AUTODESK. UNIVERSITY

# Technology-Driven Sustainable Construction

## CS463763

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# Nate Coombs

## Product Specialist, Sustainability

## Thought Leader & Technologist

Nate grew up in Rutland, Vermont. He attended the University of Vermont, graduating with a BS in Civil Engineering with a focus in structures. Shortly after graduation. he joined a BIM start up called Assemble Systems as their first dedicated application engineer. He went on to lead the Assemble team of engineers up until the acquisition by Autodesk, where he went on to become a Product Specialist. Outside of leading Assemble's application engineering team, Nate was responsible for the support and workflow development of Assemble's largest accounts, while also leading the international expansion of the product since the acquisition by Autodesk. It was during his travels abroad where he realized his passion for sustainability could be tied to his work in Building Information Modeling. He continues to look at new ways to leverage technology to offset unsustainable construction practices, while also driving efficiency and collaboration throughout the entire construction life cycle. Nate currently lives in Boston, Massachusetts and enjoys photography in his free time.

## 01

### How bad is it?

The current state of the world & construction

## 02

### Technology’s Value

What’s out there and why is it important?

## 03

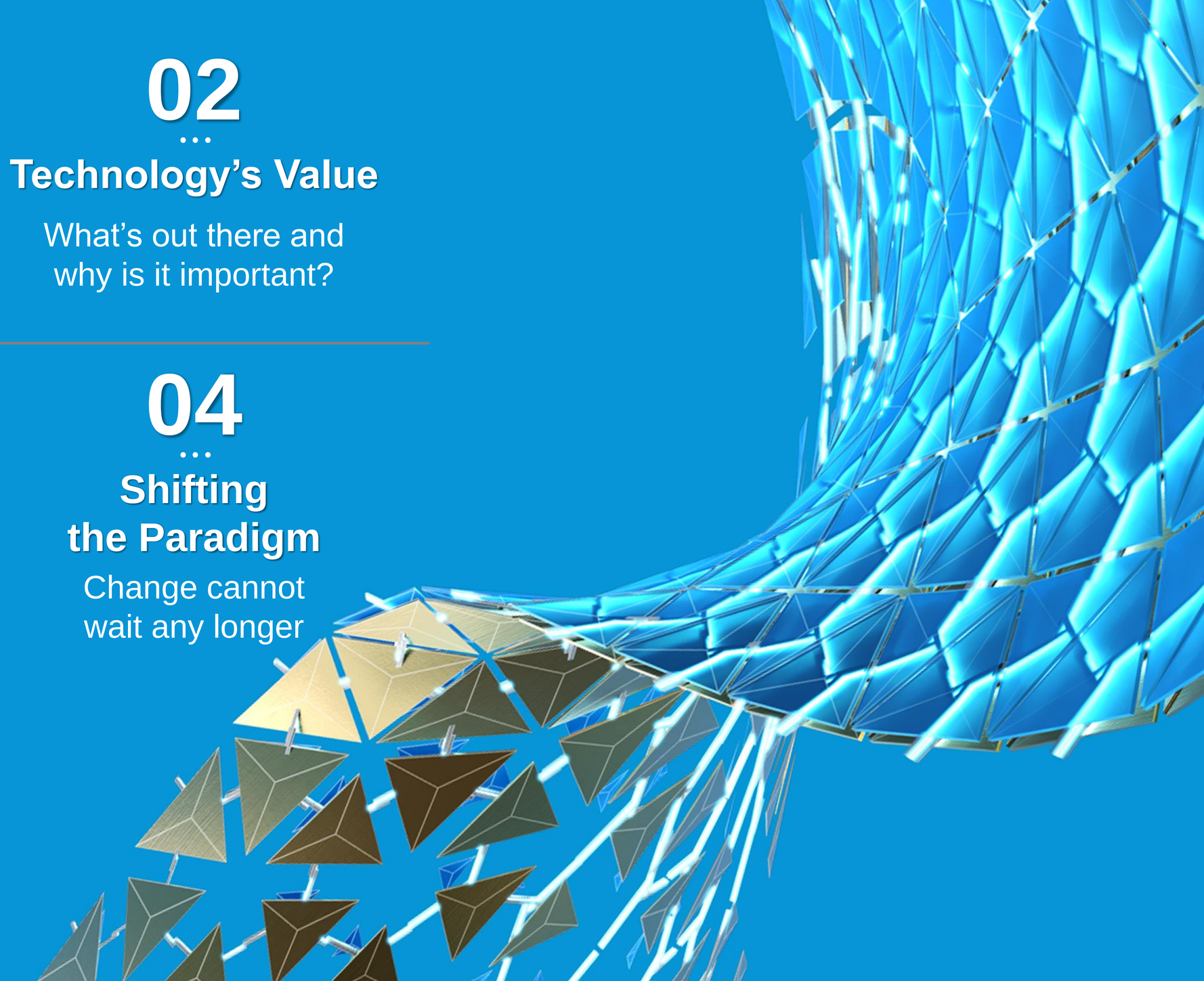
### This must be Futuristic Right?

