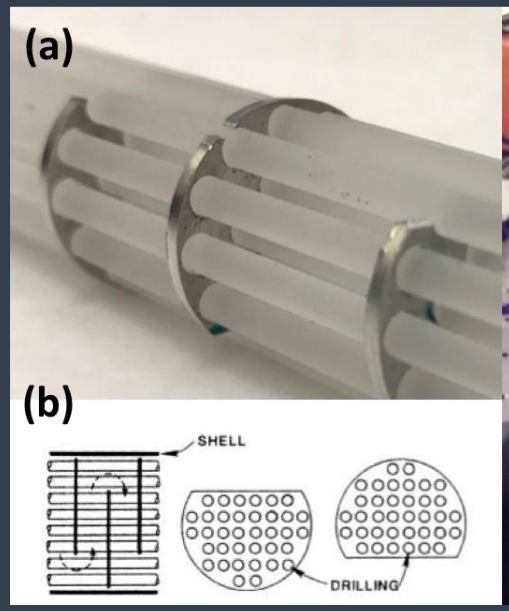
HI-LIGHT: Artificial Photosynthesis Reactor

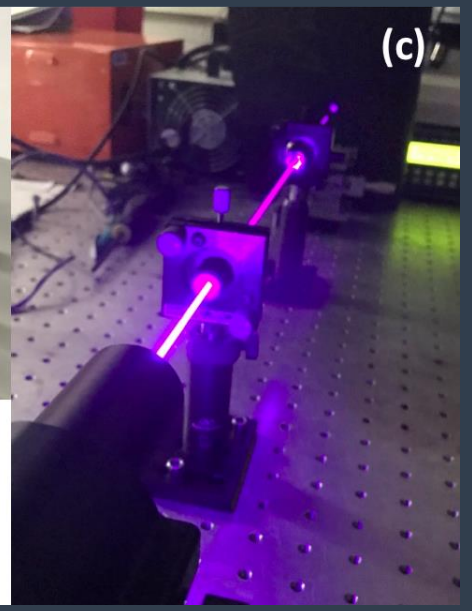
HI-LIGHT Photo Reactor



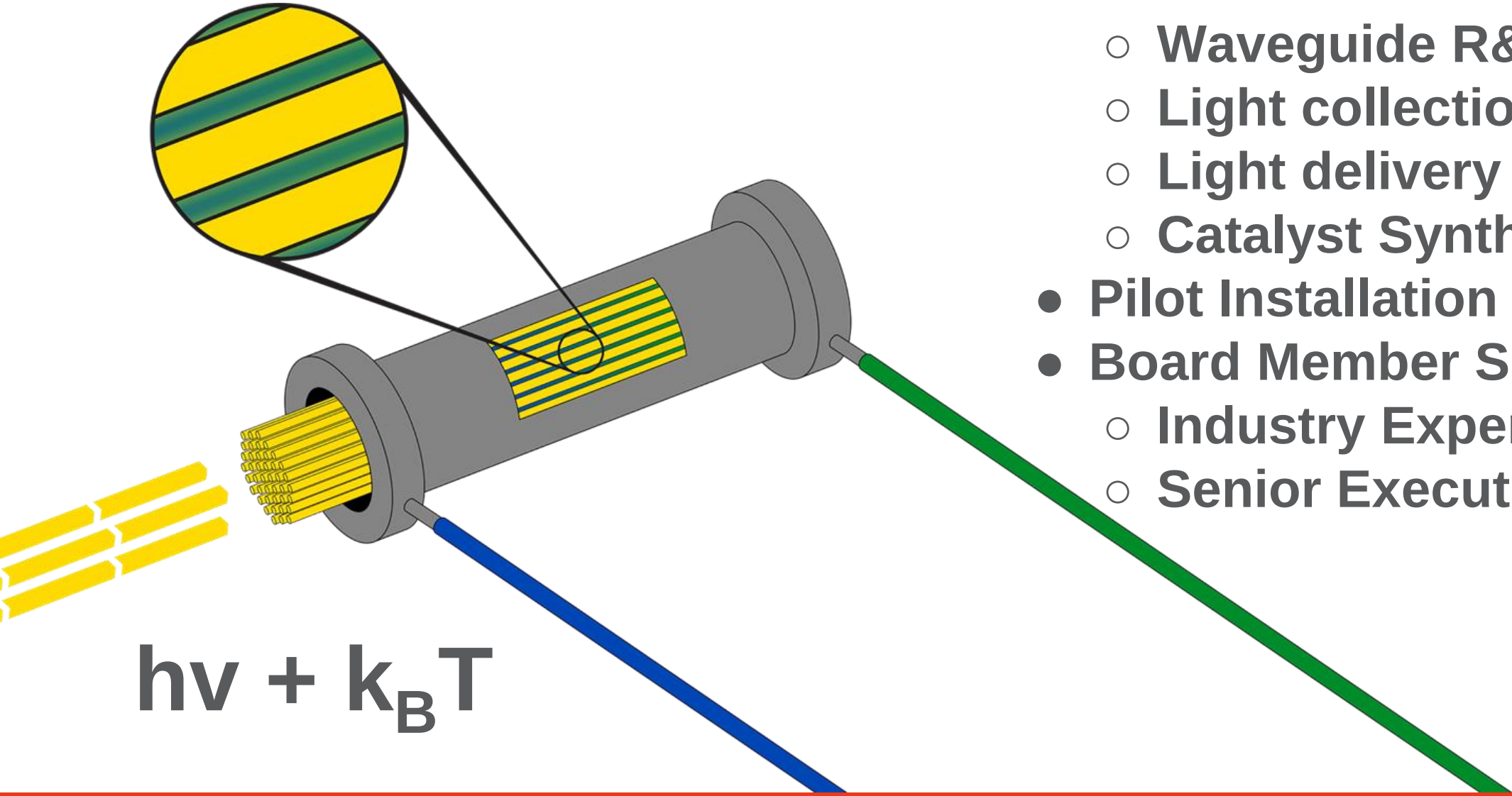








Next Steps



$hv + k_BT$

- Development and Commercialization
  - Waveguide R&D + MFG
  - Light collection
  - Light delivery
  - Catalyst Synthesis
- Pilot Installation
- Board Member Search
  - Industry Experts
  - Senior Executives

HI-LIGHT Photo Reactor

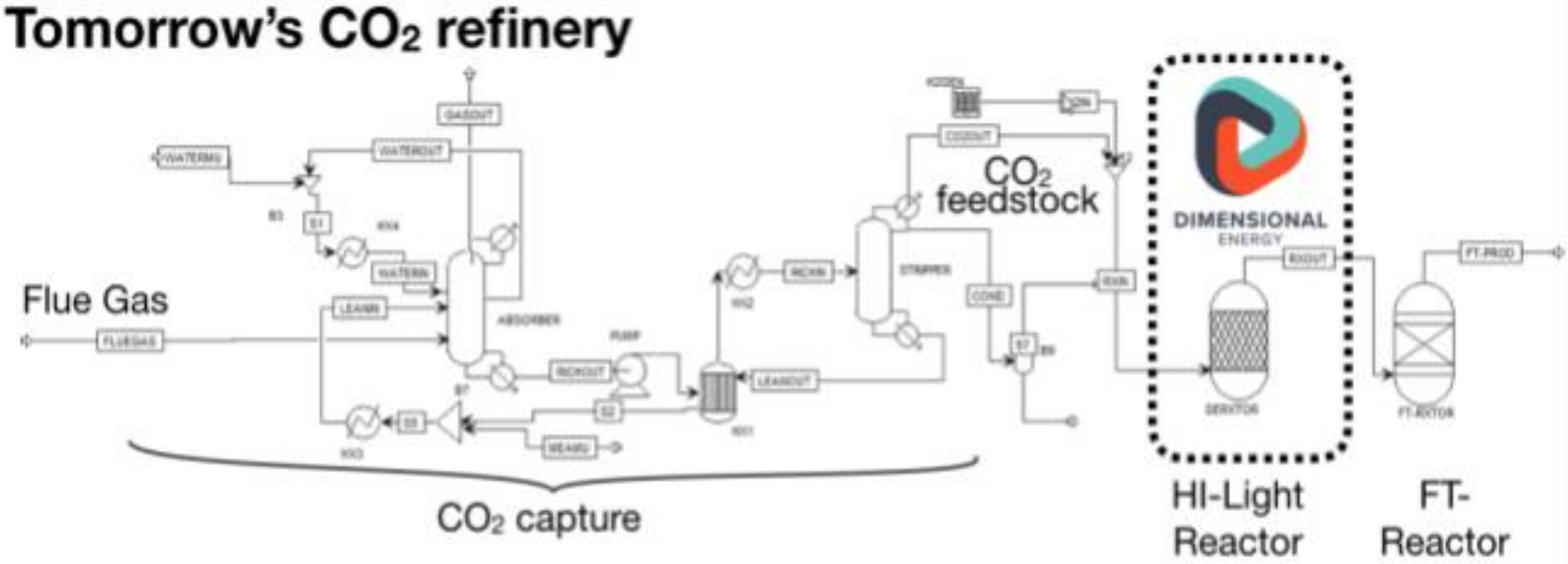


Figure 1.4 Schematic illustration of the 'CO2 refinery'. The HI-Light reactor developed at Dimensional Energy is integrated with upstream CO2 capture and downstream syngas conversion in a Fischer-Tropsch (FT) reactor to form higher hydrocarbon products.

Dimensional Energy Team

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CEO

Clayton Poppe
COO

Tobias Hanrath
Co-founder
Technical Advisor

David Erickson
Co-founder
Technical Advisor

Dimensional Energy Labs

Mihir Gada
Process Engineer

Miao Wang PhD
Chemical Engineer

Juan Guzman PhD
Process Engineer

Matt Lowe
Marketing

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PhD, Mechanical Engineering

Jessica DaSilva
PhD, Chemical Engineering

Yuval Kaminer
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Cornell Engineering

