



GHOSTFIRE®



LIGHTING

THE

FUTURELIGHTING

THE

FUTURELIGHTING

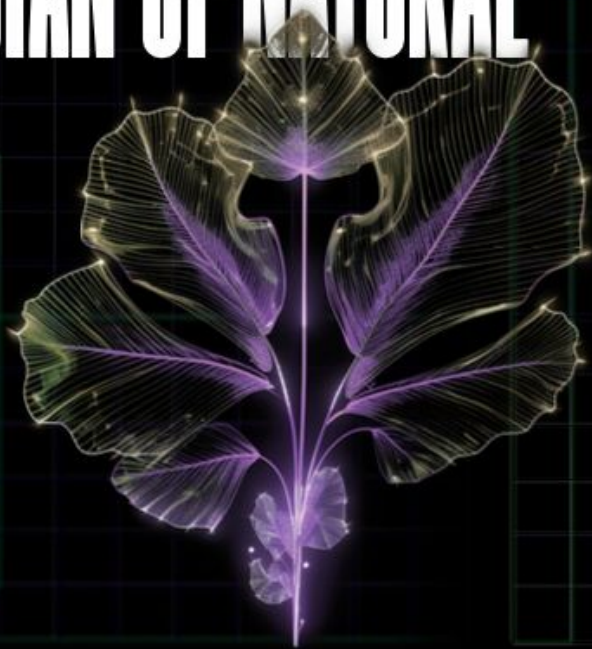
THE

FUTURE

*Synthetically
Engineered*

*Bioluminescent
Plants*

GHOSTFIRE. THE NEW GUARDIAN OF NATURAL LIGHT.



We are leading a prismatic plant-based *revolution*. Guiding humanity's path into a world where light is natural and life giving. Rather than artificial and energy depleting.

No longer will power stations struggle to keep up with the demands of lighting overcrowded cities.

No more will the ecological footprint of electric light leave a blemish on the environment.

No gardens will rely on wires and electricity to submerge the landscape in surreal glowing ambience.

Today marks a reawakening of humanity's benevolent consciousness. One that seeks solutions that are sustainable. Rather creating problems that are terminal.

We are the generation that knows what we are truly capable of. The good, the bad and the naturally beautiful.

We are GhostFire. And we are growing the planet of tomorrow.



Astral Lighting Corp.

LEADING THE FUTURE
LUMINA THE
PROFESSIONAL
THE
LEADING THE FUTURE
PROFESSIONAL
THE
LEADING THE FUTURE
PROFESSIONAL

STFEIRE®

BACKGROUND

TFIRE®

LEADING THE FUTURE
LUMINA THE
PROFESSIONAL
THE

(IR)

Plants have shaped our planet over millions of years.

For *700 million* years
plants have created
life-sustaining
oxygen

For *2 million* years
plants have provided
life-sustaining
nutrients

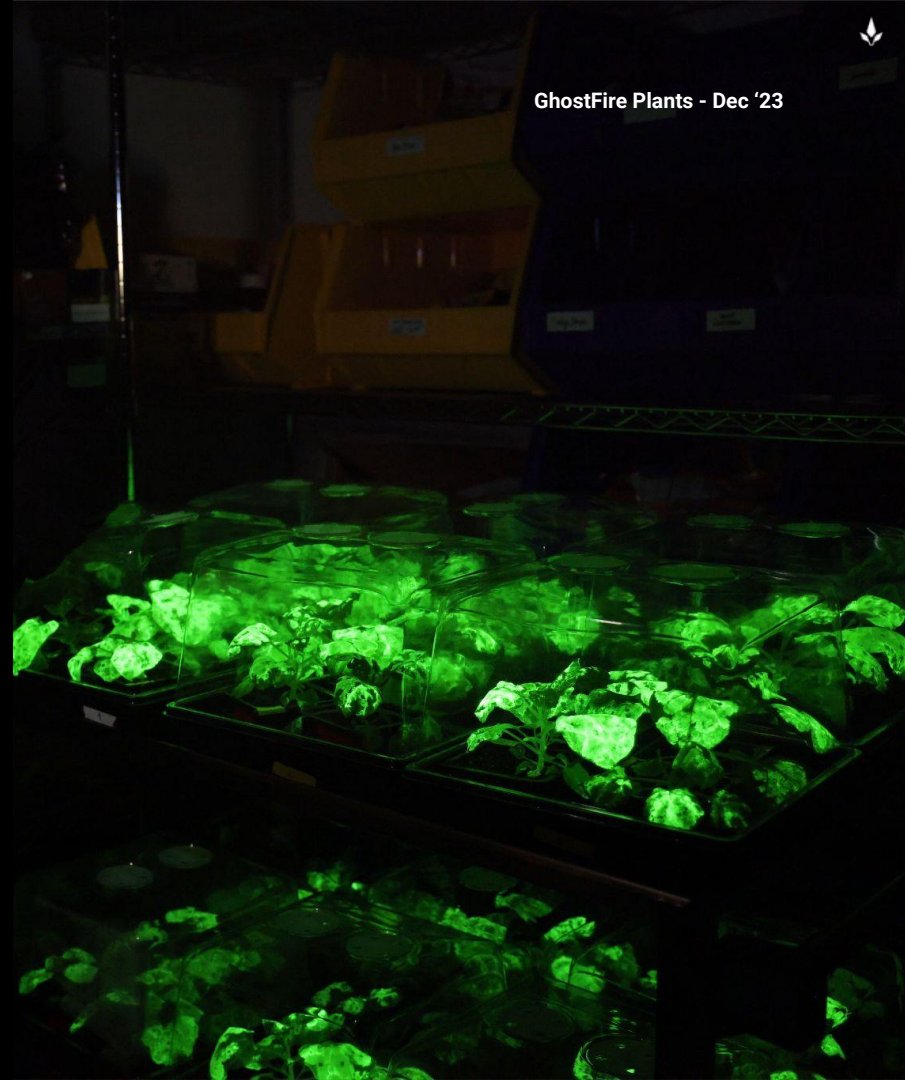
For *0.5 million* years
plants have generated
life-sustaining
energy



Naturally Engineering *A Brighter* Future.
Welcome to Ghostfire.



