FINDING A NEW MODEL

GLOBAL CLIMATE CHANGE
AND THE IMPACTS IN GOLF AND THE ENVIRONMENT

NINE BRIDGES FORUM

SENTOSA GOLF CLUB
SINGAPORE

Presented By

Andrew H. Johnston
General Manager / Director of Agronomy

Disclaimer: There is no intent to endorse products or intent to sell any products, in my discussion and presentations. At times I will or may recognize a product and or company / distributor that sells a product to illustrate an example of what we or Sentosa Golf Club may do with a product. However, at no point am I attempting to sell products for the purpose of any personal gain or to help any product make sales. This is intended to be educational and informative.

That includes all spelling mistakes.

SENTOSA GOLF CLUB
SINGAPORE

WE HAVE A PROBLEM... ...AND EVERYONE KNOWS IT

“Only a small increase in sea-level rise would imperil all of the world’s links courses before the end of the century.”

Climate Coalition

“There really isn’t anything in sustainability that isn’t good for golf businesses.”

Eric Lynge, CEO AGIF

“I think every golf course around the world is going to be impacted by climate change in one way or another. I believe golf is more impacted by climate change than any other sport aside from skiing.”

Steve Isaacs, R&A

GLOBAL CLIMATE CHANGE

FINDING A NEW MODEL

I am here to share my experiences on how Sentosa Golf Club is addressing the problem

TO SHARE THE IMPORTANCE ON WHY IT MATTERS

To outline measures that are within reach for all of us that can make such an incremental difference

SENTOSA GOLF CLUB
SINGAPORE

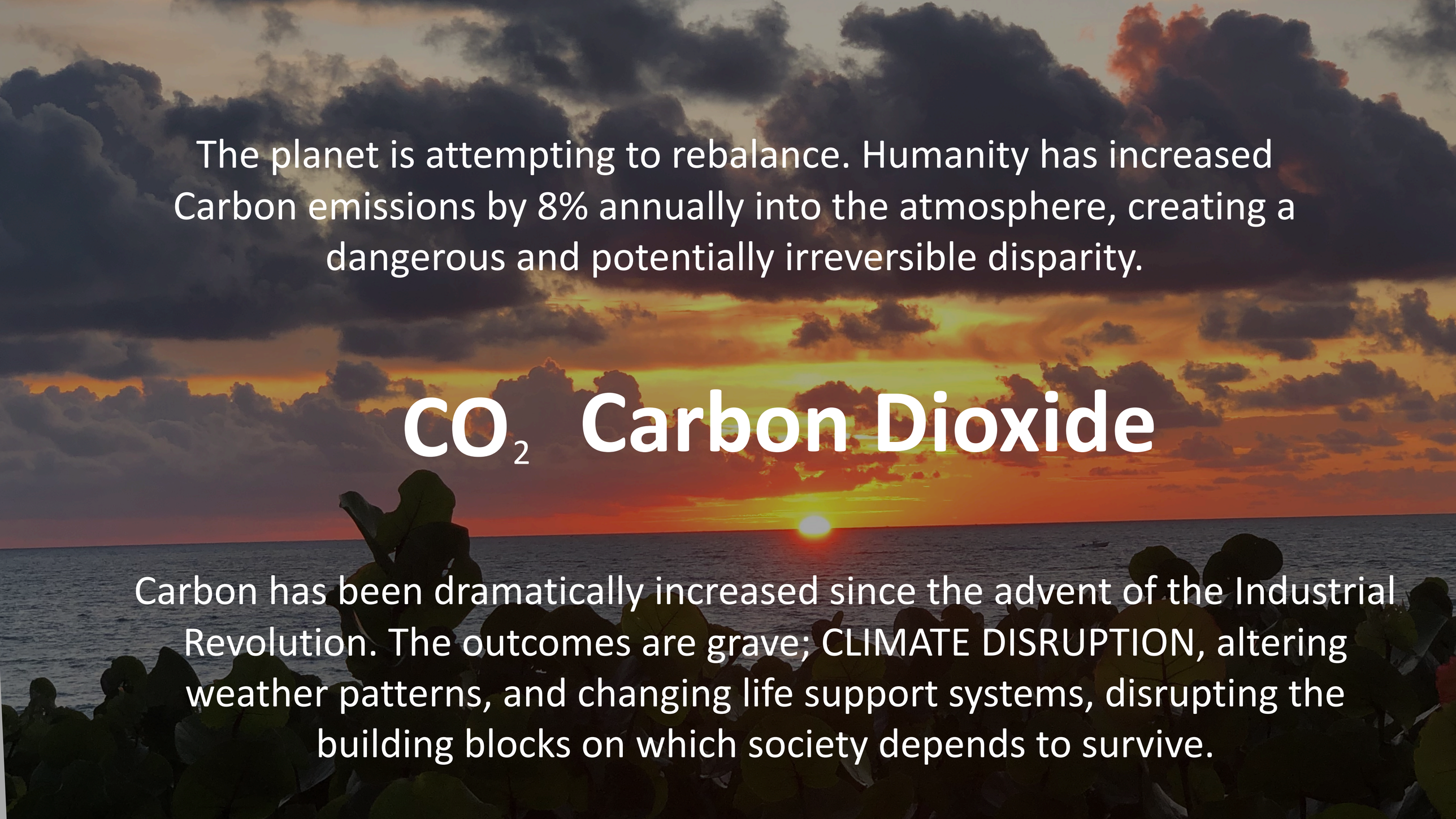
To call for us to come together as an industry; transform our behavior to better understand the positive outcomes that can be achieved

To portray the very necessary sense of urgency;

THE TIME IS NOW

SO, LET'S SET OFF WITH A RECAP FROM THE SCIENCE CLASSROOM….

SENTOSA GOLF CLUB
SINGAPORE

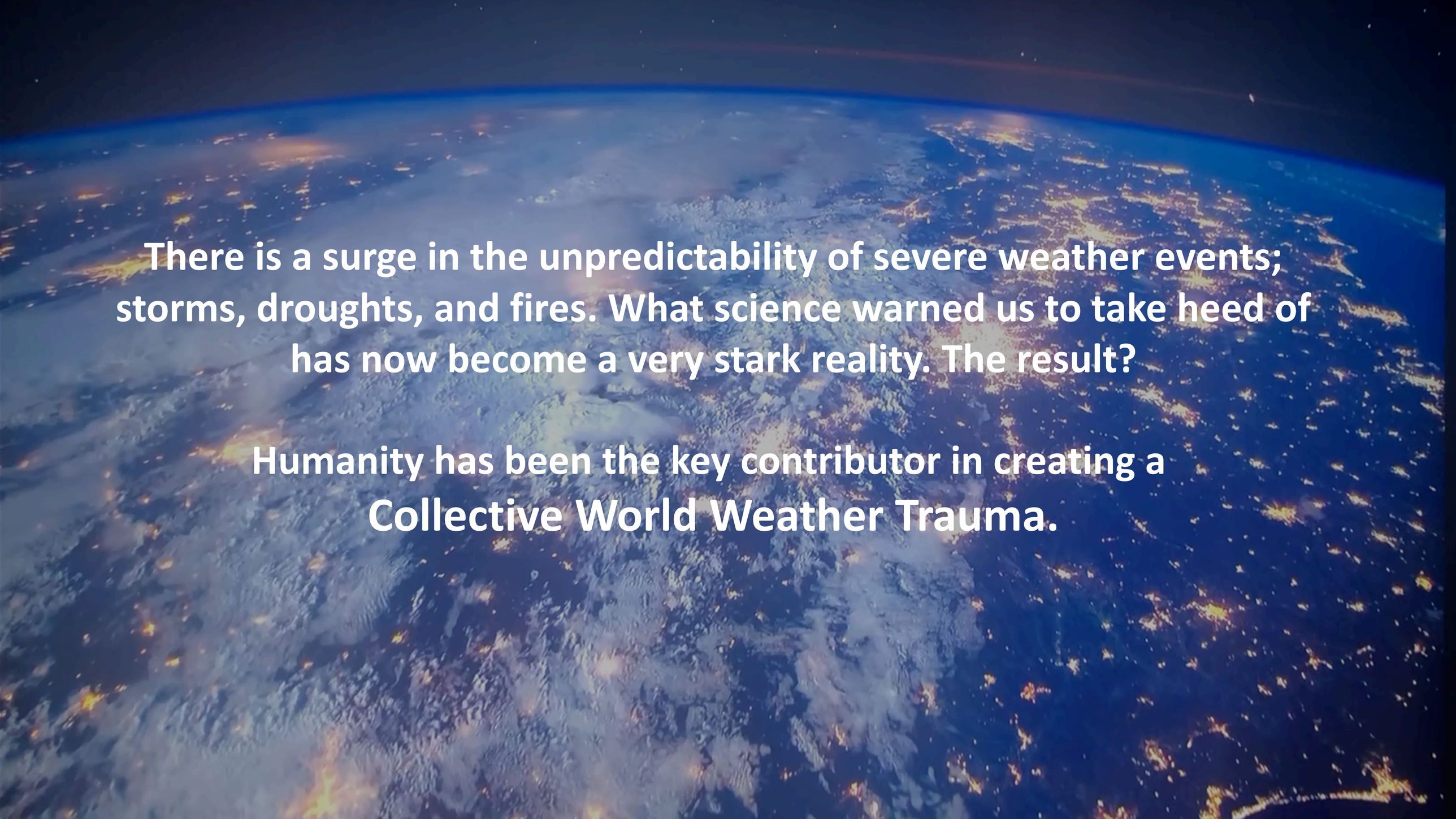


The planet is attempting to rebalance. Humanity has increased Carbon emissions by 8% annually into the atmosphere, creating a dangerous and potentially irreversible disparity.

CO_2 Carbon Dioxide

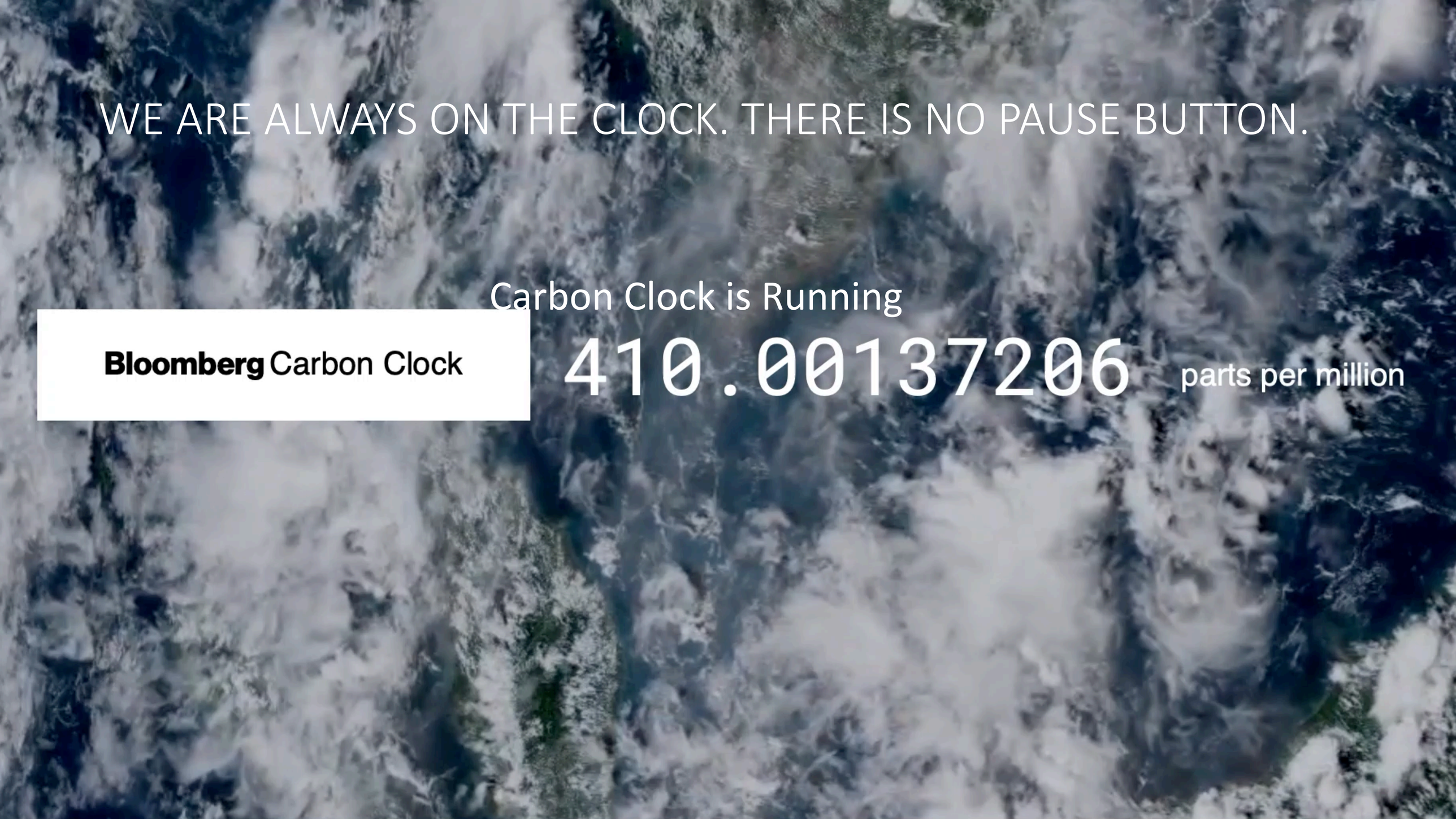
Carbon has been dramatically increased since the advent of the Industrial Revolution. The outcomes are grave; CLIMATE DISRUPTION, altering weather patterns, and changing life support systems, disrupting the building blocks on which society depends to survive.