Nope. Examples of sustainable construction practice across the world

## 04

### Shifting the Paradigm

Change cannot wait any longer



# What does it mean to be Sustainable?

**sus·tain·a·bil·i·ty**

/sə stānə biləd**ē**/

*noun*

the ability to be maintained at a certain rate or level.
“the sustainability of economic growth”

# What it actually means….

## Cost Effective

If you don’t manage costs, your business isn’t going to last very long

• • •

## Renewable/Reusable

Whether it be programs, process, or even hardware. If you can’t use things more than once you might have a problem

## Safe

I don’t think I even have to explain this one to the construction folks in the room

• • •

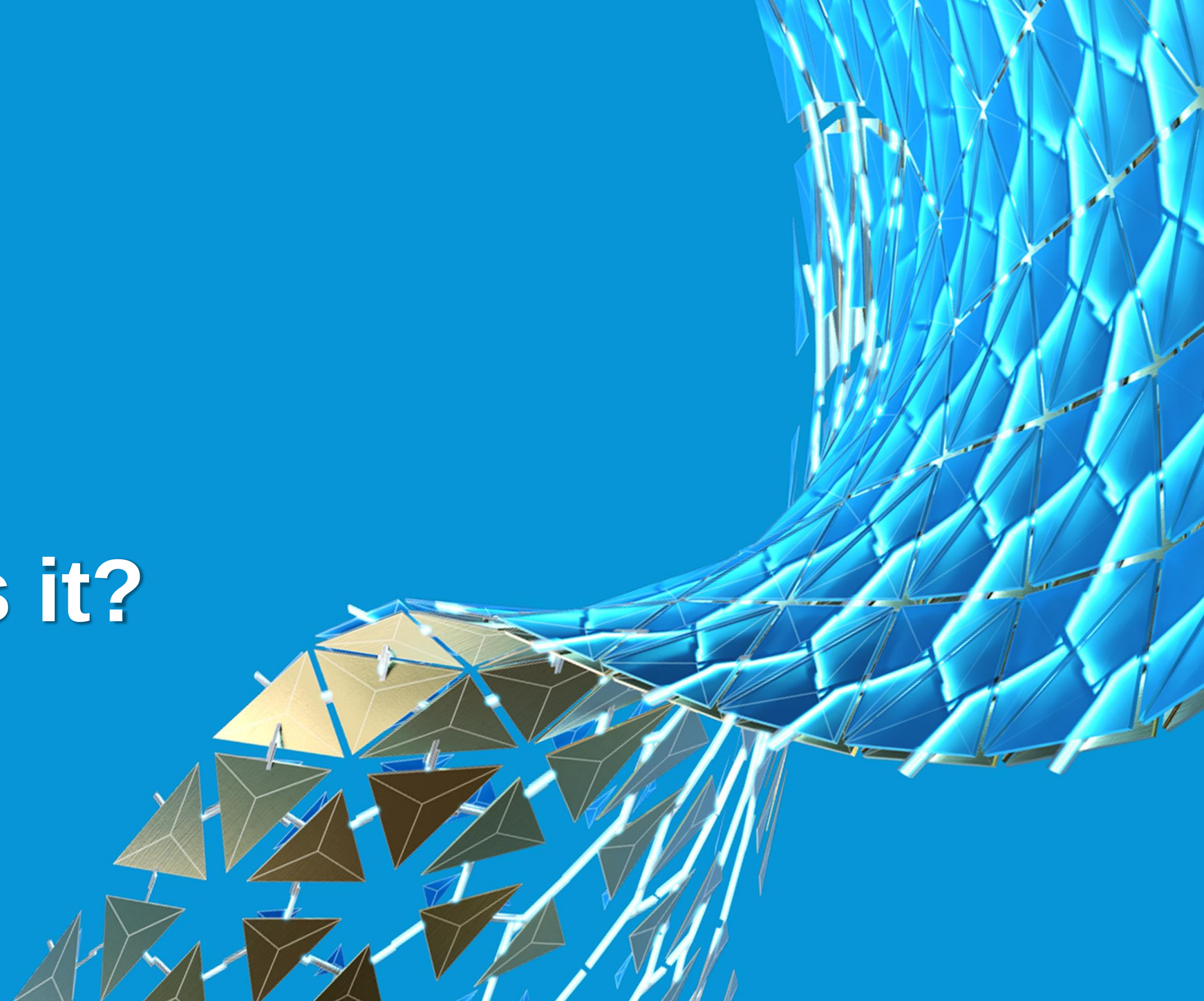
## Green

Who isn’t happier and working harder when they’re surrounded by plants?

# 01

# How bad is it?

(worse than you thought)



# We all live in what’s called a Linear Economy…

**Take**

Extraction of natural resources

**Make**

Manufacture & produce goods from resources

**Distribute**

Distribute goods by truck, plane, boat worldwide

**Use**

We consume and use a product until it wears out or breaks

**Dispose**

Throw it away, get a new one and start the process over again

# In the United States during 2017:

• • •

# 569,400,000

## Tons

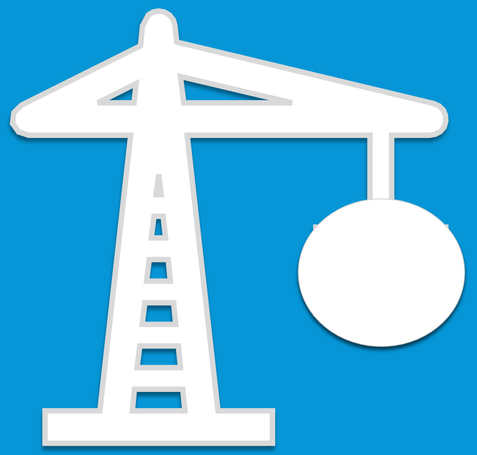
of waste were generated by
Construction & Demolition

**Environmental Protection Agency (EPA). (2019). (publication). *Advancing Sustainable Materials Management*: 2017 Fact Sheet (pp. 18–19). Washington, DC: EPA.**

# Of that 569.4 million tons:

**90%** Of the waste was produced from demolition of existing buildings

**70%** Of the debris & waste produced comes from concrete



Environmental Protection Agency (EPA). (2019). (publication).