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APPENDIX

HI-LIGHT Photo Reactor

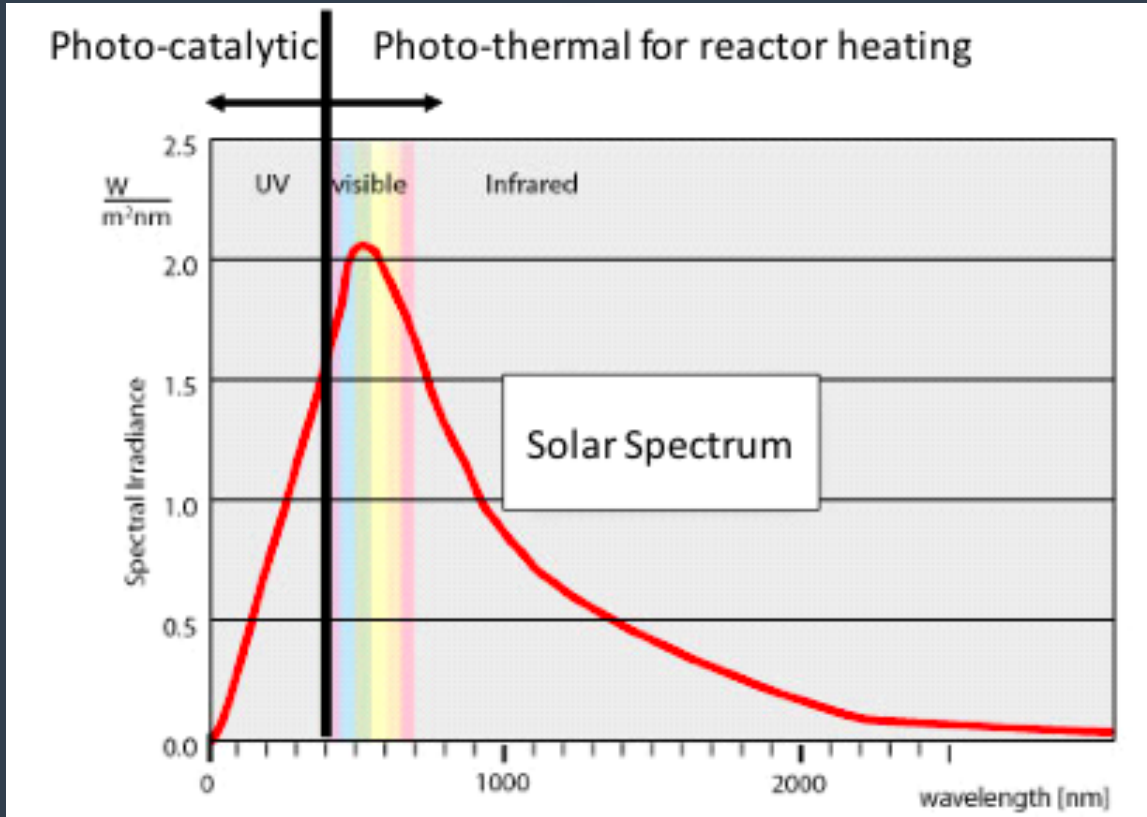


Figure Y: Solar Spectrum. A method we intend to use to reduce the reactor heating load is to take advantage of the entire solar spectrum to provide photocatalytic energy to drive the reaction and photothermal energy to heat the reactor.

HI-LIGHT Photo Reactor

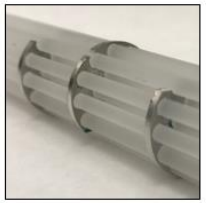
Length scale-up

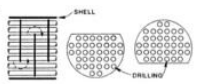
Light scattering test

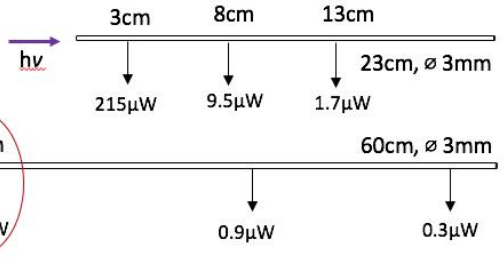
- Ensure that light reaches the center of the reactor