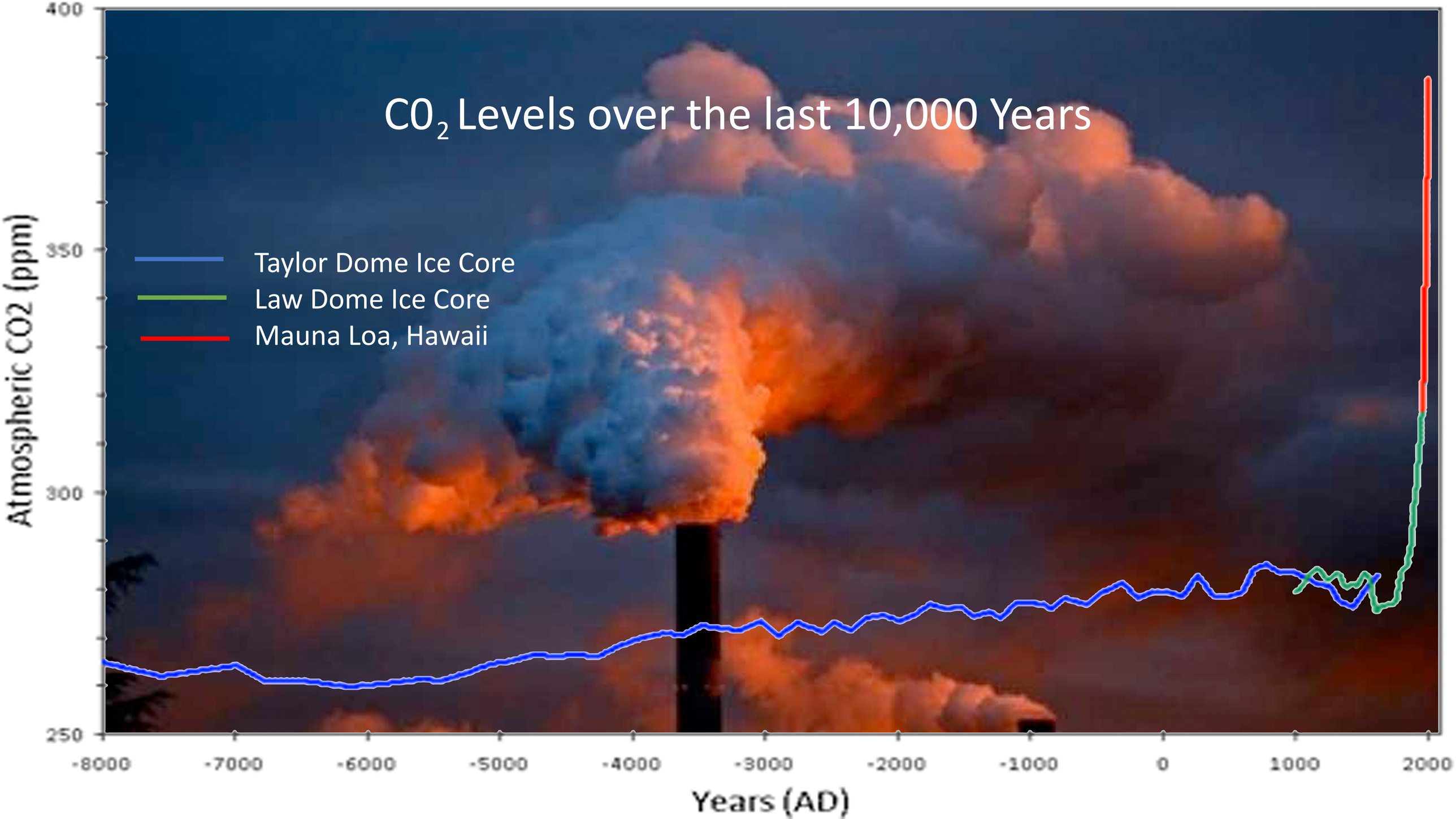

Climate Change is reducing the Arctic Sea Ice
and influencing a modification of Polar Air
and the Jet Stream
CO_2


There is a surge in the unpredictability of severe weather events; storms, droughts, and fires. What science warned us to take heed of has now become a very stark reality. The result?
Humanity has been the key contributor in creating a
Collective World Weather Trauma.

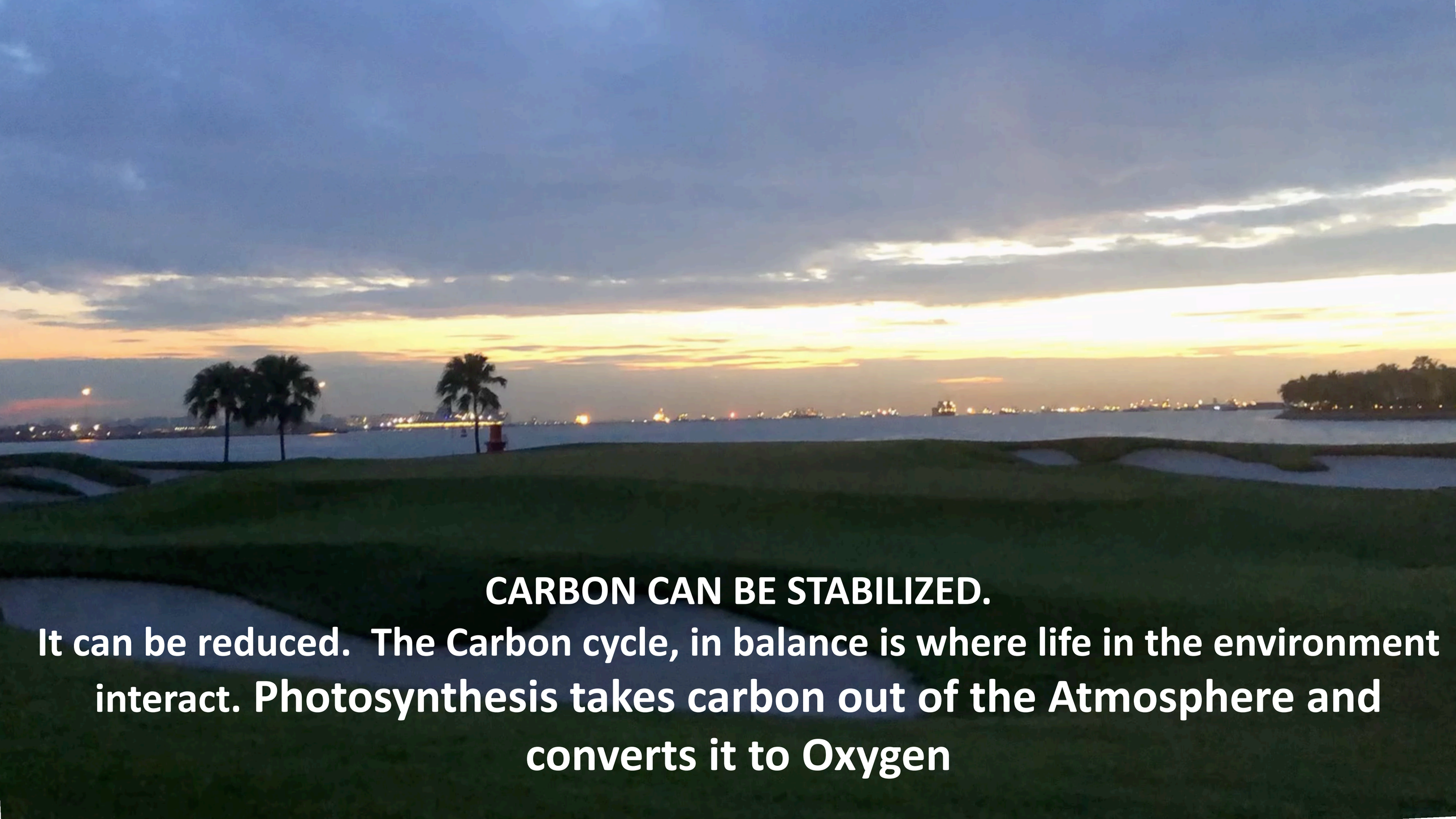
Climate disruption is causing a rise in extinctions, and this is not the first time there is a link in the increase of carbons and the past 5 massive extinctions.

History reveals; Every time Carbon rises, the web of life weakens and at times, collapses.