Advancing Sustainable Materials Management:
2017 Fact Sheet (pp. 18–19). Washington, DC: EPA.

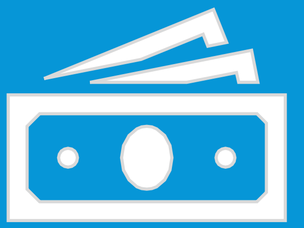
# Projections show that from 2018-2021:

...

# $5,400,000,000,000

will be spent on the construction in the United States

Design Build Institute of America. (2018). (rep.). Design-Build Utilization Combined Market Study June 2018 (pp. 8–8). Washington DC: DBIA.



# Of that $5.4 Trillion:

**44%** Of the dollars spent on construction will be design build contracts [1]

**75%** Of Projects were at least 10% past due on their schedules[2]


1. Design Build Institute of America. (2018). (rep.). *Design-Build Utilization Combined Market Study June 2018* (pp. 8–8). Washington DC: DBIA.

2: Viafora, A., & Ellis, G. (2020, March 18). *100+ Construction Industry Statistics [2020 Edition]*. Autodesk Construction Blog. https://constructionblog.autodesk.com/construction-industry-statistics/.



# Design-Build projects are completed

# 102% faster

## on average than conventional Design-Bid-Build contracts.

Impact. DBIA. (2020, July 23). https://dbia.org/impact/.

## Globally, the buildings and construction sector are accountable for…

**39%** Of energy & process related $CO_2$ emissions in 2018.

**11%** Of which resulted from manufacturing building materials

IEA (2019), Global Status Report for Buildings and Construction 2019, IEA, Paris
https://www.iea.org/reportsglobal-status-report-for-buildings-and-construction-2019/

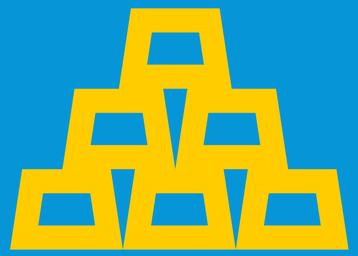
# The next gold rush?