The Future
is already here.





STFIRE®



Astral Lighting Corp.

LEADING THE FUTURE
LIGHTING THE FUTURE
THE FUTURE IS NOW
LEADING THE FUTURE
LIGHTING THE FUTURE
THE FUTURE IS NOW

IMAGINE

Live among the *light*. Imagine a glowing new world at night, lit with *natural light*.

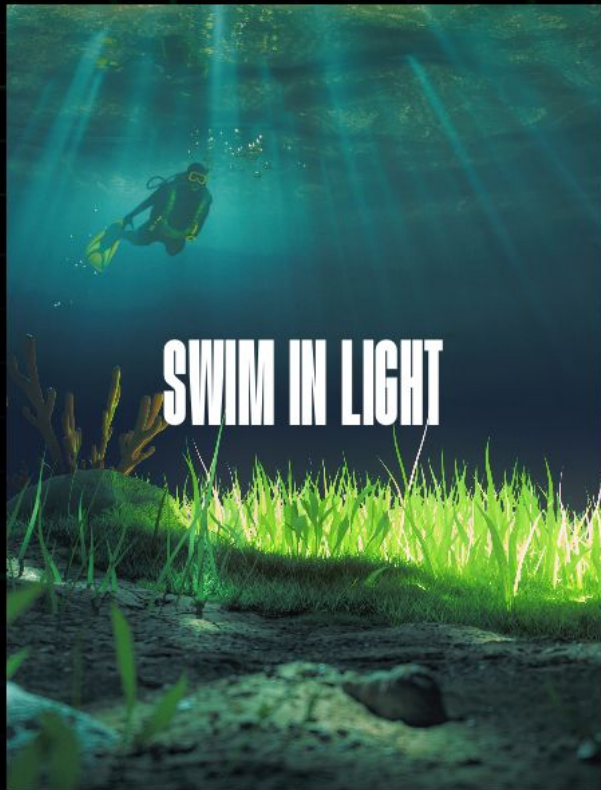
TFIRE®

THE FUTURE IS NOW
THE FUTURE IS NOW
THE FUTURE IS NOW



CONFIDENTIAL

Live among the light. Imagine a glowing new world
at night, lit with natural light.



ARTIFICIAL LIGHTING

Light pollutions impact on our environment, health and wellbeing.

Negative impacts of modern, *artificial* lighting



Energy Consumption

Even LED-lighting requires large amounts of electricity when used at scale - burdening our finite supply of fossil fuels.

Ecological Destruction

Traditional lighting disrupts the natural patterns of all life on Earth, ranging from fish and insects to birds, plants and even humans.

19% Of the world's energy consumption

Medically *Unhealthy*

Blue light—the kind used in cell phones and LEDs - is even more harmful on the health of humans and wildlife than other forms of lighting.

[HTTPS://WWW.PRESCRIPTIVEDATA.IO/CONTENT/CHART-OF-THE-DAY/LIGHTING-IN-CITIES-ACCOUNT-FOR-19-OF-WORLDS-TOTAL-ELECTRICITY-CONSUMPTION](https://www.prescriptivedata.io/content/chart-of-the-day/lighting-in-cities-account-for-19-of-worlds-total-electricity-consumption)

LIGHTING

Rooted in the Earth. Invested in its future.

The time has come to make this change. Our environment is suffering from the impacts of artificial light.

THE
NEW YORKER

IS ARTIFICIAL LIGHT POISONING THE PLANET?

A Swedish ecologist argues that its ubiquity is wrecking our habitats—and our health.

By Adam Gopnik
February 20, 2023



Among the many looming ecological disasters that terrify us today, one that only a handful of people have contemplated as sufficiently looming and terrifying is the loss of the bats in our belfry. According to “[The Darkness Manifesto](#)” (Scribner), by the Swedish ecologist Johan Eklöf, most churches in southwest Sweden had bat colonies back in the nineteen-eighties, and now most of them don’t. Light pollution, his research suggests, has been a major culprit: “District after district has installed modern floodlights to show the architecture it’s proud of, all the while the animals—who have for centuries found safety in the darkness of the church towers and who have for 70 million years made the night their abode—are slowly but surely vanishing from these places.”

OH health Life, But Better Fitness Food Sleep Mindfulness Relationships

Doctors issue warning about LED streetlights

By Nicholas J. Rapp / Science, The Conversation
Updated on 06/07/23, 7:00 AM EDT



Two problems with LED street lighting

An incandescent bulb has a color temperature of 2400K, which means it contains far less blue and far more yellow and red wavelengths. Before streetlights, we burned wood and candles at night; this artificial light has a CRI of about 100%, which enhances and allows us to see things we have seen in only artificial light.

The new “white” LED street lighting which is rapidly being installed in cities throughout the country has two problems, according to the study. The first is discomfort and glare. Because LED light is so concentrated and has high blue content, it can cause severe glare, resulting in a negative correlation to the road. Blue light causes more in the human eye than the longer wavelengths of yellow and red, and sufficient levels can [impair the ability to safely driving or walking at night](#).

You can reduce this severity if you look directly into one of the control lights on your new street lighting or other appliances. It is very difficult to do because it hurts. Street lighting can have the same effect, especially if it is blue content is high and there is not appropriate shielding.


The other issue addressed by the ADA statement is the impact on human circadian rhythms.

SCIENCE

Light pollution is messing with coral reproduction

More than 7 million square miles of coastal ocean are possibly affected by increasingly common nighttime lights.