WE ARE ALWAYS ON THE CLOCK. THERE IS NO PAUSE BUTTON.
Carbon Clock is Running
Bloomberg Carbon Clock
410.00137206
parts per million

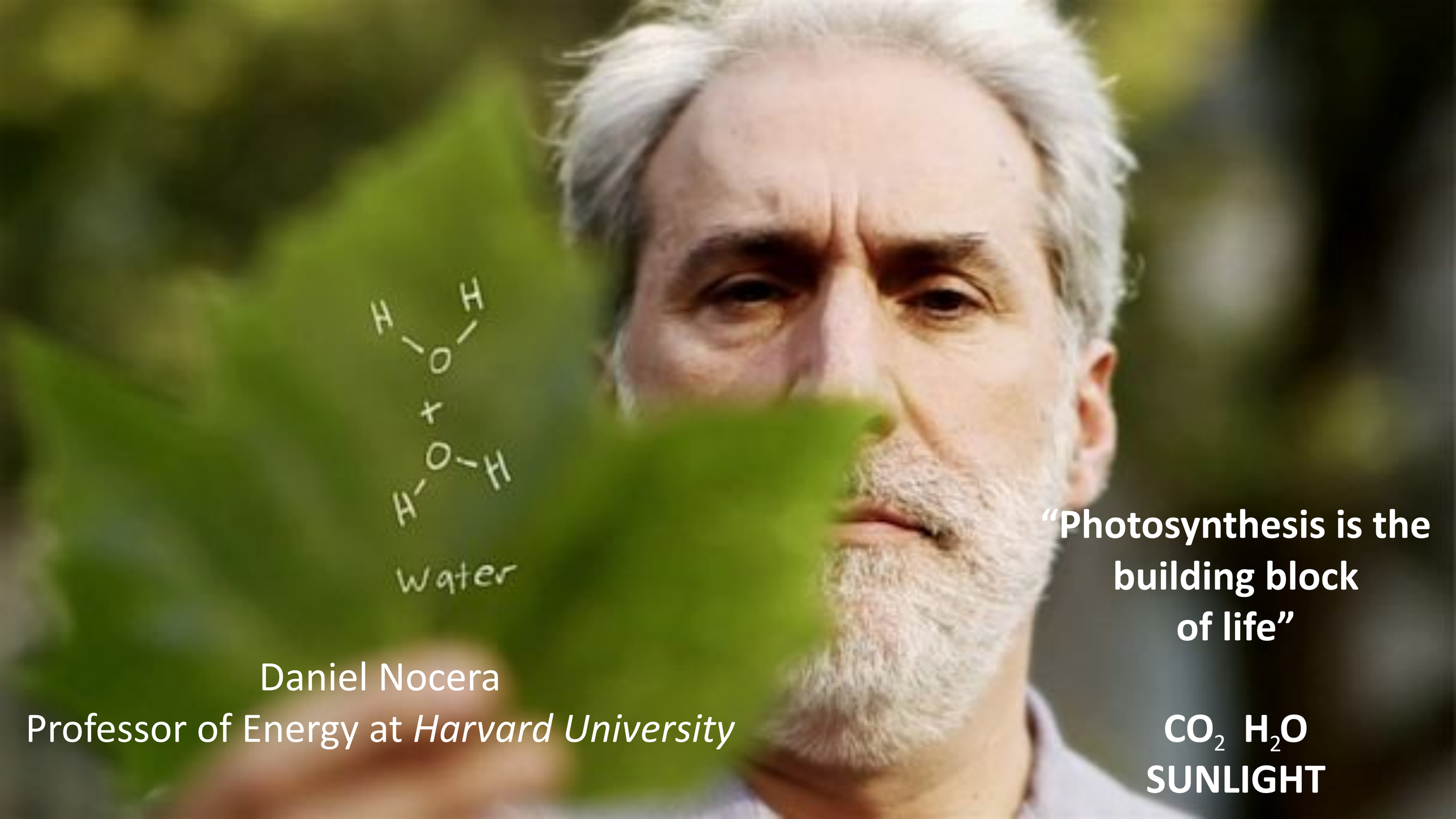

CO_2 Levels over the last 10,000 Years
Taylor Dome Ice Core
Law Dome Ice Core
Mauna Loa, Hawaii
Atmospheric CO2 (ppm)
400
350
300
250
-8000
-7000
-6000
-5000
-4000
-3000
-2000
-1000
0
1000
2000
Years (AD)


We can however divert the “END GAME” and
rectify irreversible man made impacts on
Climate Change.



CARBON CAN BE STABILIZED.

It can be reduced. The Carbon cycle, in balance is where life in the environment interact. Photosynthesis takes carbon out of the Atmosphere and converts it to Oxygen



Daniel Nocera
Professor of Energy at *Harvard University*

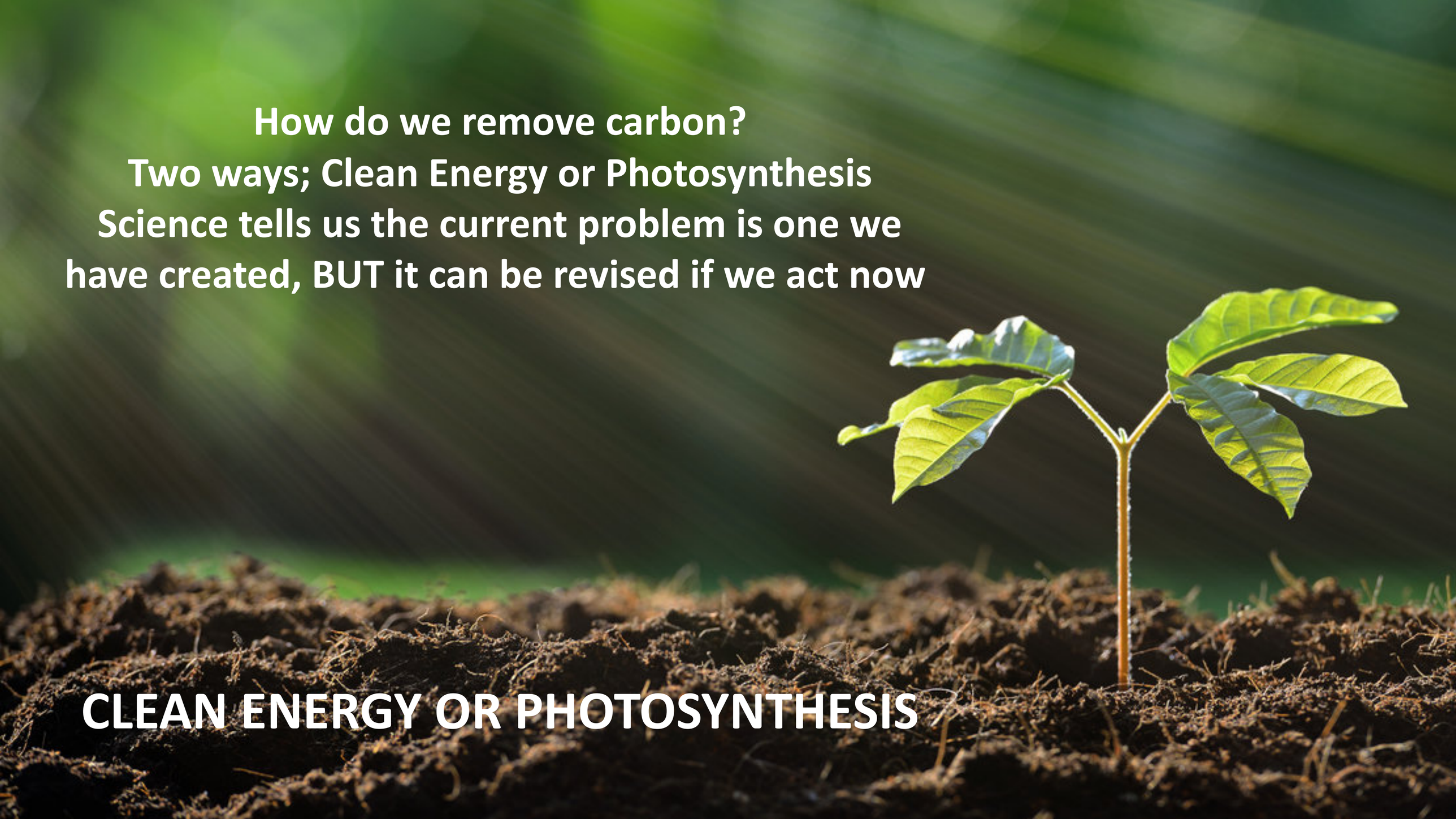
“Photosynthesis is the building block of life”

CO_2 H_2O SUNLIGHT

How do we remove carbon?

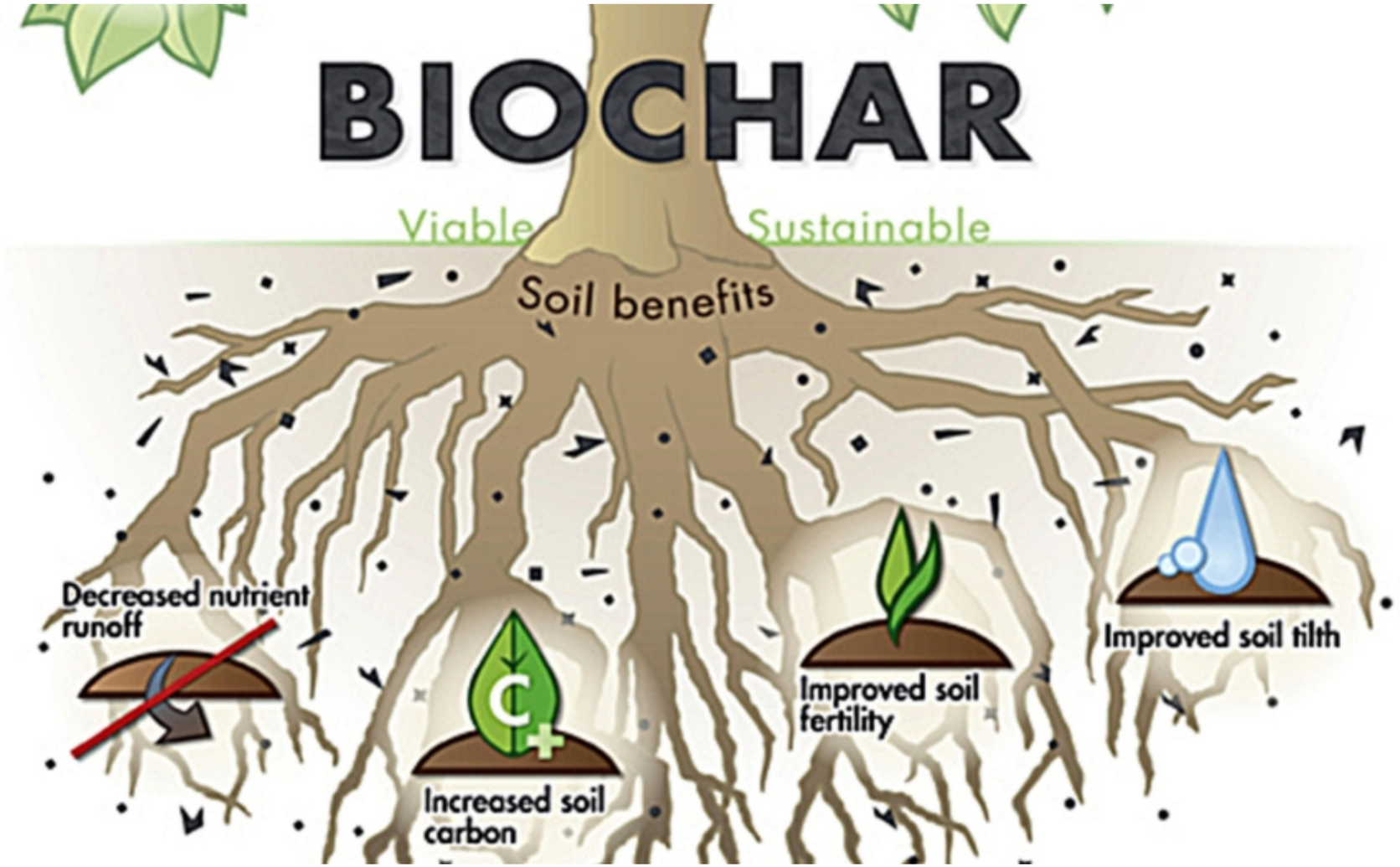
Two ways; Clean Energy or Photosynthesis

Science tells us the current problem is one we have created, BUT it can be revised if we act now



CLEAN ENERGY OR PHOTOSYNTHESIS


ITS NOT ROCKET SCIENCE; We need to absorb more carbon,
build better soils and use less NPK, Fungicides & Insecticides



Understanding how (and acting) to build healthier soil profiles will produce stronger plant life that consumes more Carbon, uses Less water additionally, becomes more disease and insect resistant.