Green Technology and Sustainability Market expected to reach

## $44.61 Billion by 2026[1]

Green Building Materials Market expect to be worth

## $364.6 Billion by 2022[2]

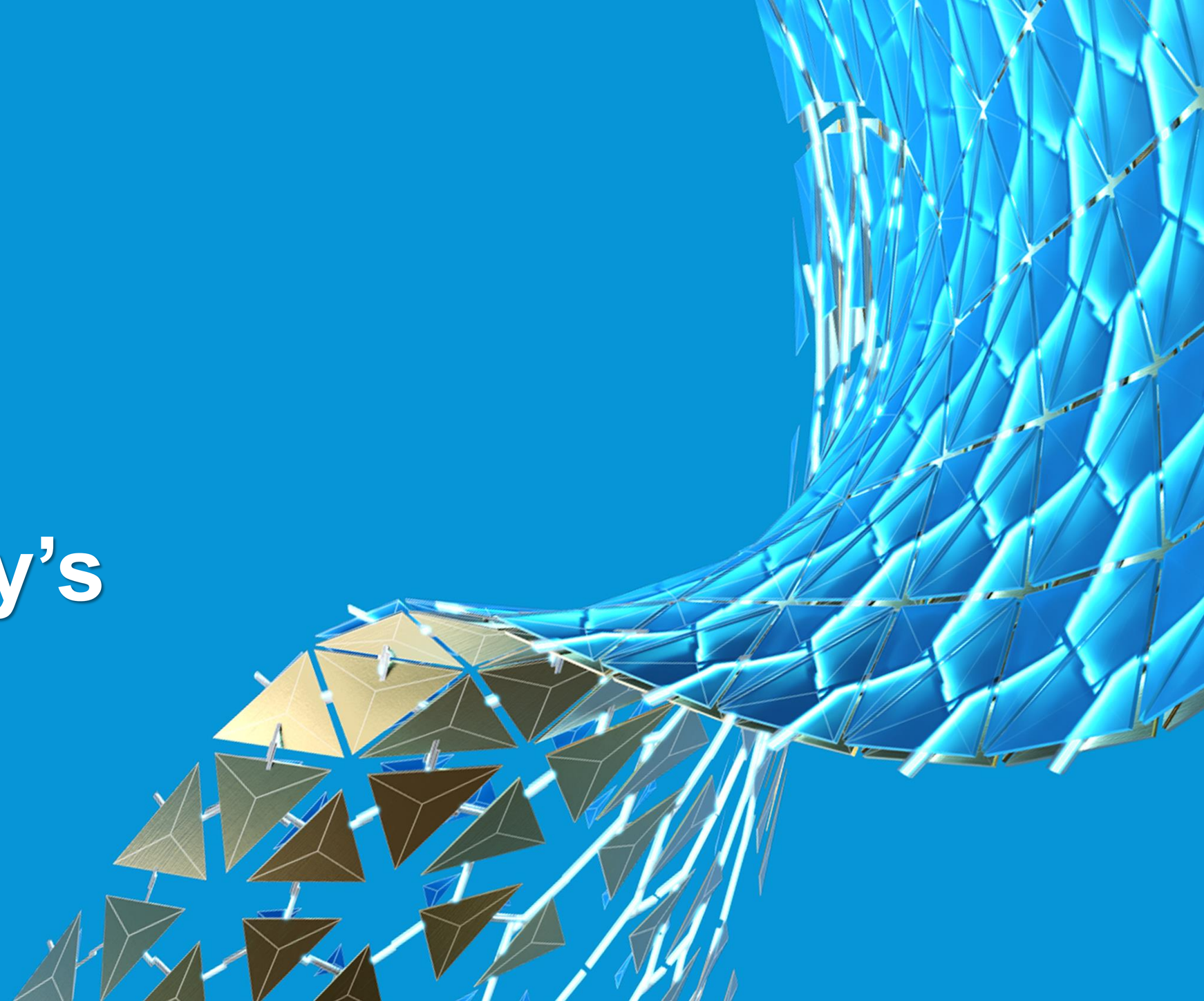



1: Green Technology and Sustainability Market is Expected to Reach $44.61 Billion by 2026. Green Technology and Sustainability Market to Reach $44.61 Bn by 2026. https://www.alliedmarketresearch.com/press-release/green-technology-and-sustainability-market.html.

2: Green Building Materials Market Size Worth $364.6 Billion By 2022. Market Research Reports & Consulting. https://www.grandviewresearch.com/press-release/global-green-building-materials-market.