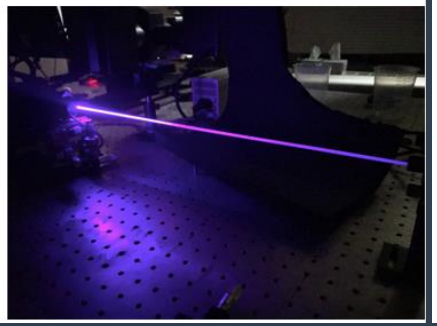
Baffles

- Improve rods structural stability and mixing





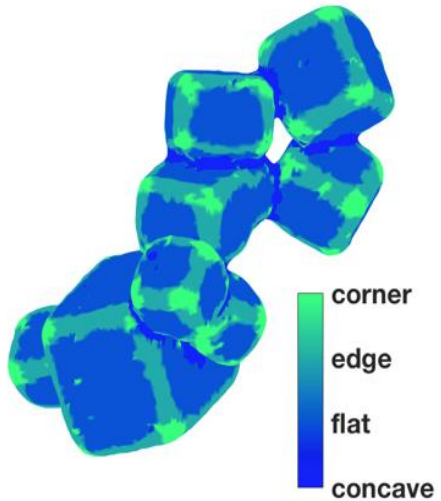




Material Segmentation

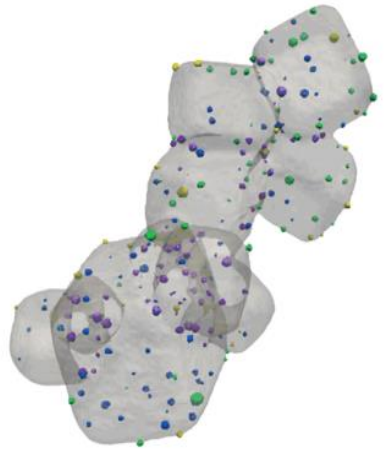
STO, Pore, Au

Curvature-based surface types

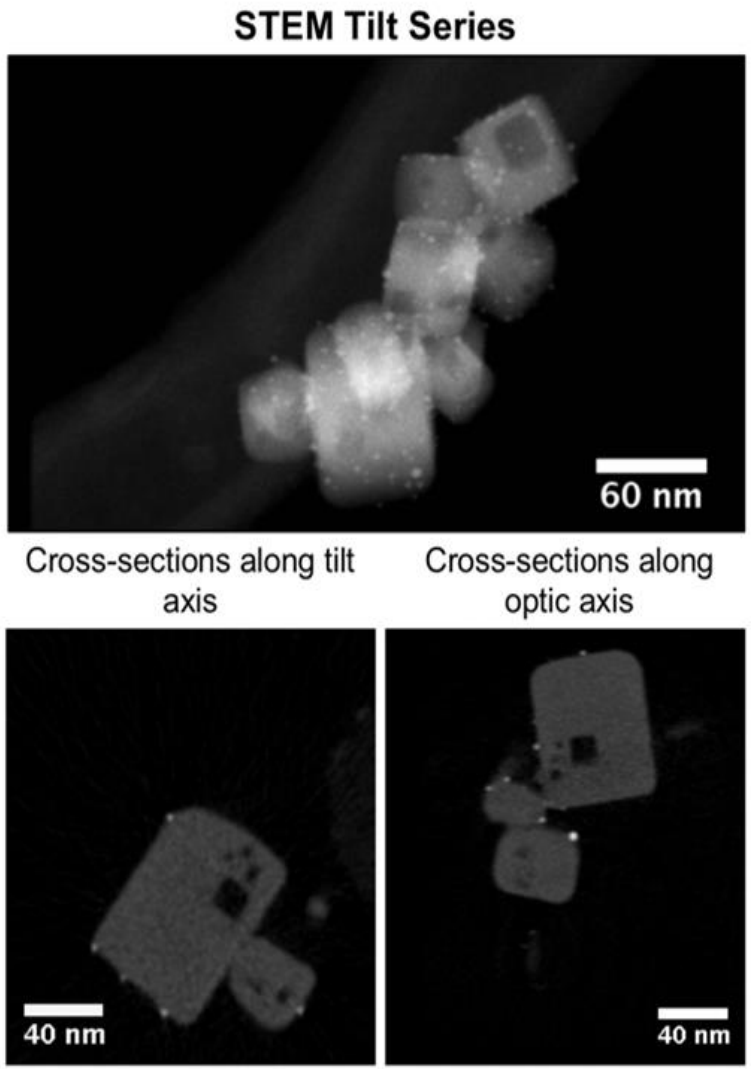