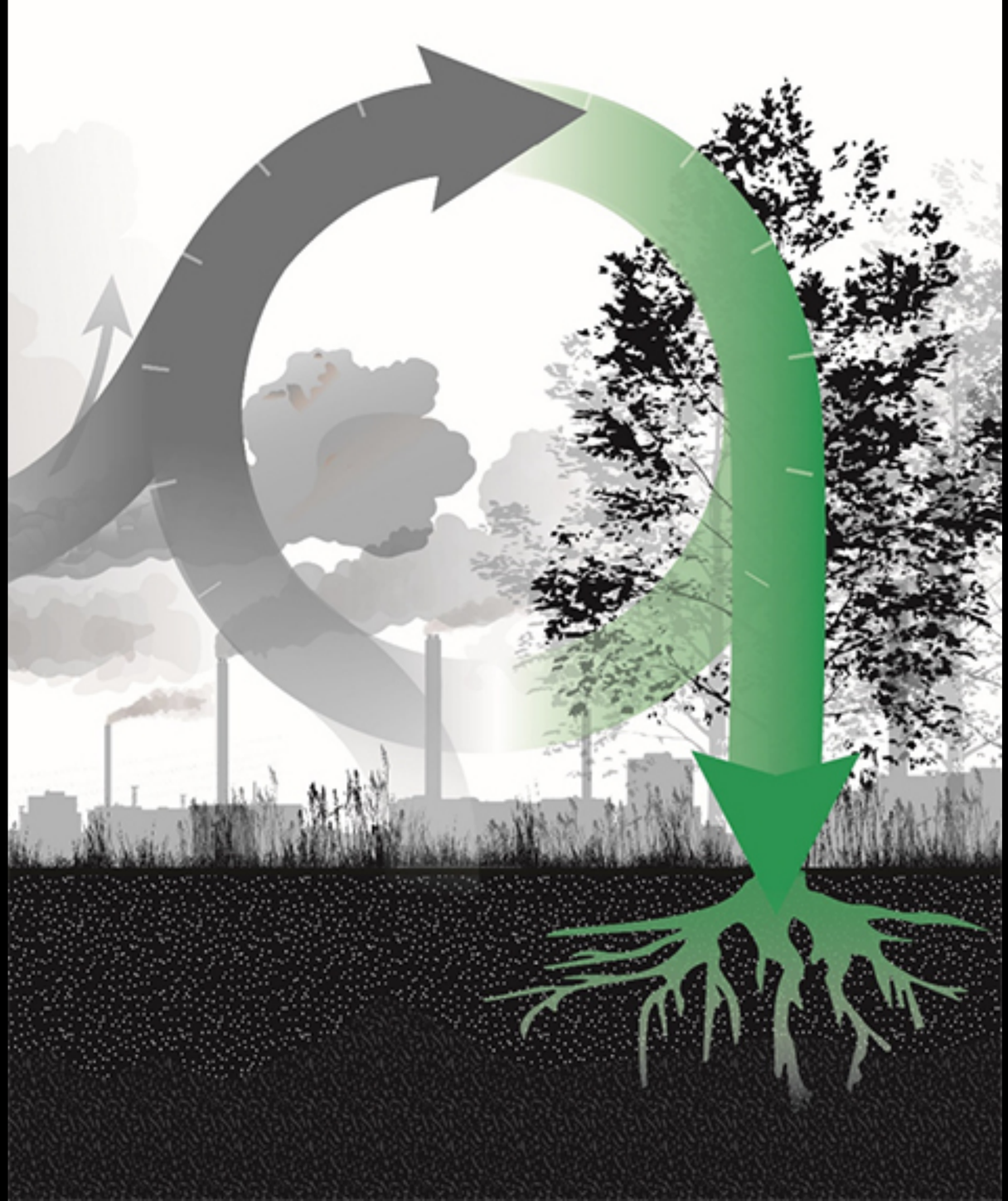
Biochar

A piece of biochar

Biochar is charcoal used as a soil amendment. Biochar is a stable solid, rich in carbon, and can endure in soil for thousands of years.[1] Like most charcoal, biochar is made from biomass via pyrolysis. Biochar is under investigation as an approach to carbon sequestration,[1] as it has the potential to help mitigate climate change.[2][3][4] It results from processes related to pyrogenic carbon capture and storage (PyCCS).[5] Independently, biochar can increase soil fertility of acidic soils (low pH soils), increase agricultural productivity, and provide protection against some foliar and soil-borne diseases.[6]

Biochar is a soil Architecture, developing and enhancing the soil foundation, giving plants the building blocks to defend themselves.

BIOCHAR, used as a soil amendment uses its properties to help reverse Carbon in the atmosphere and increase the carbon in take, some scientist say if used on large scale it could help consume up to 10% more carbon.



We are already connected to the solution

Measures have been mobilized

Transformation must be prominent in our thinking

This is a long journey, there is a clear path ahead of us, but we **MUST** stay the course

R&A

GREEN LINKS

Green Links is a project which aim to ensure The Open Championship has no detrimental impact on the environment.

USGA

R&D

Since 1920, the USGA has funded projects at land grant universities across the country at a cost of $40 million to improve the playing conditions and enjoyment of the game.

GEO

RAISON D'ETRE

GEO Foundation is dedicated to delivering programmes that help people on the ground to evaluate, improve and credibly communicate their work across the agenda of nature, resources and community.

OTHER

ACSP

The Audubon Cooperative Sanctuary Program for Golf Courses (ACSP) is an award-winning education and certification program that helps golf courses protect the environment and preserve the natural heritage.

Thanks to science, the technology is at our finger tips. We must harness the willpower to foster a culture of transformative behavior, based on better understanding of the root causes and how to counter.

How can GOLF help make an impact?

THE PATH WE HAVE TAKEN AT SENTOSA

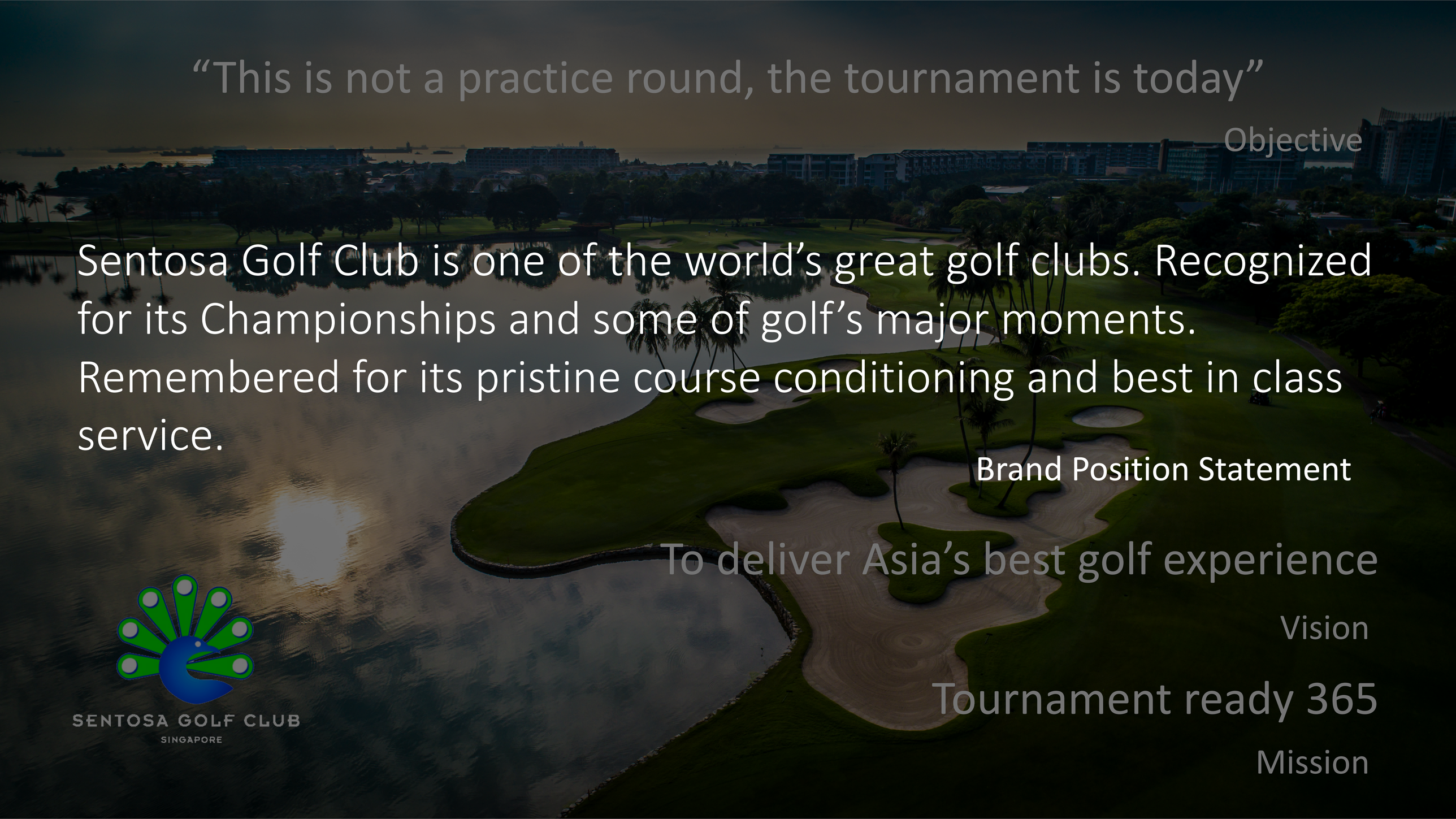
CULTURE

Living our Values

"*OUR* VALUES DEFINE WHO WE ARE"

Our Culture defines the Quality of our Club, this frames the relationships we have with our Colleagues, our Stake Holders, our Members and our Guests, this is not an act, it's a habit and a way of life to our success".

SENTOSA GOLF CLUB
SINGAPORE



“This is not a practice round, the tournament is today”

Objective

Sentosa Golf Club is one of the world’s great golf clubs. Recognized for its Championships and some of golf’s major moments. Remembered for its pristine course conditioning and best in class service.

Brand Position Statement

To deliver Asia’s best golf experience

Vision

Tournament ready 365

Mission

SENTOSA GOLF CLUB
SINGAPORE

Forbes

Work Place Culture

“If your not a leader on the bench, don’t call yourself a leader on the field. You're either a leader everywhere or nowhere”.

SENTOSA GOLF CLUB
SINGAPORE

Work Place Culture Develops Leaders

The difference between a manager and a leader.

“MANAGERS DO THINGS RIGHT”

“LEADERS DO THE RIGHT THINGS”