# 02

# Technology's Value



# What is out there?

## Biomaterials

Self healing concrete, CLT Timber Design, Bamboo, etc

## Generative Design

Site Layout & Design Optimization

## BIM

Building Information Modeling

## Prefabrication

Modular design and off site prefabrication

## Green Buildings

The more plants the better

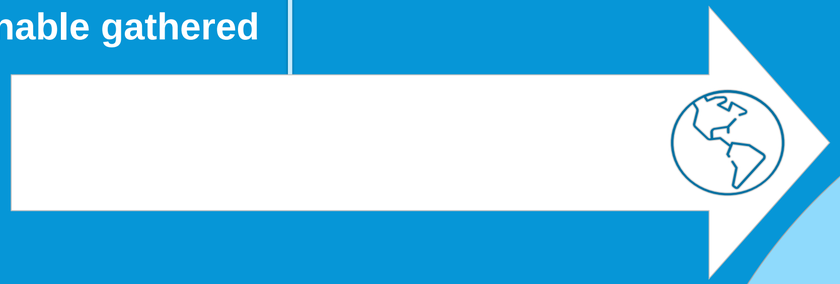
## Digitization

You really still use paper?

# Ideal Circular Economy

## Raw Materials

Locally sourced and sustainable gathered



## Design & Manufacture

Design products with sustainable materials and to be used in the long term

## Recycle & Reuse

Recyclable materials collected, and non recyclable products refurbished & repurposed

## Consume & Use

Use products through their entire project lifecycle with trash as last option

## Distribute

Locally distributed and consumed close to where it was manufactured

# Digitization

/ˌdijədəˈzāSH(ə)n/

noun

1. the conversion of text, pictures, or sound into a digital form that can be processed by a computer.

# What do you have against the trees?

According to data from the Global Forest Resource Assessment roughly 80,000 to 160,000 trees are cut down each day around the world with a significant percentage being used in the paper industry

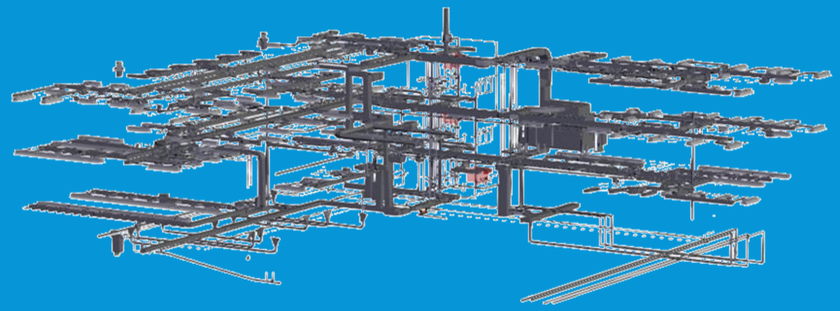
In the United States, paper industries accounted for roughly 20% of the air pollution in 2015.

Kiprop, J. (2018, November 20). *How Many Trees Does It Take To Make 1 Ton Of Paper?* https://www.worldatlas.com/articles/how-many-trees-does-it-take-to-make-1-ton-of-paper.html.

# BUILDING INFORMATION MODELING (BIM)

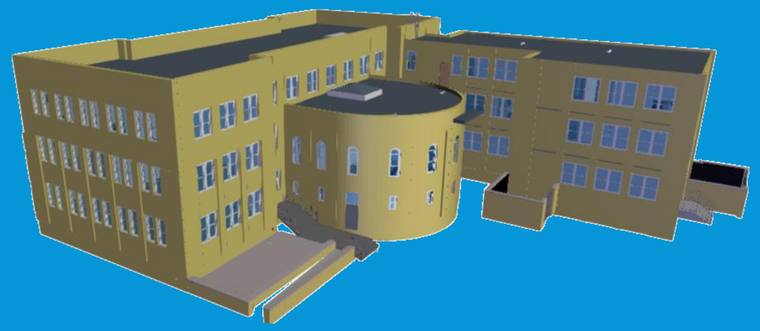
Digitizing the Engineering & Design Process