By DANIEL BARNARD, UNIVERSITY OF EXETER, 11 JULY 2023



The light pollution from cities along the coast can trick the corals into opening outside of their optimal reproductive times, according to a study published May 13 in the journal *Nature Communications*.

“Corals are critical for the health of the global ocean, but are being increasingly damaged by human activity. This study shows it is not just changes in the ocean that are impacting them, but the continued development of coastal cities as we try and accommodate the growing global population,” Thomas Barrett, a study co-author and conservation ecologist at the University of Plymouth in the United Kingdom, says in a statement.

NATION

Are lightning bugs from night face some



Sarah Bowman
Indianapolis Star

Published 1:07 p.m. ET July 2, 2023

Chasing lightning bugs

You know how it goes, you clap your hands in a split second, and a small flash between your

In North America, there are fireflies emitting beetles, and they are around for millions of years

But you may feel as if you are a child when you were younger, chasing a beetle that once was so common, but has become a thing of the past

Lightning bugs or fireflies



Astral Lighting Corp.

ILLUMINATING THE FUTURE
THE FUTURE OF LIGHTING
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THE FUTURE OF LIGHTING
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THE FUTURE OF LIGHTING

STFIIRE®

BENEFITS

TFIRE®

ILLUMINATING THE FUTURE
THE FUTURE OF LIGHTING
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ILLUMINATING THE FUTURE
THE FUTURE OF LIGHTING



Potential impact that illuminate both science and imagination.

THE GHOSTFIRE BENEFITS

Environmentally *Net Positive*



Zero energy consumption, no negative impact on human or animal health, no maintenance and negative carbon footprint.

Visually *Stunning*



Must see species with unique ability to change color and texture creates an almost dreamlike "Avatar" like experience.

Spatially Sentient



Plants can be programmed with sentinel-like capabilities such as glowing upon the detection of toxins, chemicals, or compounds / cells.



Astral Lighting Corp.

LEADING THE MARKET
ADAPTING THE
THE
PRODUCTION
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LEADING THE MARKET
ADAPTING THE
THE
PRODUCTION

STFEIRE®

LIGHTING

TFIRE®



THE
PRODUCTION
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PRODUCTION



Man-made lighting is responsible for at least 15% of global electricity consumption.

Zero Electricity Consumed



Truly SMART cities, made safer and more inviting with glowing trees and plants along streets and sidewalks

Buildings illuminated by plants that grow up the walls

Homes lit by house plants that light-up when you walk by

Cities where stars are finally visible again

Human and animals living in peaceful, naturally lit environments

Municipal lighting bills reduced by 100%

Lighting-related carbon emissions reduced by 100%



GHOSTFIRE TARGET MARKETS



COMMERCIAL REAL ESTATE & SMART CITY

Street Lights
Building Elements
City Scaping
Landscaping
Campus Lighting

RESIDENTIAL REAL ESTATE

Outdoor Lighting
Indoor Lighting
Building Elements
Landscaping
Decor

DESTINATIONS

Ecotourism
Night Sports
Hotels & Resorts
Casinos
Museums

BRAND PARTNERSHIPS

Events
Product Placement
Entertainment
Experiences

CONSUMER

Indoor Plants
Outdoor Plants
Landscaping
Aquariums

TOTAL LIGHTING MARKET — \$243B

\$115B

48% OF TOTAL MARKET

Global Commercial and
Smart City Lighting Market

\$65B

27% OF TOTAL MARKET

Global Residential
Lighting Market

\$63B

25% OF TOTAL MARKET

Global Destination
Lighting Opportunity

LEVERAGING GLOBAL PARTNERS FOR REACH AND SCALE

01

Brand Partners

GhostFire's Brand Partners (including Influencers) drive awareness and interest for both Consumer and Commercial markets.

02

Grow Partners

Leveraging experienced Grow Partners drives quicker scale and less capex and opex.

03

Distribution Partners

GhostFire's relationships with Global Distributors ensures reach and efficiency of Consumer and Commercial channels.

THREE YEAR GO TO MARKET PLAN

Series Seed 1 Raise

Confidential Campaigns re:
Influencers, Key Partners and
SAB/Advisory Boards

Launch Brand Partnerships Platform

Temporary installations with
Brands and first sales to
Commercial Market (Destinations)

Expanded B2B Sales

Direct sales to Commercial
Real Estate Market (inc.
Universities & Colleges)



FINANCIAL PROJECTIONS In \$m's

	2024	2025	2026	2027	2028
TOTAL REVENUE					
Brand Partnerships	\$ -	\$ 4.5	\$ 6.0	\$ 12.0	\$ 14.9
Consumer Sales	-	0.1	2.2	6.5	13.6
Commercial Sales	-	4.1	13.7	32.8	53.6
Total Revenue	\$ -	\$ 8.7	\$ 21.9	\$ 51.2	\$ 82.1
TOTAL REVENUE GROWTH					
<i>Sequential</i>					
Brand Partnerships	-	-	32%	100%	24%
Consumer Sales	-	-	2370%	198%	109%
Commercial Sales	-	-	234%	139%	64%
Total Revenue	-	-	151%	135%	60%

	2024	2025	2026	2027	2028
COMMERCIAL SALES REVENUE					
Commercial Real Estate	\$ -	\$ -	\$ 3.0	\$ 8.8	\$ 16.4
Residential Real Estate	-	-	-	2.9	7.0
Destinations/Experiences	-	4.1	10.7	21.1	30.2
Total Commercial Sales Revenue	\$ -	\$ 4.1	\$ 13.7	\$ 32.8	\$ 53.6
COMMERCIAL SALES REVENUE GROWTH					
<i>Sequential</i>					
Commercial Real Estate	-	-	-	193%	86%
Residential Real Estate	-	-	-	-	143%
Destinations/Experiences	-	-	161%	97%	43%
Total Commercial Sales Revenue	-	-	234%	139%	64%