SENTOSA GOLF CLUB
SINGAPORE

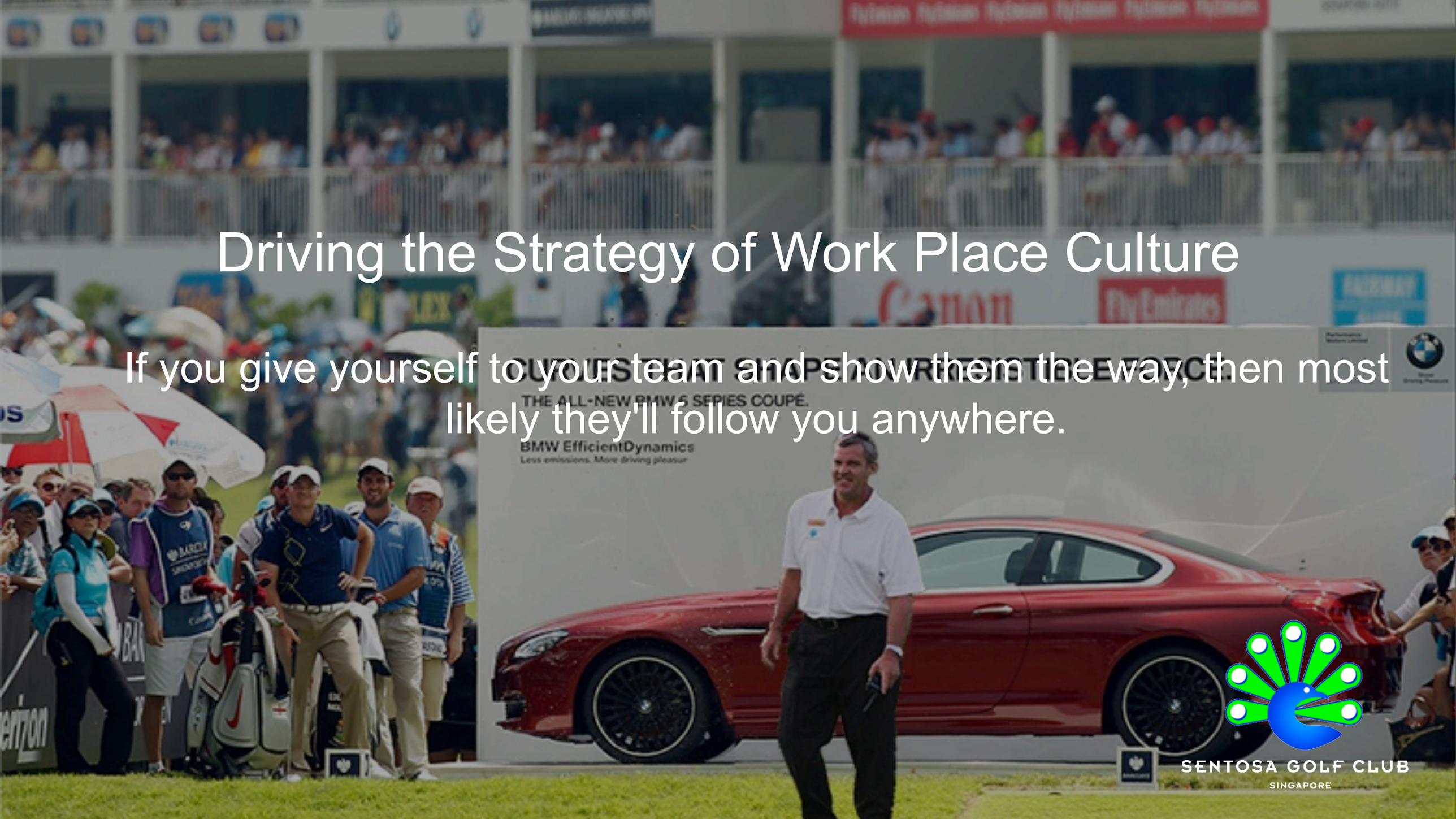
It's best to be both a manager and a leader
They're just different processes

As a leader, it is your job to inspire the people around you to push themselves and, in turn, the company to greatness. To do this, you must show them the way by doing it yourself.

SENTOSA GOLF CLUB
SINGAPORE

Driving the Strategy of Work Place Culture

If you give yourself to your team and show them the way, then most likely they'll follow you anywhere.



Teamwork Culture

Leading by Example – Walk the Walk – Talk the Talk

SENTOSA GOLF CLUB
SINGAPORE

Alignment of the Work Place Culture

Board Level

Ownership Level

Committee Level

Stake Holders Level

Staff Level

Membership Level

SENTOSA GOLF CLUB
SINGAPORE

Sustainable Environmental Strategy

SENTOSA GOLF CLUB
SINGAPORE

Clubhouse Upgrades

Built in 1995

Replacement of Air Conditioning
Replacement of Hot Water Systems

PORSCHE

Electric Car Charging

Sustainable Herb Garden

Growing our own herbs

Removal of Plastic

Recyclable Biodegradable Plastic

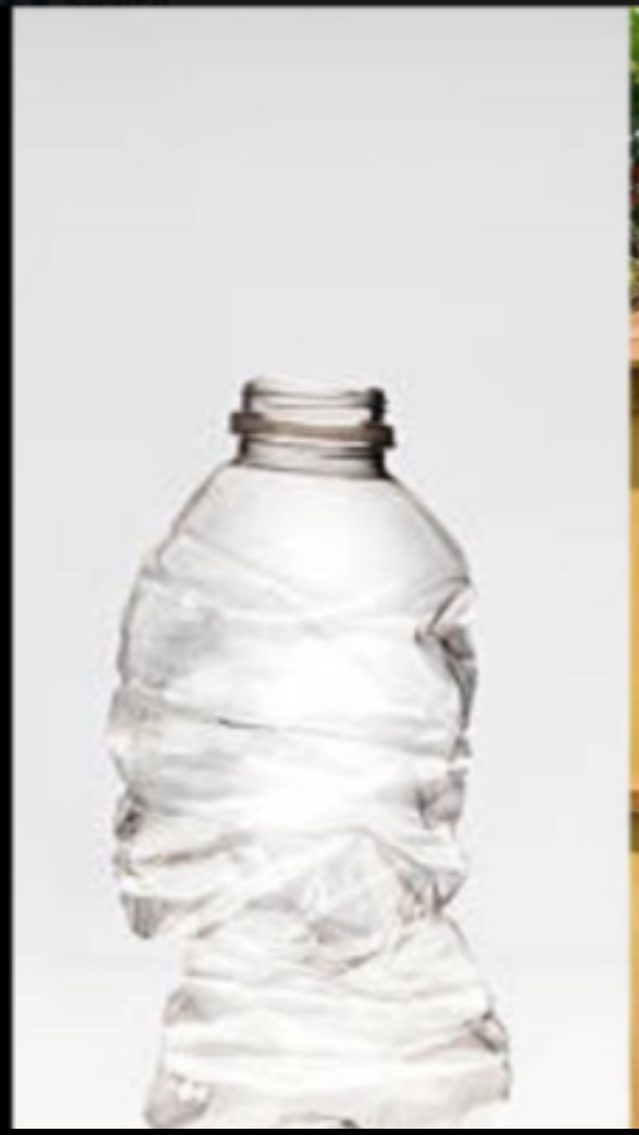
SENTOSA GOLF CLUB
SINGAPORE

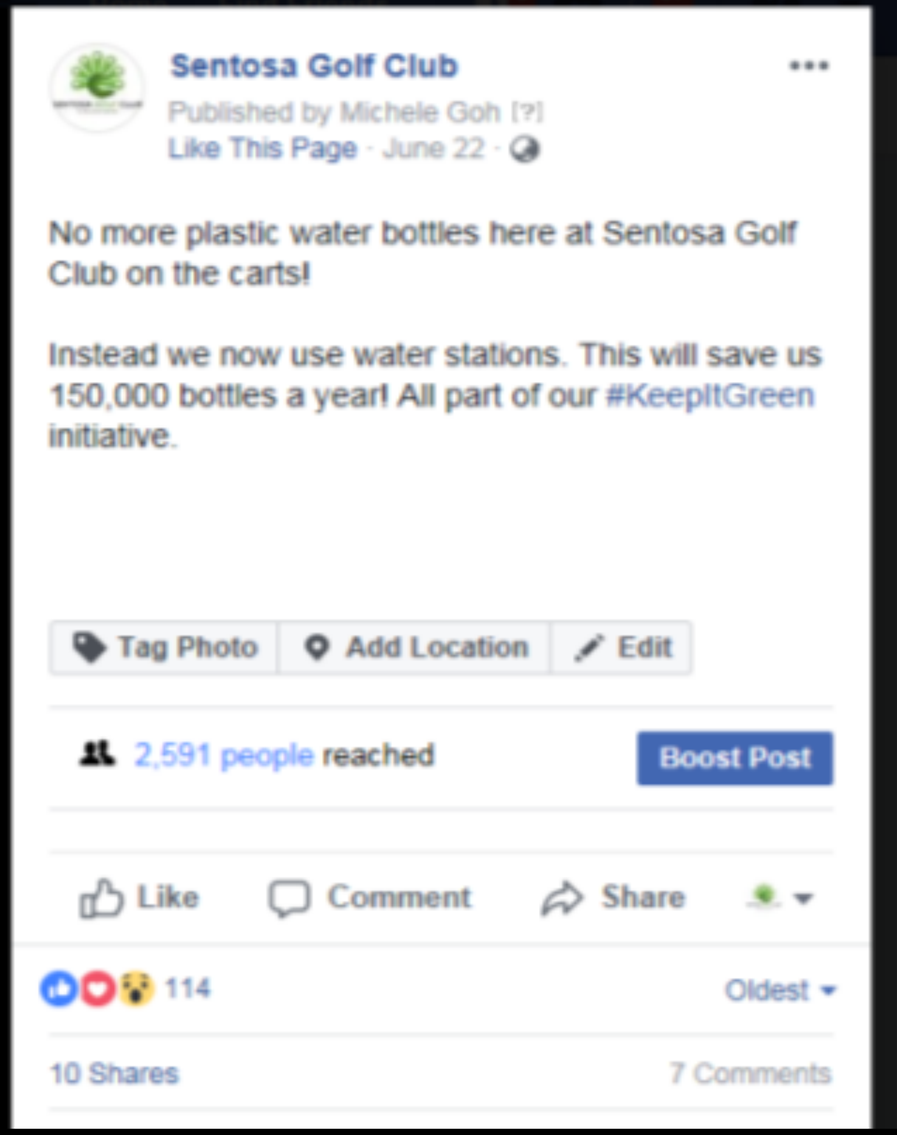
REMOVING DRINKING STRAWS

We've put away drinking straws in our continued effort of reducing plastic waste, and will only give them out if you specifically ask for one. Join us in our effort by saying NO to plastic straws.

Environmental
On Course Strategy

SENTOSA GOLF CLUB
SINGAPORE





Removal of Plastic

150,000 plastic bottles annually

NEWS

JUN 28TH, 2018

SENTOSA GOLF CLUB LOSES ITS BOTTLE

And strengthens its commitment to the environment

15 Weeds

15 weeds x 75 = 1125 weeds a day
7 days a week = 7875
Per month = 34,125


MIRIMICHI GREEN™
Activate Nature.


AmpAgronomy™
TOOLS FOR GROWTH

BENEFITS OF PROPER SOIL CARBON RATIOS

When microorganisms have enough carbon, they:

Promote active and diverse soil biology.

Reactivate and sustain naturally occurring biological cycles.

Increase soil exchange capacity.

Improve soil structure which facilitates air and water movement in the soil.

Increase soil’s available essential nutrients.

Enhance root function which increases the plant’s access to nutrients and water.

Suppress disease and reduce stress.

Improve water management efficiencies.

And Reduce excess soil biocarbonates and sodium accumulation making for healthier soil.

Nematode Essays

The Turf Disease Centre

Dr Kate Entwistle
Waverley Cottage, Sherfield Road, Bramley, Hampshire, RG26 5AG, UK
Tel: +44 (0)1256 880246 Fax: +44 (0)1256 880178 Mobile: +44 (0)7879 468641
Email: kate@theturfdiseasecentre.co.uk Web: www.theturfdiseasecentre.co.uk

SAMPLE ANALYSIS REPORT

Date received:	23 December 2015	**Sample number:**	SA151210
Sent by:	Rodney Mckeown, Superintendent	**Result to:**	Rodney Mckeown
Sample taken from:	Sentosa Golf Club	**Result delivered by:**	Email
Location:	Serapong Green 18	**Number of Pages:**	2

THE RESULT REFERS ONLY TO THE SAMPLE(S) RECEIVED

A hole changer core sample was received for disease analysis. The plants were assessed for fungal disease & insect pest activity and the washed roots assessed visually for any endoparasitic nematodes.

The received turf sample was heavily contaminated with rootzone that affected identification of foliar fungal disease. Although a small number of plants were removed from the sample and assessed as received, the majority of the turf was washed clean and incubated for 24h to allow development of any active fungal disease.

Received sample:

FUNGAL DISEASE
There was no evidence of any active fungal disease on the incubated turf sample but the pre-washed plants did show a small number of *Curvularia* sp. fungal spores. The fact that the incubated plants did not develop a significant fungal infection on the washed leaf tissues would suggest that any previously active infection might well have been controlled by the applied fungicide.

INSECTS
There was no evidence of any insect pests on the received turf.

OBSERVATION
The newly developing roots were noticeably swollen and analysis of all of these swollen roots confirmed that they contained Root-knot nematode juveniles. Each of the assessed roots contained multiple nematodes.