## Quantification



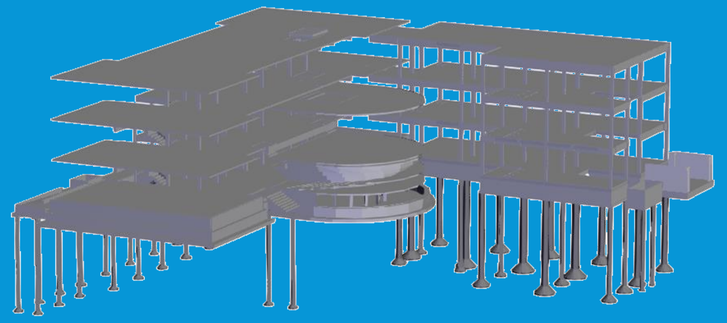
Instant and precise bill of materials, quantities & quantification of design updates

## Reduced Rework

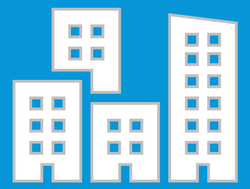


Clash Detection & Coordination tools allow for issues and conflicts to caught as early as possible

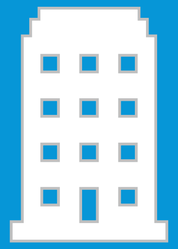
## Collaboration

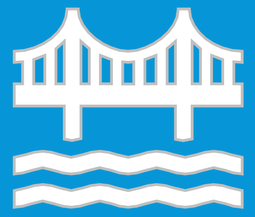


Through cloud products and technology design data can get into the hands of way more people



# A PICTURE IS WORTH A THOUSAND WORDS, A MODEL IS WORTH A THOUSAND PICTURES





# Generative Design

AUTODESK.

Make anything.

## Design Optimization

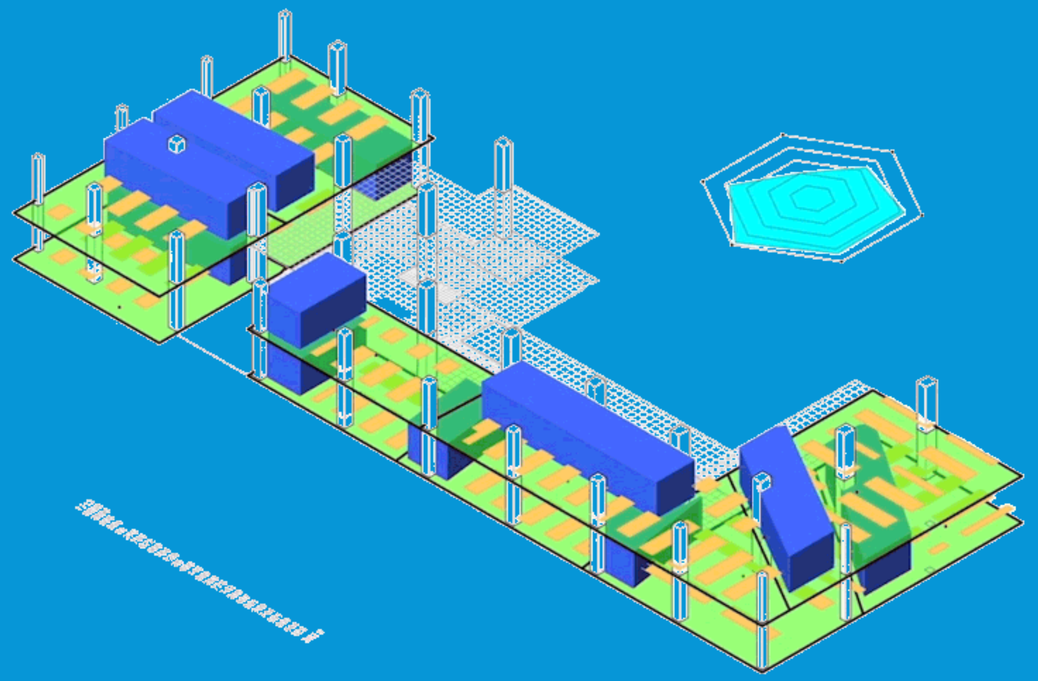
Based on goals, materials, constraints & requirements. AI will optimize your design based on all possible combinations

## Site Layout

Applying the same concept, optimize your site for best sunlight, cross breeze, and building layout

## COVID-19

I bet you can’t produce a better way to lay out desk in an office 6 feet apart!