- Revenue contribution starts in FY25:
 - \$4.5m from Brand Partnerships
 - \$4.1m from Commercial Sales
- While Brand Partnerships continue to be a driver of Revenue and brand awareness, Commercial Sales Revenue quickly dominates Total Revenue (projected to comprise 65% of Total Revenue by 2028).
- Some plant production will be leveraged for Consumer Sales however, by 2028 Consumer Sales Revenue is projected to only be ~18% of Total Revenue.
- Commercial Revenue includes the following:
 - Destinations revenue begins in 2025. By 2028, this vertical comprises ~55% of Total Commercial Revenue.
 - Commercial Real Estate revenue begins in 2026. By 2028, this vertical comprises ~30% of Total Commercial Revenue.
 - Residential Real Estate revenue begins in 2027 and contributes < 15% to 2028 Total Commercial Sales.

FINANCIAL PROJECTIONS In \$m's

	2024	2025	2026	2027	2028
Revenue					
Brand Partnerships	\$ -	\$ 4.5	\$ 6.0	\$ 12.0	\$ 14.9
Consumer Sales	-	0.1	2.2	6.5	13.6
Commercial Sales	-	4.1	13.7	32.8	53.6
Total Revenue	\$ -	\$ 8.7	\$ 21.9	\$ 51.2	\$ 82.1
Total COGS	-	2.8	6.9	16.2	26.2
Total Gross Profit	-	5.9	15.0	35.0	55.9
<i>Gross Profit Margin</i>	<i>n/a</i>	<i>68%</i>	<i>68%</i>	<i>68%</i>	<i>68%</i>
Operating Expenses					
Sales & Marketing	1.1	3.2	6.5	11.5	17.3
Plant Technologies	3.3	5.9	8.3	10.8	13.4
Corporate	1.3	1.6	3.1	5.3	8.4
Total OpEx	5.6	10.6	18.0	27.7	39.2
Total EBITDA	(5.6)	(4.7)	(3.0)	7.3	16.7
<i>EBITDA %</i>	<i>n/a</i>	<i>-54%</i>	<i>-14%</i>	<i>14%</i>	<i>20%</i>
Other Income (Expense)	(0.1)	(0.3)	(0.4)	(0.5)	(0.5)
Net Income	\$ (5.8)	\$ (5.0)	\$ (3.5)	\$ 6.8	\$ 16.2

Cash Flows from Operations	\$ (2.9)	\$ (5.7)	\$ (2.1)	\$ 4.7	\$ 17.2
Cash Flows from Investing	(0.7)	(0.9)	(0.2)	(0.2)	(0.2)
Cash Flows from Financings	10.0	-	-	-	-
Net Cash Flow	\$ 6.4	\$ (6.6)	\$ (2.3)	\$ 4.6	\$ 17.0
Ending Cash Balance	\$ 7.6	\$ 1.0	\$ (1.3)	\$ 3.2	\$ 20.2

- Gross Profit reflects 68% gross margin on plants given unique nature, exclusivity of market and replacement of traditional lighting.
- Sales & Marketing investment includes direct sales to Commercial Market and use of Distribution Partners in out years. Marketing discretionary alone accounts for ~10% of OpEx.
- Plant Technologies includes the science and plant biology departments. These expenses scale nicely as breakthroughs are leveraged across all plant species.
- By 2028 (5 years post GTM) EBITDA reaches 20%.

INTRODUCING GHOSTFIRE SYNTHETICALLY ENGINEERED BIOLUMINESCENT PLANTS

01 Luciferin Utilization

Luciferins are organic substances present in luminescent organisms and produce light when oxidized by its respected luciferase.

These enzymes catalyze the oxidation of luciferins, causing a visible glow.

02 Synthetic Genomics

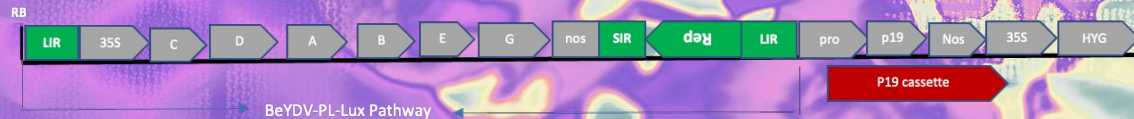
Using synthetic genomics, Ghostfire extracts and/or synthesizes luciferin and then edits it into other plants.

MAP -> SPLICE -> TEST -> COMMERCIALIZE

03 Sustained Reproduction

Ghostfire plants are neither sprayed nor coated. Their DNA is engineered to create bioluminescence which persists with plant growth.

GhostFire Construct - Bacterial



Successfully integrated the fungal and bacterial pathways into model species

Optimizing genomic constructs with addition of novel genes to increase brightness