The photographs below show some of the affected roots on the received plants. Where arrowed, the roots are newly developing white roots that are distinctly swollen and each contained several Root-knot juvenile nematodes.

SUMMARY
Although the received sample showed evidence of a recent past Curvularia sp. fungal infection through the sward, the incubated plants failed to develop any additional disease, suggesting that the fungal infection has (at last for now) been controlled by the recent fungicide application(s). *Curvularia* spp. are generally found colonising senescing tissues and are often seen on plants in which there is some additional, primary cause for the decline in turf strength. The presence of the Root-knot nematode juveniles inside the newly developing roots would suggest a currently active population which could have caused the initial weakness in the turf. There was no evidence of any *Pythium* infection or other fungal disease in the received sample.

Results: Nematode numbers found in the samples are presented in the accompanying Table.

Table 1: Numbers of nematodes (per100ml soil) in the soil & root system

Nematode type	8th	9th	*Threshold for damage*
In rootzone			
Bacterial/fungal	1588	11964	*Beneficial*
Tylenchus			***300***
Heterodera J2s & ♂ (cyst)			***40***
Punctodera J2s (cyst)			***100***
Hoplolaimus (lance)		1145	***150***
Pratylenchus (lesion)			***100***
Longidorus (needle)			***20***
Paratylenchus (pin)			***300***
~~Criconemella (ring)~~	~~695~~	~~255~~	~~***600***~~
Meloidogyne J2s & ♂(root-knot)	1291	1527	***20***
Subanguina J2s			***80***
~~Hemicycliophora (sheath)~~			~~***80***~~
Helicotylenchus (spiral)	1092	127	***400***
Rotylenchus (spiral)			***500***
Paratrichodorus (stubby-root)			***100***
Tylencorhynchus (stunt)			***300***
Pratylenchoides (false lesion)			***80***
Xiphinema (dagger)			***100***
Belonolaimus (sting)			***10***
Gracilacus (pin)			***300***
Aphelenchoides			***300***
Ditylenchus			***400***
In plant roots			
Heterodera cysts			***40***
Meloidogyne galls	32	41	***20***
Subanguina galls			***20***
Nematode Damage Index (NDI)	70.0	86.8	

Key for recommended chemical treatment

NDI 0.0-0.5	NDI 0.5-1.0	NDI 1-10	NDI>10
Treatment not required at the moment but monitor levels if plant parasitic nematodes are present	Treatment not urgent but should be seriously considered to restrict nematode levels building to damaging levels	Immediate treatment recommended to reduce nematode levels which are approaching concerning levels	Immediate and urgent treatment required. Multiple applications may be required depending on types of nematode present

Results and management suggestions are based on the samples submitted for analysis.
For further information or discussion contact the laboratory

Results: Nematode numbers found in the samples are presented in the accompanying Table.

Table 1: Numbers of nematodes (per100ml soil) in the soil & root system

Nematode type	Serapong 5 green	Serapong 18 green	Tanjong 13	Tanjong 14	*Threshold for damage*
In rootzone					
Bacterial/fungal	3472	5701	7302	7193	*Beneficial*
Tylenchus					***300***
Heterodera J2s & ♂ (cyst)					***40***
Punctodera J2s (cyst)					***100***
Hoplolaimus (lance)		148			***150***
Pratylenchus (lesion)					***100***
Longidorus (needle)					***20***
~~Paratylenchus (pin)~~					~~***300***~~
Criconemella (ring)		150	762	617	***600***
Meloidogyne J2s & ♂(root-knot)	1680	3901			***20***
Subanguina J2s					***80***
Hemicycliophora (sheath)					***80***
Helicotylenchus (spiral)	1568	143			***400***
Rotylenchus (spiral)					***500***
Paratrichodorus (stubby-root)					***100***
Tylencorhynchus (stunt)					***300***
Pratylenchoides (false lesion)					***80***
Xiphinema (dagger)					***100***
Belonolaimus (sting)					***10***
Gracilacus (pin)					***300***
Aphelenchoides					***300***
Ditylenchus					***400***
In plant roots					
Heterodera cysts					***40***
Meloidogyne galls	10	15			***20***
Subanguina galls					***20***
Nematode Damage Index (NDI)	88.4	197.4	1.3	1.1	

Key for recommended chemical treatment

NDI 0.0-0.5	NDI 0.5-1.0	NDI 1-10	NDI>10
Treatment not required at the moment but monitor levels if plant parasitic nematodes are present	Treatment not urgent but should be seriously considered to restrict nematode levels building to damaging levels	Immediate treatment recommended to reduce nematode levels which are approaching concerning levels	Immediate and urgent treatment required. Multiple applications may be required depending on types of nematode present

Results and management suggestions are based on the samples submitted for analysis.
For further information or discussion contact the laboratory