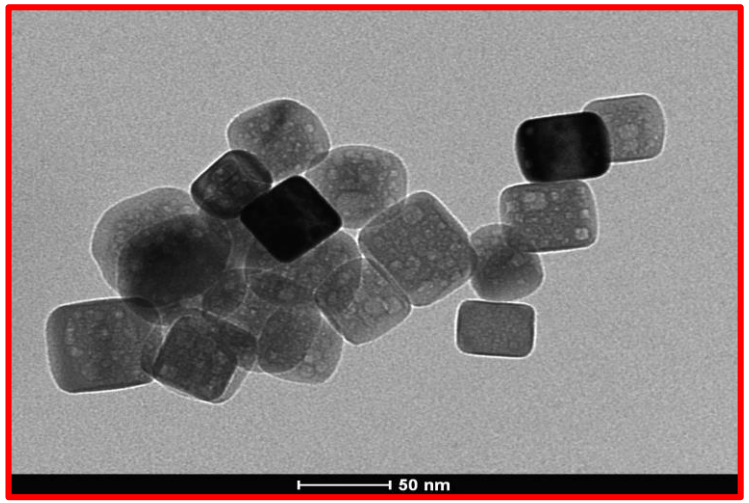
Local curvature-based assignment

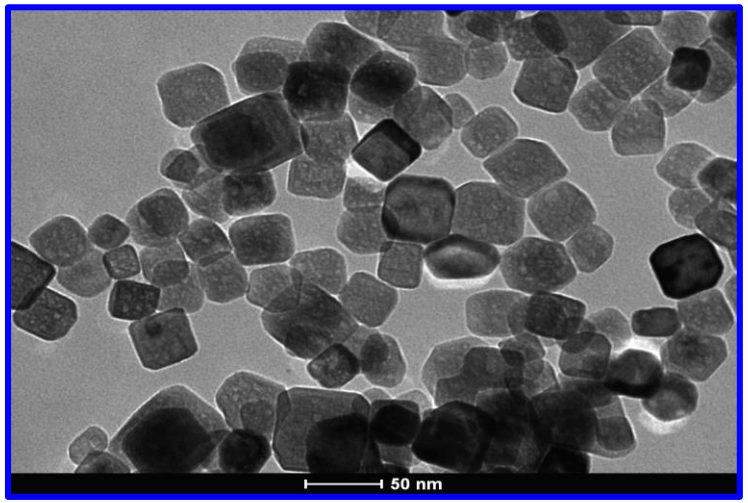
STO, Concave, Flat, Edge, Surface

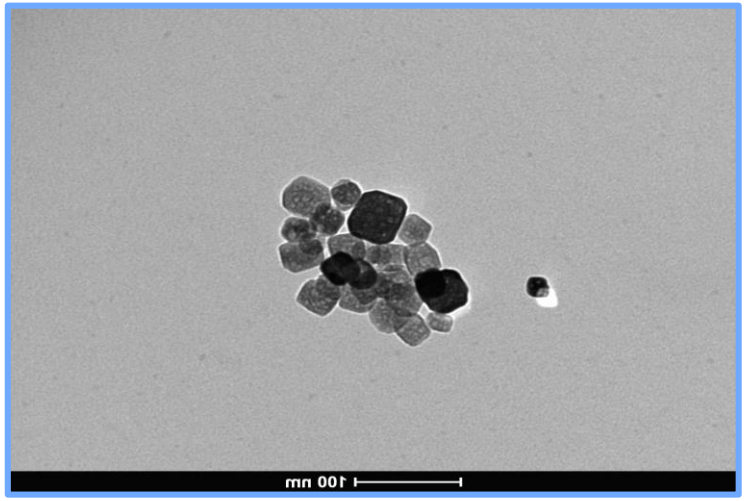


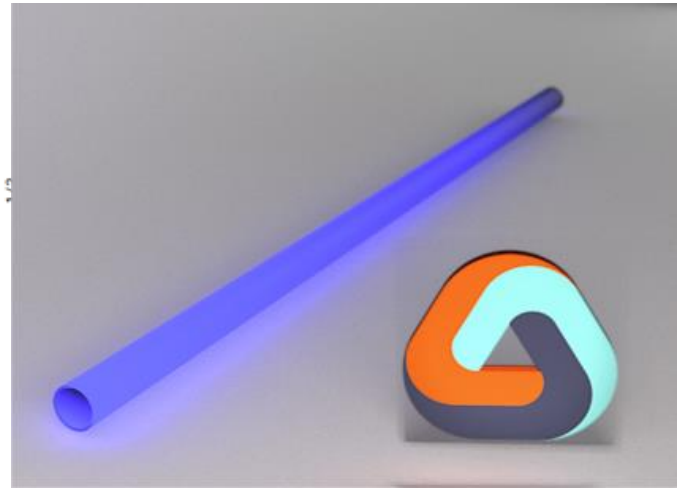
Catalysts Current











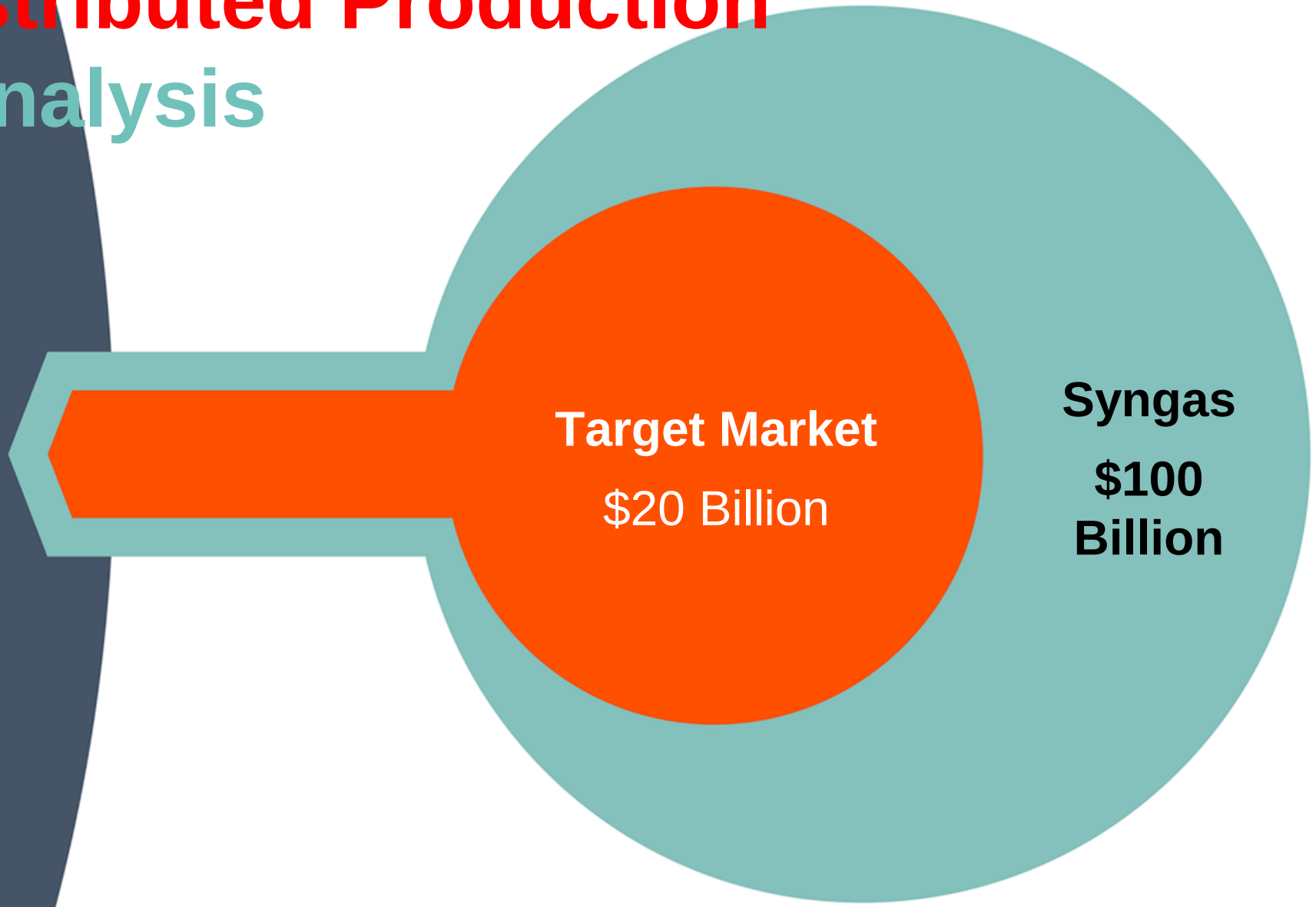
Energy (eV)