GhostFire construct generates autoluminescence observed by the naked eye

2023

2024

GhostFire Construct - Fungal



ACHIEVING AUTOLUMINESCENCE VIA FUNGAL AND BACTERIAL PATHWAYS

GHOSTFIRE SCIENCE

SHIKIMATE PATHWAY

PYRUVIC ACID
PHENYLALANINE
CINNAMIC ACID
COUMARIC ACID
CONIFERALDEHYDE

INTERMEDIATES

FERULOYL - COA
CCR
CONIFERALDEHYDE
LIGNINS

CAFFEYOYL PYRUVATE

CAFFEYOILPYRUVIC ACID
OXYLUCIFERIN
CPH

H3H

HAL COA
ERIODICTYOL CHALCONE
ERIODICTYOL
FLAVONOIDS
ANTHOCYANINS
CONDENSED TANNINS

LUZ

FUNGAL LUCIFERIN
3-HYDROXYHISPIDIN

CAFFEIC
ACID
CYCLE

Fungal Nuclear Pathway

GHOSTFIRE SCIENCE

SHIKIMATE PATHWAY

PYRUVIC ACID
PHENYLALANINE
CINNAMIC ACID
COUMARIC ACID
CONFERRALDEHYDE

INTERMEDIATES

FERULOYL-COA
CCR
CONFERRALDEHYDE
LIGNINS

CAFFEYOYL PYRUVATE

CAFFEYOYL PYRUVIC ACID
OXYLUCIFERIN
CPI

H3H

MAL-COA
ERIODICTYOL CHALCONE
ERIODICTYOL
FLAVONOIDS
ANTHOCYANINS
CONDENSED TANNINS

LUZ

FUNGAL LUCIFERIN
3-HYDROXYHISPIDIN

CAFFEIC ACID CYCLE

Fungal Nuclear Pathway

GHOSTFIRE SCIENCE

SHIKIMATE PATHWAY

PYRUVIC ACID
PHENYLALANINE
CINNAMIC ACID
COUMARIC ACID
CONFIFERALDEHYDE

INTERMEDIATES

FERULOYL - COA
CCR
CONFIFERALDEHYDE
LIGNINS

CAFFEYOYL PYRUVATE

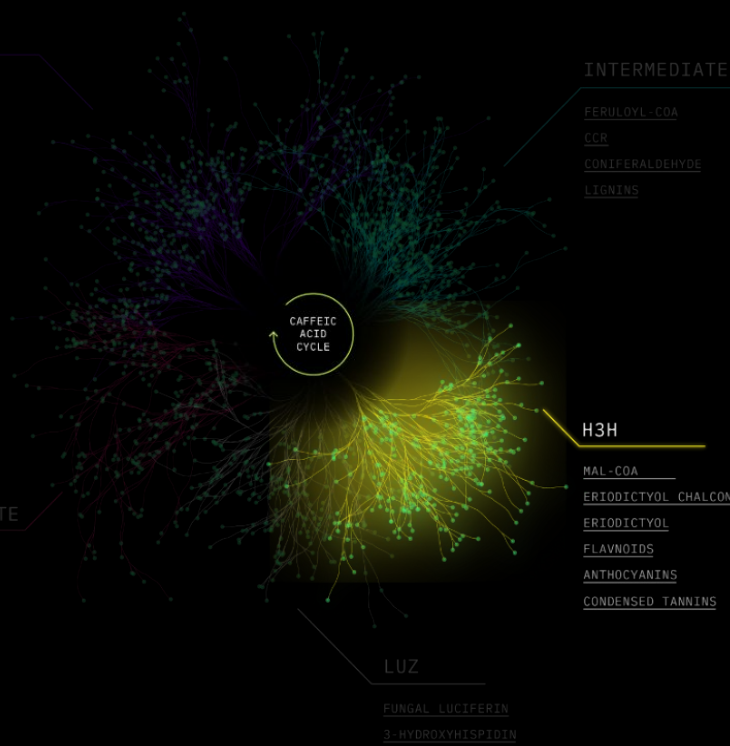