ENVIRONMENTAL EQUIPMENT STRATEGY

SENTOSA GOLF CLUB
SINGAPORE

THE PUTTING GREEN - PURSUIT OF PERFECTION

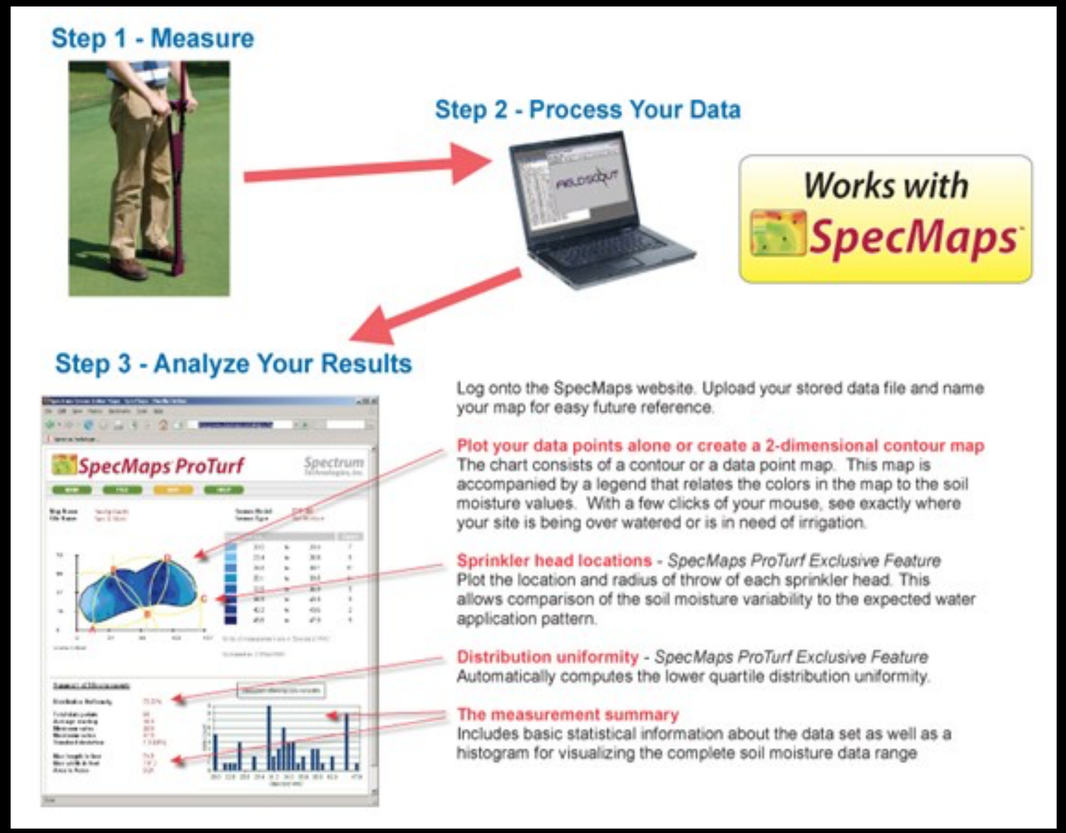
SENTOSA GOLF CLUB
SINGAPORE

Great Greens, Tees, Bunkers are not an Accident

IRRIGATION WATER / WATER CONDITIONING

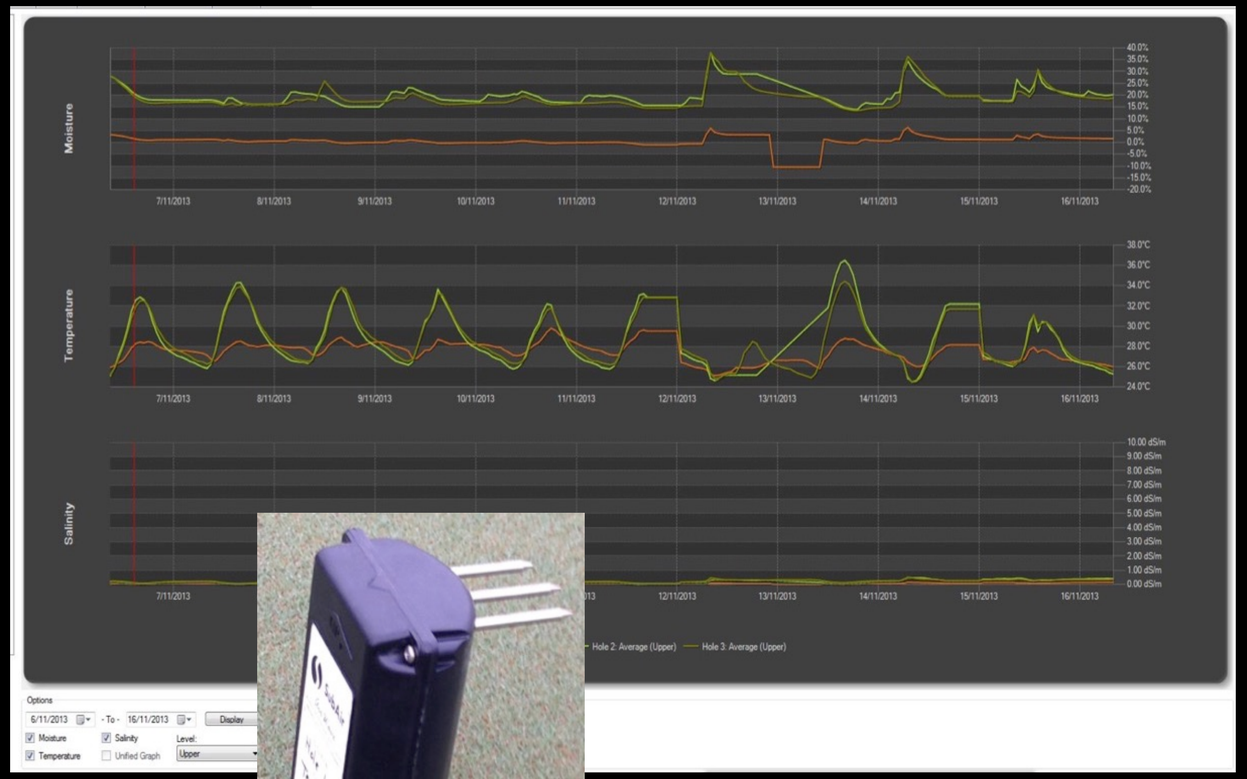
SENTOSA GOLF CLUB
SINGAPORE

WATER MANAGEMENT

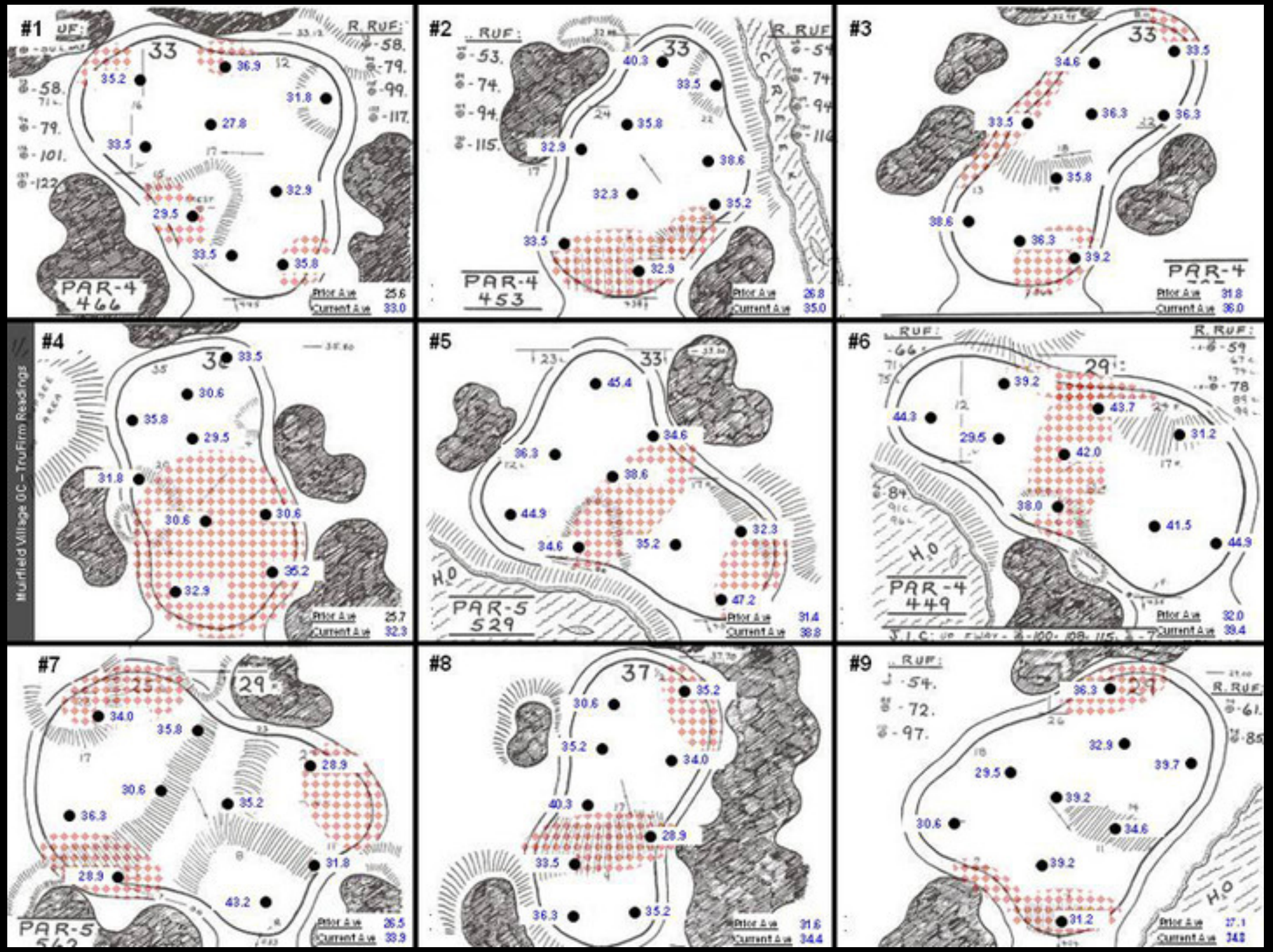


Soil Moisture Tools

EVALUATE ENVIRONMENTAL INFORMATION



SENTOSA GOLF CLUB
SINGAPORE



Mapping The Green

Every Green has a Culture within the Culture

High Spots

Low Spots

High Moisture Areas

Dry Areas

IRRIGATION AND WATER MANAGEMENT

WATER MANAGEMENT

SENTOSA GOLF CLUB
SINGAPORE

Overwatering

IRRIGATION AND WATER MANAGEMENT

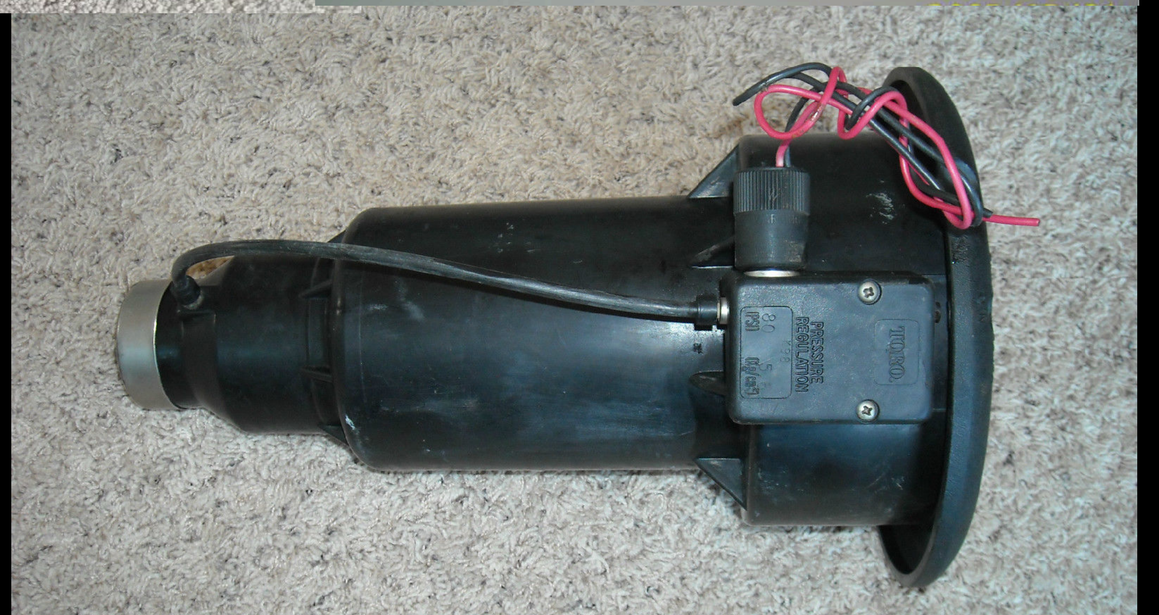
SENTOSA GOLF CLUB
SINGAPORE

5 Minute Cycle

EVOLUTION OF IRRIGATION HEADS

Large Cannon
Single Row
Smaller Heads
Hard line Coverage

- 1960
- 1970
- 1980
- 1990
- 2000
- 2100



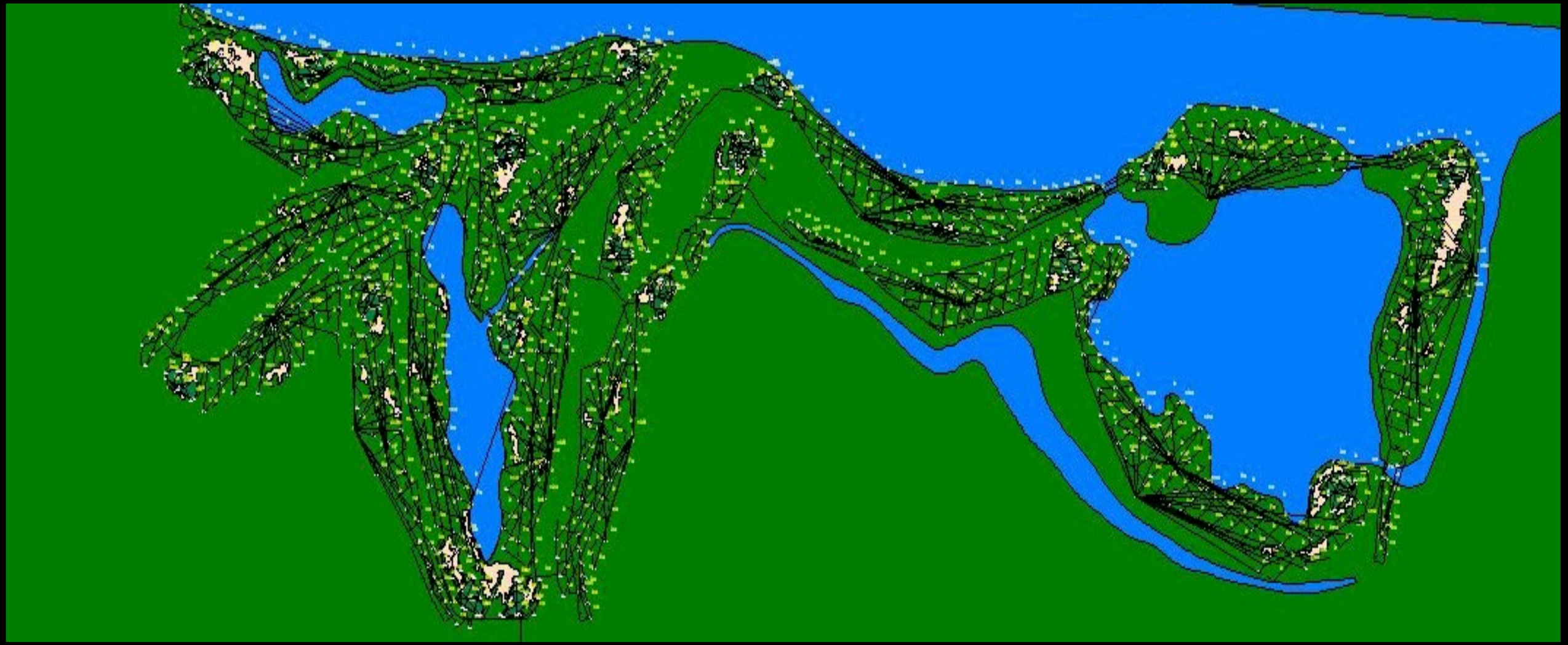
IRRIGATION SINGLE HEAD CONTOL

SENTOSA GOLF CLUB
SINGAPORE

SINGLE HEAD CONTROL

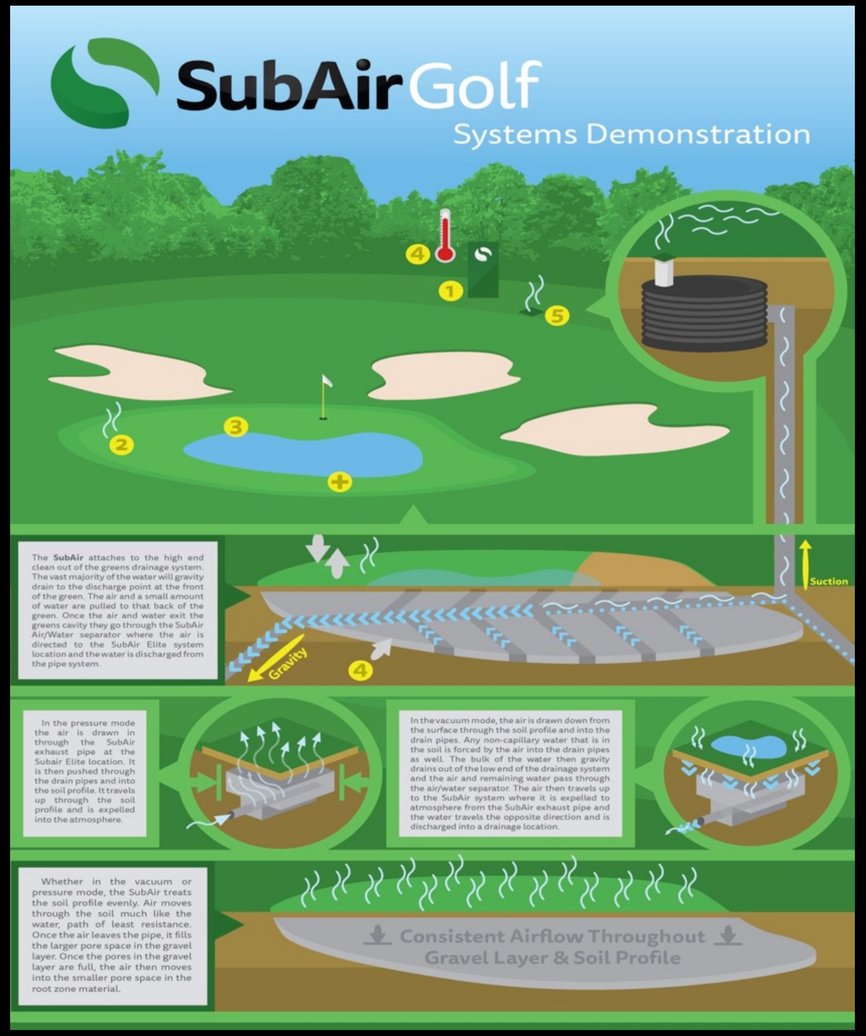
SENTOSA GOLF CLUB
SINGAPORE

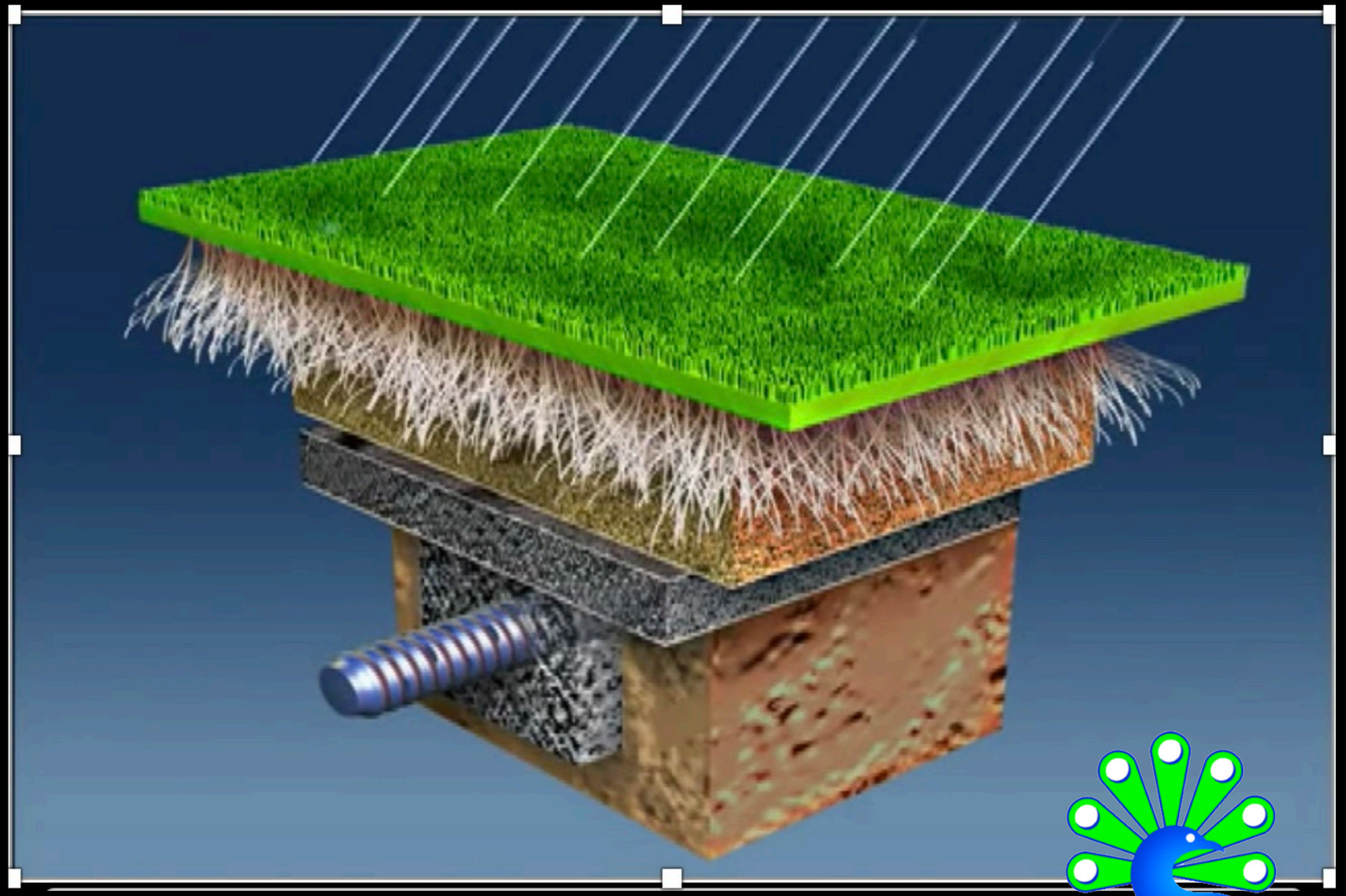
IRRIGATION AND WATER MANAGEMENT



More Heads = Less Consumption 1,200 individually controlled Sprinkler Heads

TOOLS THAT ALTER THE ENVIRONMENT





SENTOSA GOLF CLUB
SINGAPORE

WEATHER TRACKING

Weather for Serapong Weather Station presented by RainwiseNet

°C

Upgrade to Pro What's in Pro?

HOME GRAPHS HISTORY ALARMS REPORTS DOWNLOAD SETTINGS

Status: Online
Updated: Oct 29, 2014 9:01 AM

Wind Direction

Direction	Av Speed	Gust
NW	2.3	7.9

Temperature 30°

Max	Min	Heat Index
30° 09:01AM	26.2° 04:41AM	36.8°

Humidity	77% ▼ Falling	Hi: 89% 05:11AM	Lo: 77% 09:01AM
Dewpoint	25.5° ◉ Rising	Hi: 25.6° 08:53AM	Lo: 23.3° 12:07AM
Pressure	1009.8 mb ▲ Rising 9:01 AM	Hi: 1009.8 09:01AM	Lo: 1007.9 03:24AM
Insolation	0 W/m²	Today: 0 kJ/m²	