Small Distributed Production
Market Analysis

Niche of Methanol or syngas focused on solar fuels
$2Billion

Chemicals

$200 mm



Business Model

LICENSE IP TO CHEMICAL COMPANIES

ONGOING REVENUE FROM LICENSORS AND CUSTOMERS

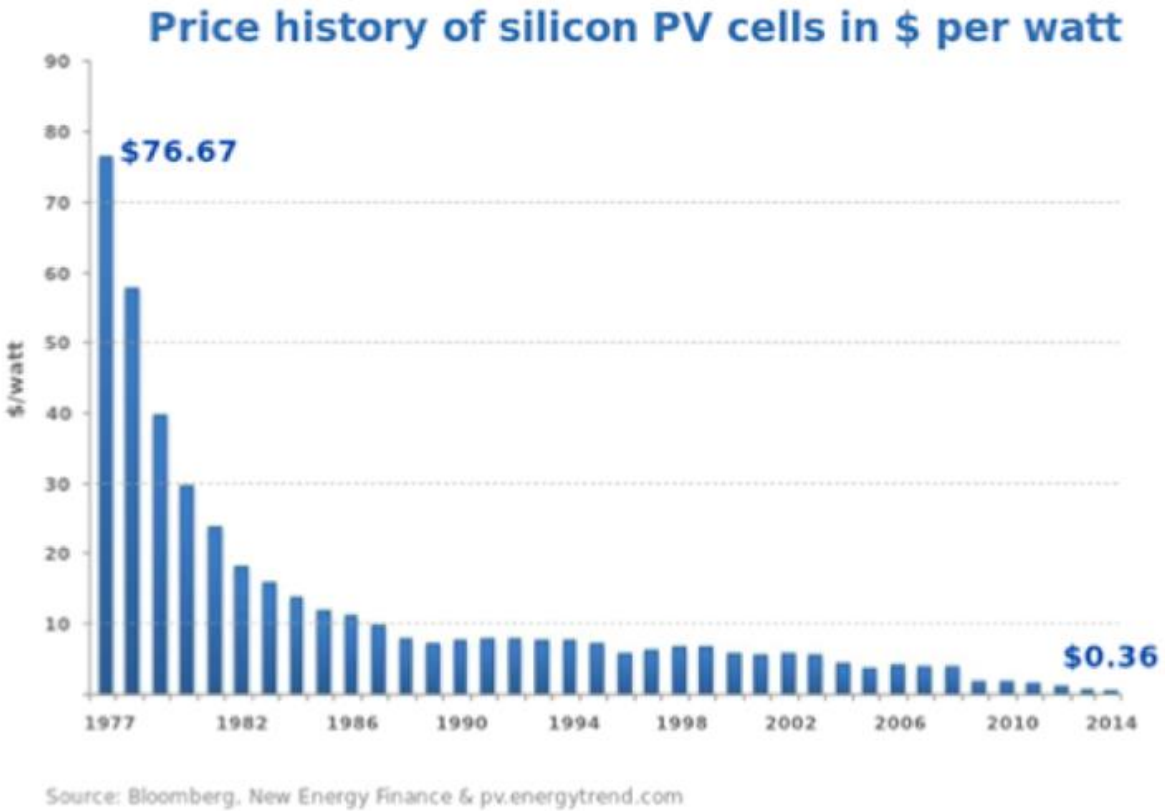
SERVICE CONTRACT

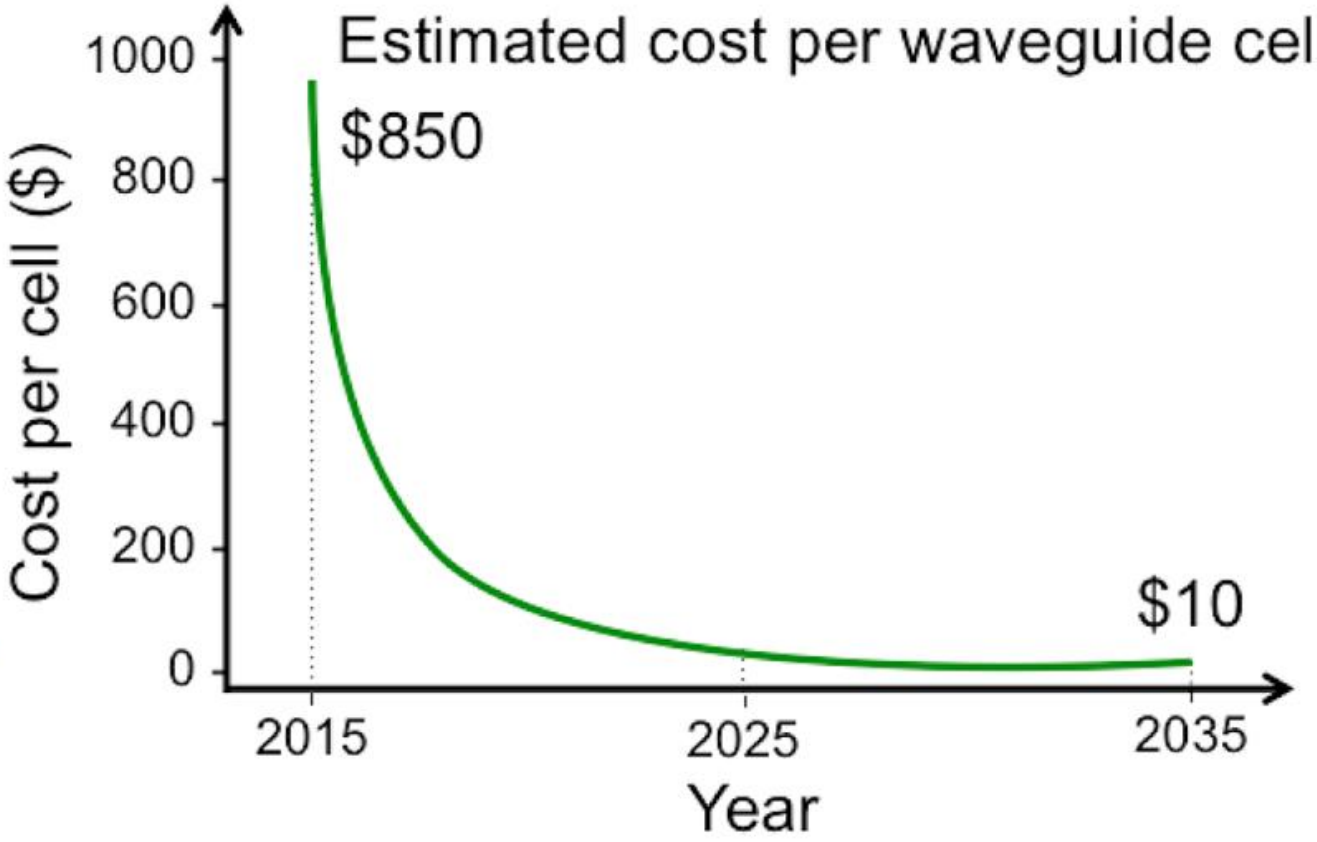
- TECHNICAL SUPPORT
- MONITORING SYSTEMS
- OPTIMIZING

HI-LIGHT SCALE UP

NEW INDUSTRIES

- FUEL
- FERTILIZER
- WATER


Price history of silicon PV cells in $ per watt
$/watt
90
80
70
60
50
40
30
20
10
$76.67
$0.36
1977
1982
1986
1990
1994
1998
2002
2006
2010
2014
Source: Bloomberg, New Energy Finance & pv.energytrend.com


Estimated cost per waveguide cell
Cost per cell ($)
1000
800
600
400
200
0
$850
$10
2015
2025
2035
Year

Earth / Ecosystem as Carbon Sink

9 tons / acre from trees
1.5 tons / acre from compost
11 billion tons / year if we restore Peatlands by 2030.

Source: Guardian 2017

DE – IP

US 9,518,248 and China 103314096 (Pending Europe 20110841822) + Continuance-In-Part (US 15/351,715)

- Waveguide light delivery mechanism coupled with the reactant transport.

US patent 9,523,070

- Improved methods of introducing and concentrating CO2.