CAFFEYOILPYRUVIC ACID
OXYLUCIFERIN
CPH

H3H

MAL - COA
ERIODICTYOL CHALCONE
ERIODICTYOL
FLAVNOIDS
ANTHOCYANINS
CONDENSED TANNINS

LUZ

FUNGAL LUCIFERIN
3 - HYDROXYHISPIDIN



Fungal Nuclear Pathway

GHOSTFIRE SCIENCE

SHIKIMATE PATHWAY

PYRUVIC ACID
PHENYLALANINE
CINNAMIC ACID
COUMARIC ACID
CONFERRALDEHYDE

INTERMEDIATES

FERULOYL - COA
CCR
CONFERRALDEHYDE
LIGNINS

CAFFEYOYL PYRUVATE

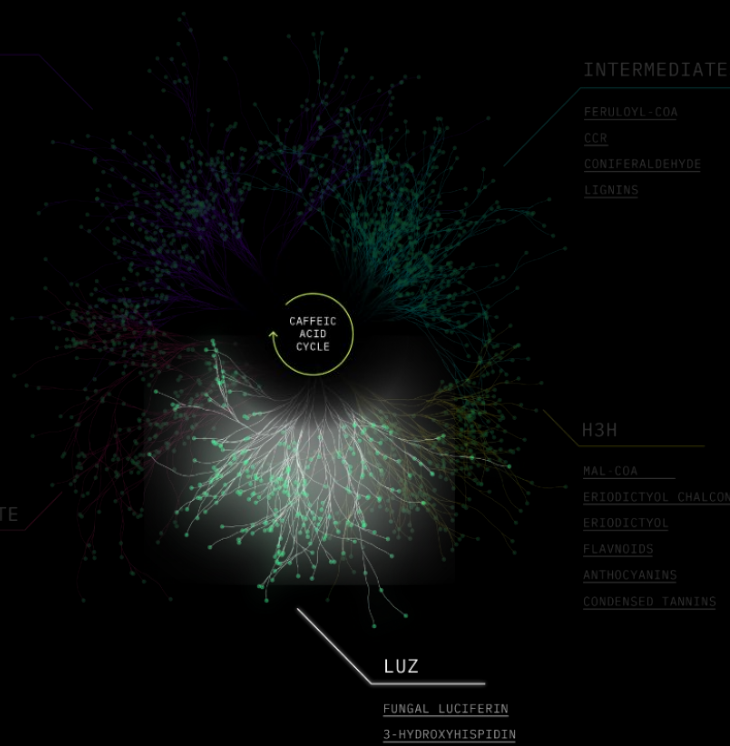
CAFFEYOILPYRUVIC ACID
OXYLUCIFERIN
CPH

H3H

MAL COA
ERIODICTYOL CHALCONE
ERIODICTYOL
FLAVONOIDS
ANTHOCYANINS
CONDENSED TANNINS

LUZ

FUNGAL LUCIFERIN
3-HYDROXYHISPIDIN



Fungal Nuclear Pathway



GHOSTFIRE SCIENCE

SHIKIMATE PATHWAY

- PYRUVIC ACID
- PHENYLALANINE
- CINNAMIC ACID
- COUMARIC ACID
- CONFERRALDEHYDE

INTERMEDIATES

- FERULOYL - COA
- CCR
- CONFERRALDEHYDE
- LIGNINS

CAFFEYOYL PYRUVATE

- CAFFEOYL PYRUVIC ACID
- OXYLUCIFERIN
- CPH

H3H

- MAL COA
- ERIODICTYOL CHALCONE
- ERIODICTYOL
- FLAVONOIDS
- ANTHOCYANINS
- CONDENSED TANNINS

LUZ

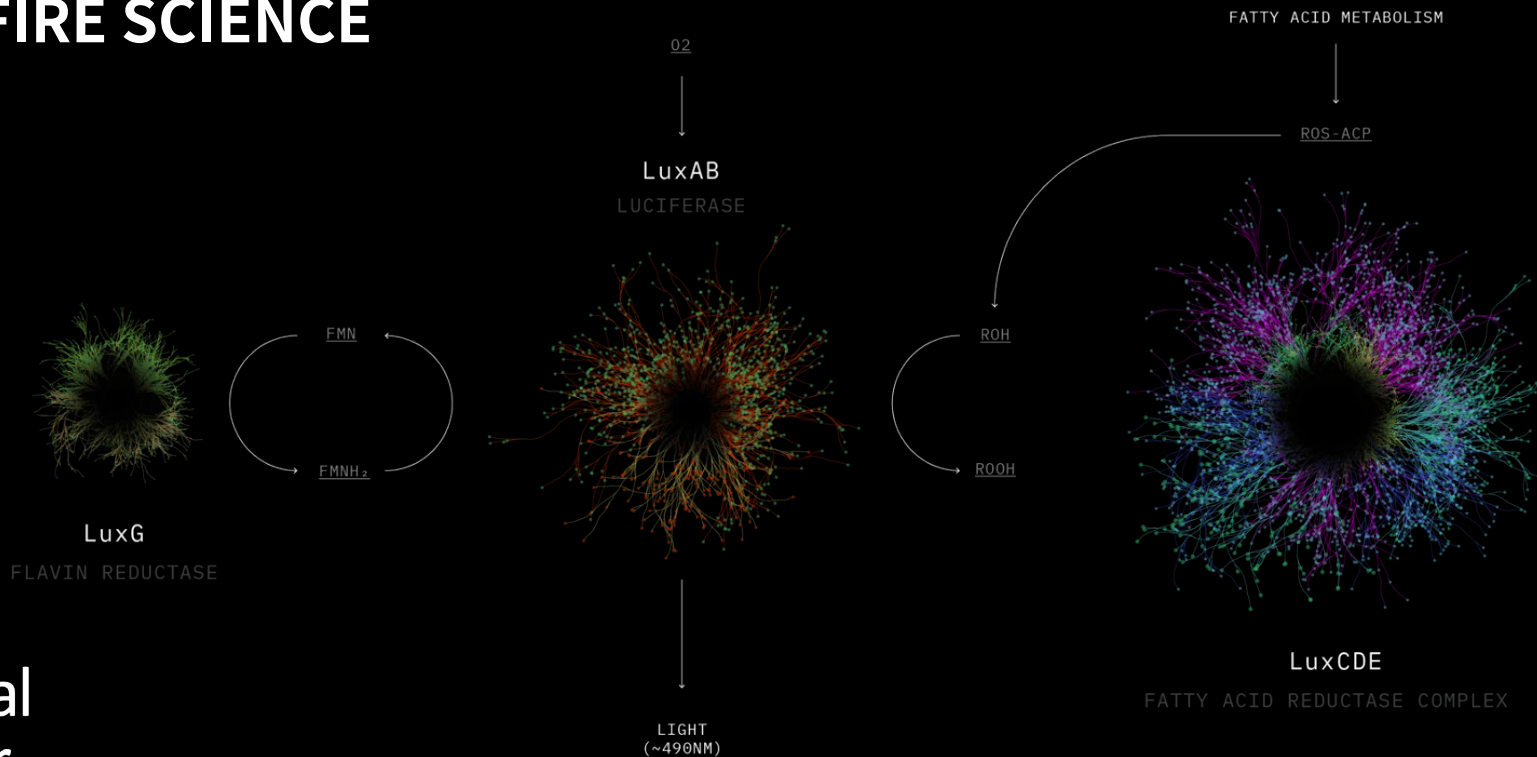
- FUNGAL LUCIFERIN
- 3-HYDROXYHISPIDIN

CAFFEIC ACID CYCLE

Fungal Nuclear Pathway



GHOSTFIRE SCIENCE



Bacterial *Nuclear* Pathway



Science of

EVOLUTION

Chemistry