# Prefabulous

## Project Schedule

On average project schedules & timelines are reduced by 25%, in turn reducing operational costs accordingly

## Waste Reduction

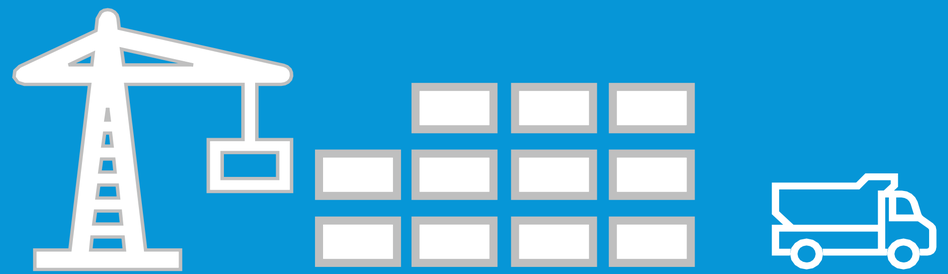
Reduce waste by 50% or more due to precise bill of materials are optimization of procurement

## Transportation Impacts

Total number of trucking deliveries to site can be reduced by up to 90%, along with decreasing average travel distance of workers to the site by 75%

## Safety

Fewer risks than a normal construction site, generally required to work outdoors around heavy machinery & at high heights



# Biomaterials at a Glance....

## Bio Concrete

Concrete Infused with bacteria that heal cracks when exposed to air & water

## Timber Design

The emergence of laminated & engineered timber beams allows for safer and taller wood structures

## Bamboo

Some of the fastest growing plants on the planet also happen to have a stronger tensile strength then steel

## Bio Fuels

Fuel produced from organic matter or waste and used in place of gasoline for trucking and machinery

# Who doesn’t love plants? Pretty Low Tech though..


- Average 6 degree surrounding air temperature decrease for facades with greenery vs ones without
  Improves building insulation by up to 30%

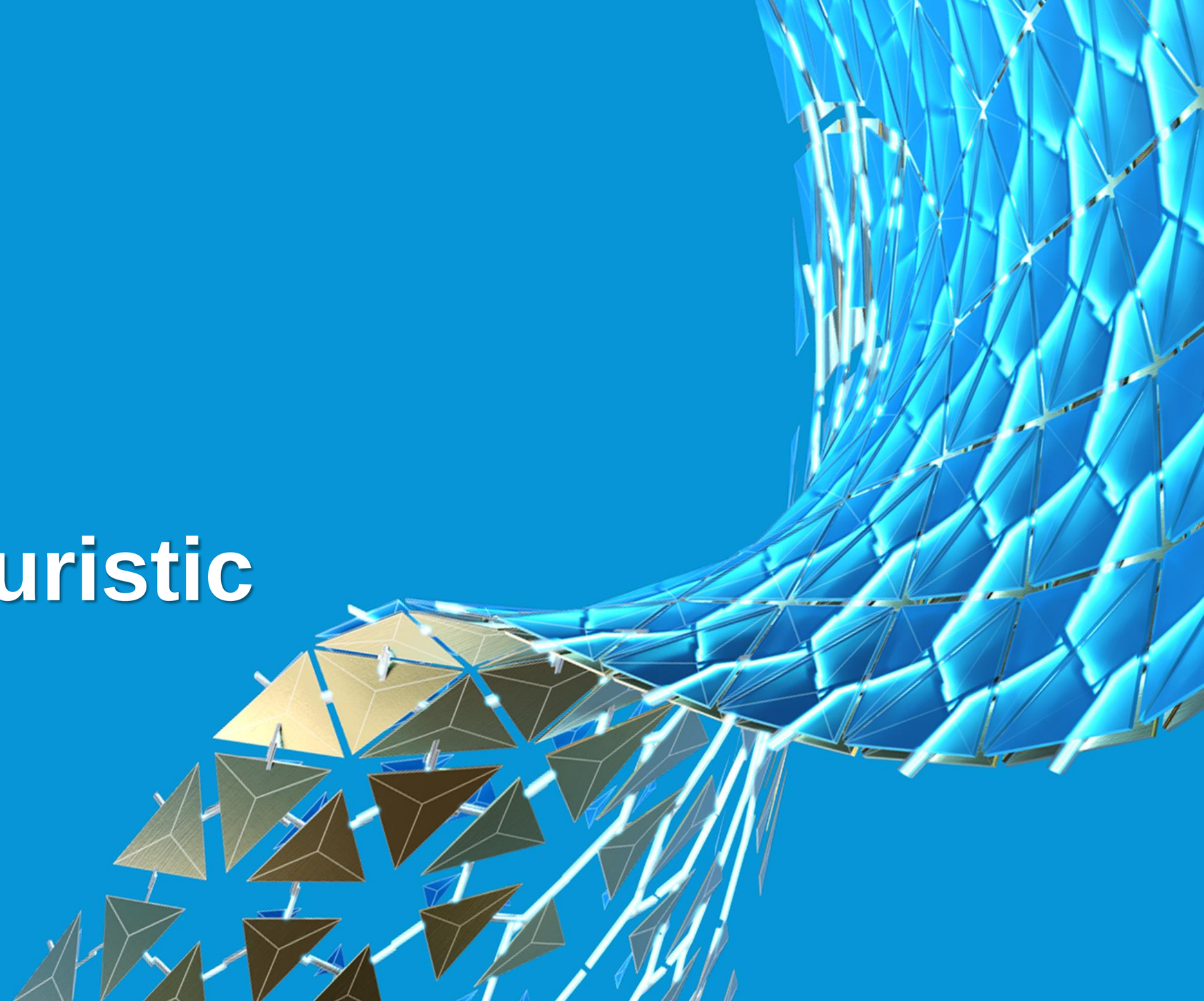
- Increased air quality of surrounding areas by 30% or more