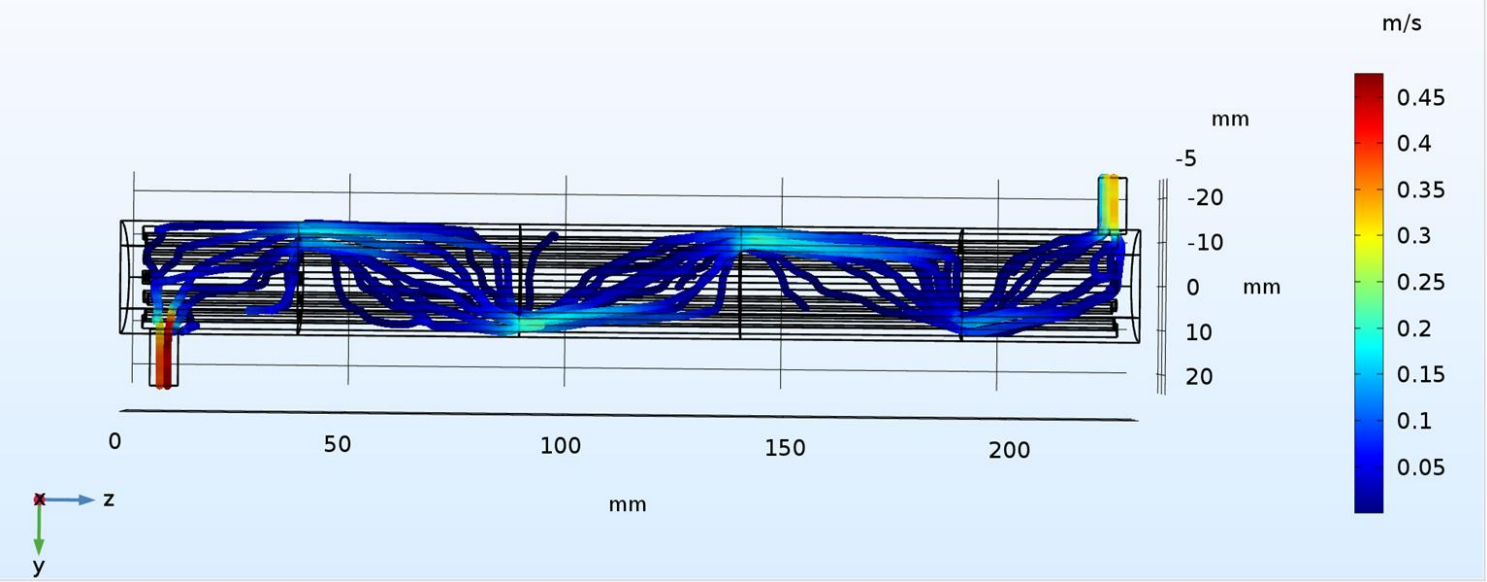
Provisional (US 62/422,342)

- Nanoparticles for CO2 capture and conversion

Plan to file more provisional patents and broaden our portfolio in next 6 months. Funding will come from Carbon Xprize in form of convertible note.

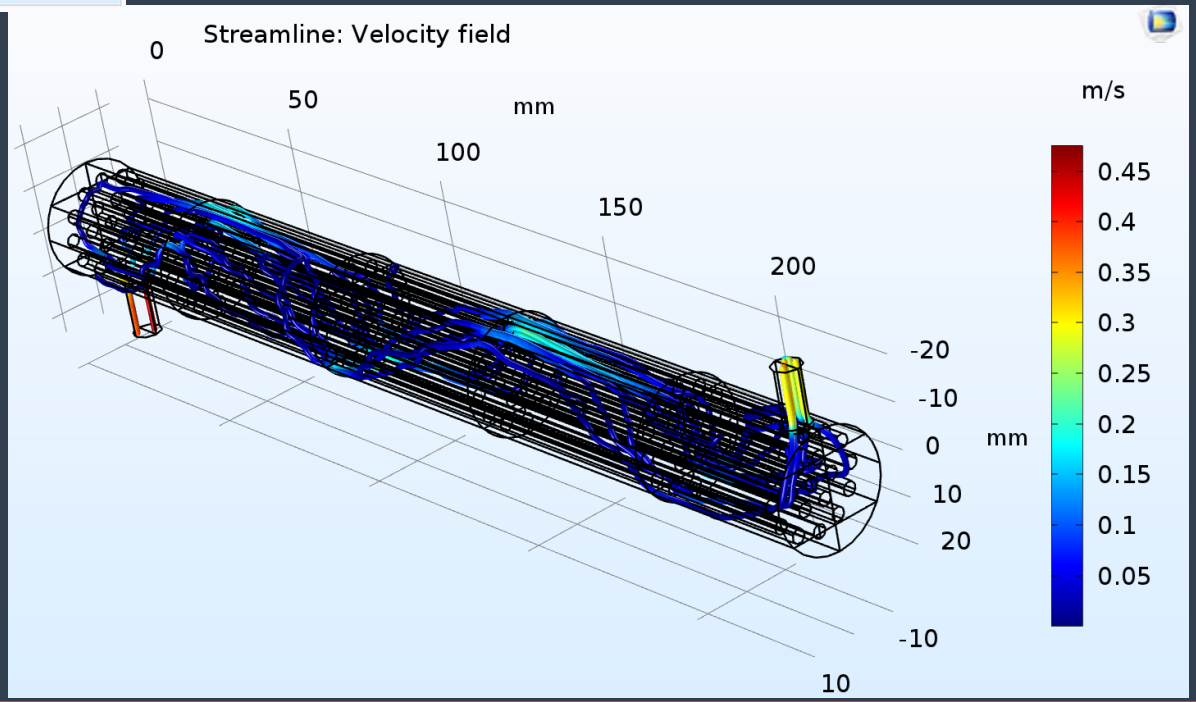
Dimensional Energy

- Market competitive solar fuel production
- Cohesive multi-disciplinary team
- Validation:
  NSF
  Shell Game Changer
  Carbon XPrize



Modeling to optimize flow

Light distribution tuned with flow



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