Substrate Quantification and Optimization

Protein Quantification and Optimization

Mutagenesis for Color generation

Computational *Biology*

Ghostfire Custom Plant Annotation Pipeline

Substrate x Luciferase *in silico* modeling and directed mutagenesis

Logic Gates

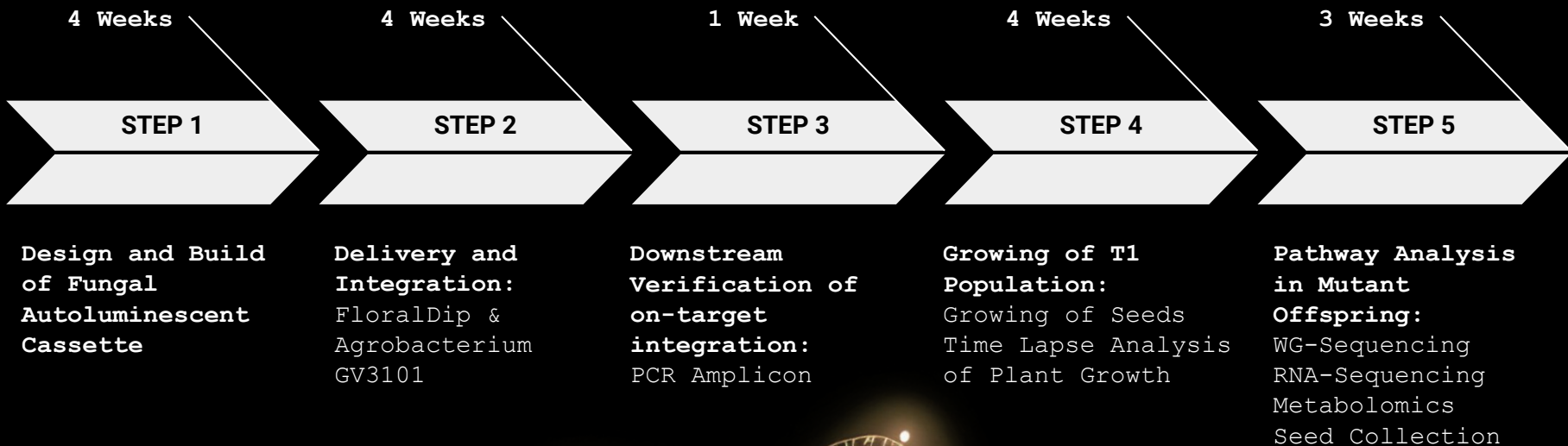
Genome *Engineering*

Custom GF construct per plant species

Regulatory Element Discovery
synthetic promoters
mSTARR-Seq
Pb enhancer hunting

PLANT ENGINEERING PIPELINE

Fungal Nuclear Pathway



GHOSTFIRE SPECIES



Arabidopsis



Nicotiana

Phase 1
Model Plant Species - Fast
Iterations for proving
GhostFire Constructs



Polka Dot Plant
*Hypoestes
phyllostachya*
[House &
Bedding Plant]



Perennial Rye
Grass
[Turf]



Thalassia
Saltwater
[Ecotourism,
Carbon
Sequestration]

Phase 2
First GTM Species - Focusing on Key
Partnerships and Feasibility

GHOSTFIRE SPECIES



Elephant Ears



Bamboo



Rose

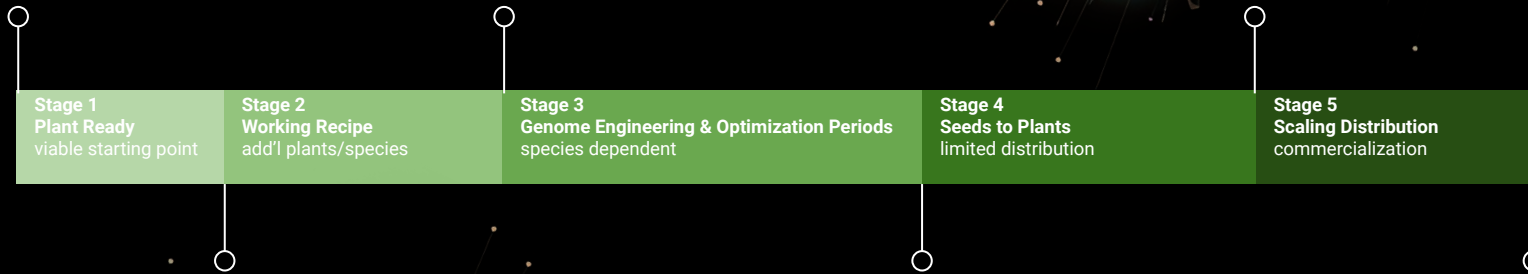
Phase 3
GTM Species

STAGES OF NEW SPECIES INTRODUCTION

Acquire Plant/Seeds

Working Recipe Defined

Min Amount of Plants

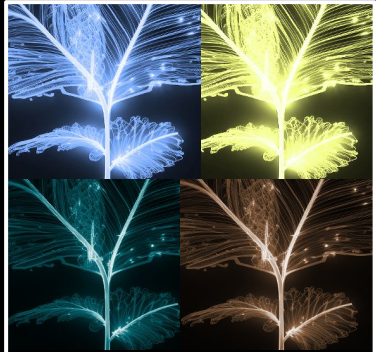


Science Ready Plant

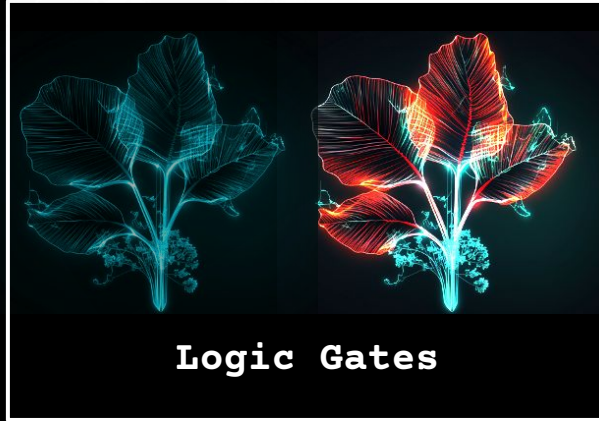
Plant Glows Green!