Precipitation	0.00 mm Today	Last hour: 0.00 mm	
Inside Temp	28.3°	Hi: 28.3° 09:00AM	Lo: 25.6° 07:11AM

Sunrise 6:46am Sunset 6:50pm

Forecast for Singapore, Singapore

Wednesday
Partly cloudy. High 31C. Winds S at 10 to 15 km/h.

Wednesday Night
Mostly clear this evening. Scattered thunderstorms developing after midnight. Low 27C. Winds light and variable. Chance of rain 40%.

Thursday
Isolated thunderstorms in the morning, then partly cloudy late. High 31C. Winds SW at 10 to 15 km/h. Chance of rain 30%.

Thursday Night
Partly cloudy skies. Low 26C. Winds light and variable.

Friday
Variable clouds with thunderstorms, especially in the morning. High around 30C. Winds SW at 10 to 15 km/h. Chance of rain 40%.

Friday Night
Variable clouds with scattered thunderstorms. Low 26C. Winds light and variable. Chance of rain 60%.

Saturday
Thunderstorms likely. High 31C. Winds SW at 10 to 15 km/h. Chance of rain 80%.

Saturday Night
Thunderstorms likely. Low 26C. Winds WSW at 10 to 15 km/h. Chance of rain 80%.

Current Radar/Satellite

SENTOSA GOLF CLUB
SINGAPORE

TOOLS THAT ALTER THE ENVIRONMENT

SENTOSA GOLF CLUB
SINGAPORE

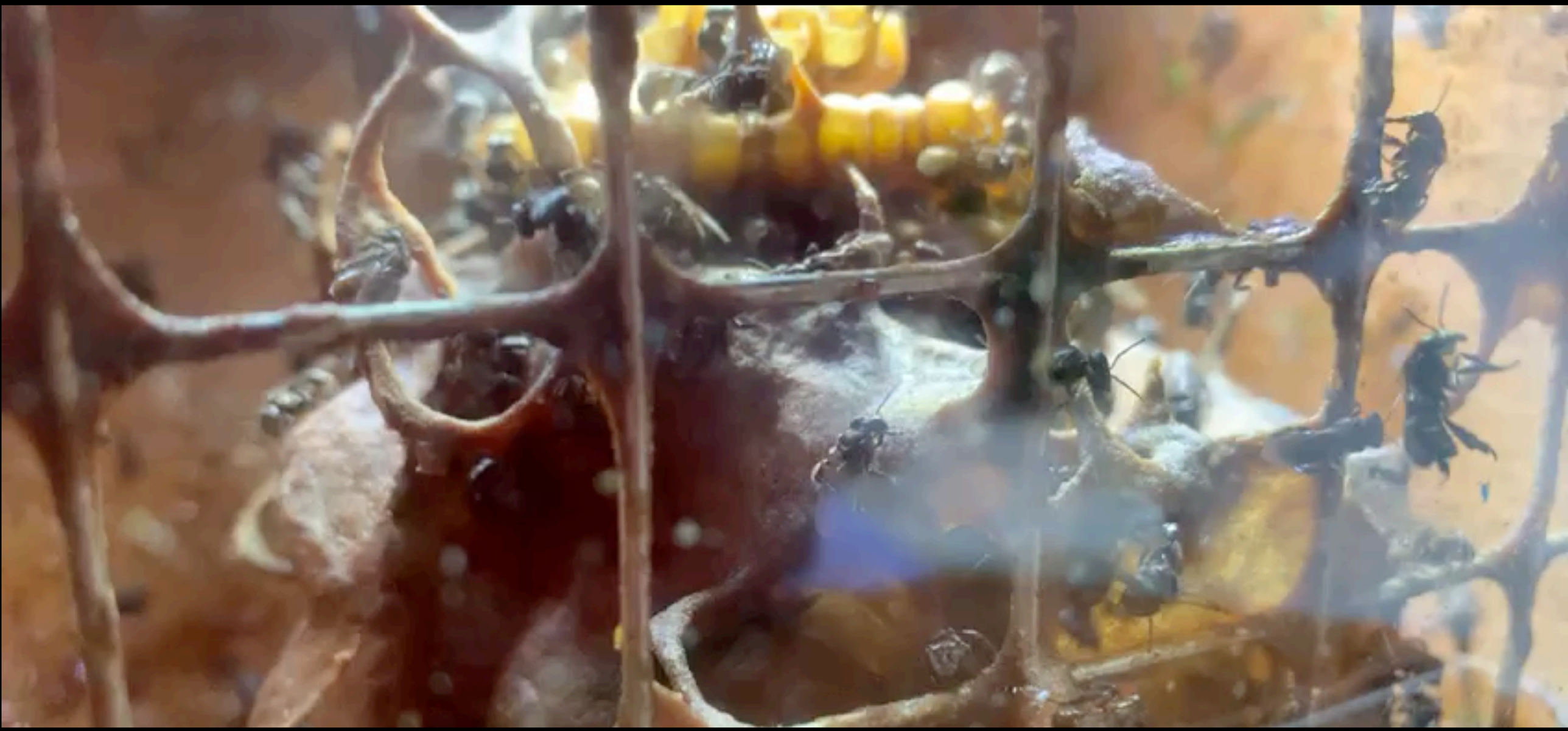
Setup / Grinding Mower Preparations

SENTOSA GOLF CLUB
SINGAPORE


sentosa
SPRAYTEK XP


JACOBSEN

LITHIUM BATTERY POWERED GOLF CARTS



Colonization of Bees

Stingless bees (Meliponini)

Food and Horticulture Digester


SMBC SINGAPORE OPEN
EXIT

WHY DOES IT MATTER?

There are +30,000 golf courses in the world, if we all work to reduce CARBON and protect the ENDANGERED we will make an impact so large, it could be one of the world leading vehicles to reverse CLIMATE DISRUPTION

SENTOSA GOLF CLUB
SINGAPORE

It is not too late and it’s not GAME OVER by any means…

SENTOSA GOLF CLUB
SINGAPORE

It is imperative the industry unite and the POWERS of GOLF bond our industry to this global cause

IT'S GAME ON

SENTOSA GOLF CLUB
SINGAPORE