Distribution Ready

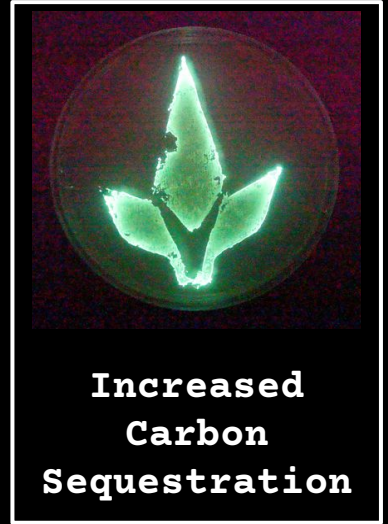
SPECIES FUTURES



**Multiple
Colors**



Logic Gates



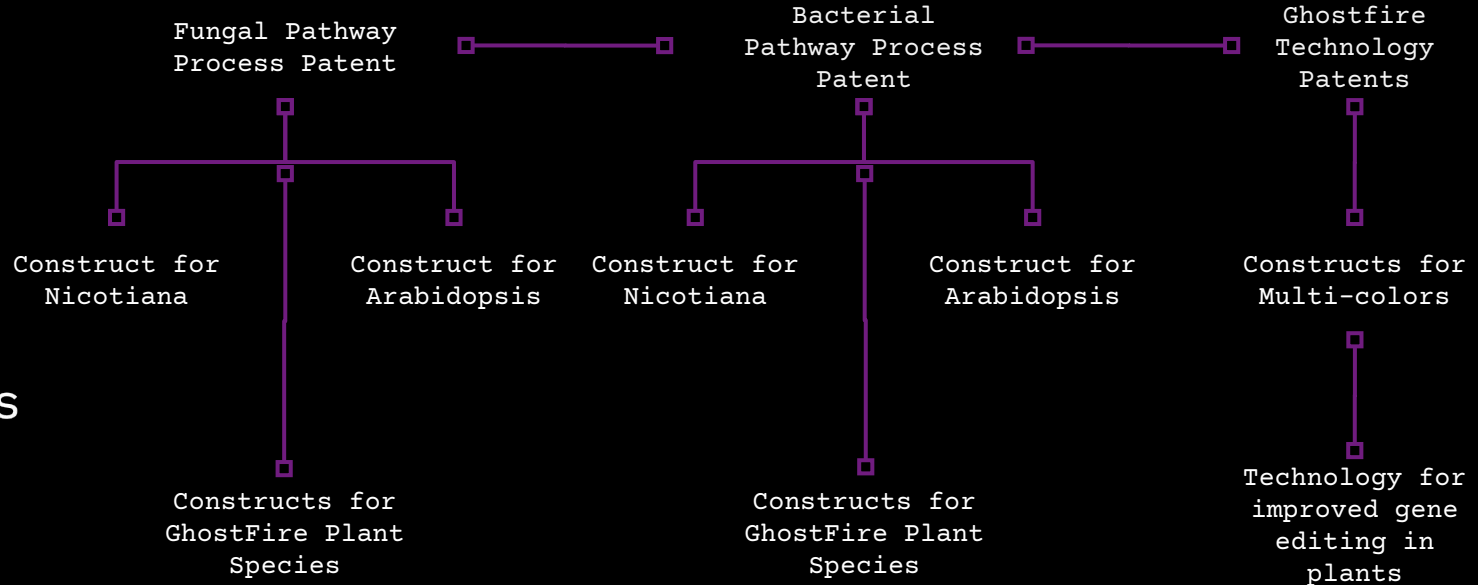
**Increased
Carbon
Sequestration**

PATENT STRATEGY

GhostFire
Stable
Integration
Constructs

Plant
Technologies

GhostFire
Autoluminescent
Plant *Process*





GEORGE CHURCH GO-FOUNDER & SCIENCE PARTNER



George Church, Ph.D. acts as the co-founder and lead scientific advisor for Ghost Fire. He is a professor at Harvard and MIT, runs the Church lab at the Harvard Medical School, and is a Core Faculty member of the Wyss Institute at Harvard where he leads the Synthetic Biology Platform. Church is a recognized leader in genomics, having pioneered a number of advances and breakthroughs that have helped advance the entire field—specifically in his work as co-founder of Colossal Biosciences, where scientists are in the process of de-extincting species like the woolly mammoth.

In 1984 with Wally Gilbert, Church developed the first direct genomic sequencing method and barcode-multiplexing tags. This led to automation and software used for the first cellular genome sequence (*Helicobacter*) in 1994, which evolved into 'in-situ sequencing' (1999) and 'next-generation sequencing' (2014).



BEN LAMM

CO-FOUNDER & PARTNER



Ben Lamm is a Texas-based serial software and tech entrepreneur and investor, renowned as the co-founder and CEO of Colossal. Driven to solve the most complex challenges facing our planet, Ben has spent more than a decade building disruptive businesses that future-proof our world.

Prior to Colossal and Ghostfire, Ben served as the founder and CEO to a number of companies, including Hypergiant, a defense-focused AI software company; Conversable, the leading conversational intelligence platform (acquired by Live Person in 2018); Team Chaos, a consumer gaming company (acquired by Zynga in 2016); and Chaotic Moon, a creative technology studio (acquired by Accenture in 2015).



CHARLES HOSKINSON & PARTNER

CO-FOUNDER



Charles Hoskinson is a Colorado-based technology entrepreneur and mathematician, best known for his presence in the cryptocurrency sector.

His professional experience is attributed to the founding of numerous blockchain and cryptocurrency platforms, such as Invictus Innovations, Ethereum, and Cardano. In 2015, he co-founded Input Output Global, Inc, a blockchain infrastructure research and engineering company. Charles also holds a variety of leadership positions in the public and private sector. He was the founding chairman of the Bitcoin Foundation's education committee and established the not-for-profit Cryptocurrency Research Group in September of 2013.

This is the future of plant-based possibilities.
This is natural light in its truest form. Created
for the *phantom* landscapes of our dreams,
this is the dawn of a new planet, a better way
of life, a brighter tomorrow—illuminated by
the *natural world*.





GHOSTFIRE®



LIGHTING

THE

FUTURELIGHTING

THE

FUTURELIGHTING

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FUTURE