# The Most Important Thing?

# Collaboration and Systematic, Iterative Design

# 03

# This is Futuristic Right?



# Industry Leaders Worldwide

**DPR Construction**
Richmond, VA

**Autodesk**
San Rafael, CA

**Skanska**
Boston, MA & Atlanta, GA

**AECOM**
London, UK

**Boklok**
Malmö, Sweden

# Autodesk Inc.

## BIM Design Market Leader

- Revit, Civil3D, Inventor, Generative Design, AutoCAD, Navisworks

## Digitized Construction Market Leader

- BIM 360, Assemble Systems, Plangrid, Building Connected, Pype, TradeTapp

## Renewable Investment

- 99% renewable energy to run cloud platforms & offices
- $39.9 Million in product donations

## Autodesk Foundation

- 1% target of operating margin to  contribution for next 3 years

**#5 most sustainable company in the world,**
**#1 most sustainable software company in the world**

**- Corporate Knights 2020 Global 100**

AUTODESK®

Make anything.

# Skanska USA

**Sustainability Initiatives & Carbon Tracking**

1. Living Building Challenges
2. Sustainability Team
3. EC3 Carbon Calculator

## Carbon Tracking – EC3

- Calculating *Embodied* Carbon
- Find & Compare Materials
- Can be used on All Projects

## Living Building Challenges

- “Process wouldn’t have been possible without technology”
- Teaming up with Universities & Colleges
- Striving for net-zero or net-positive energy

## Sustainability Initiatives

- Sustainability team within Skanska
- Matterport scanning to scan spaces for materials, atrium space & amount of light
- Sustainability driven by owner

EC3

LIVING BUILDING CHALLENGE

SKANSKA

# DPR Construction

## Schedule Reductions

- 3 buildings all similar
- 1st – 30 day schedule completed in 15
- 2nd – 15 day schedule completed in 11
- 3rd – In progress

## Material Tracking & Waste Reduction

- 80 Miles of Struts in first 2 buildings
- Only 1 pallet /~ 300 feet left over
- 5 truck loads from warehouse to site for each building
- 1 dumpster of waste from shop each week

## BIM Data Management

- Library of BIM data for future projects
- 3D Model quantification
- Cloud Collaboration

## Prefabrication & Material Tracking

1. BIM Workflows
2. Off Site Prefabrication
3. Installation Tracking

DPR CONSTRUCTION

# The Kicker…

**“We didn’t even do it for environment’s sake. Steel prices were going up and we needed to make sure quantities were exact for cost reasons.”**

# AECOM UK

**Carbon Modeling, Generative Design, Modular & BIM**

## Model Data

- Imputing embodied Carbon into BIM Models
- Library of Parts to optimize design process
- embedding construction intelligence into libraries to automate construction information

## Generative Design

- Establishing Baseline & New Potentials
- Site Optimization
- Solar Path & Wind path planning
- Distance to transport links and services

## Modular

- Housing
- Material Optimization
- High Performance Materials
- Built using BIM

## “Kicking Carbon”

1. BIM Design & Data
2. Modular Building
3. Repetition

AECOM

# BOKLOK

**SUSTAINABLE, QUALITY HOMES AT A LOW PRICE, FOR ALL.**

## Founded in Sustainability

- Modular design & construction
- Industrialized timber construction
- Sustainability personnel on staff

## Solar as a Standard

- Every Swedish Housing Project includes solar (PV) technology
- Economical
- Regional Challenges

## Monitor & Maintain

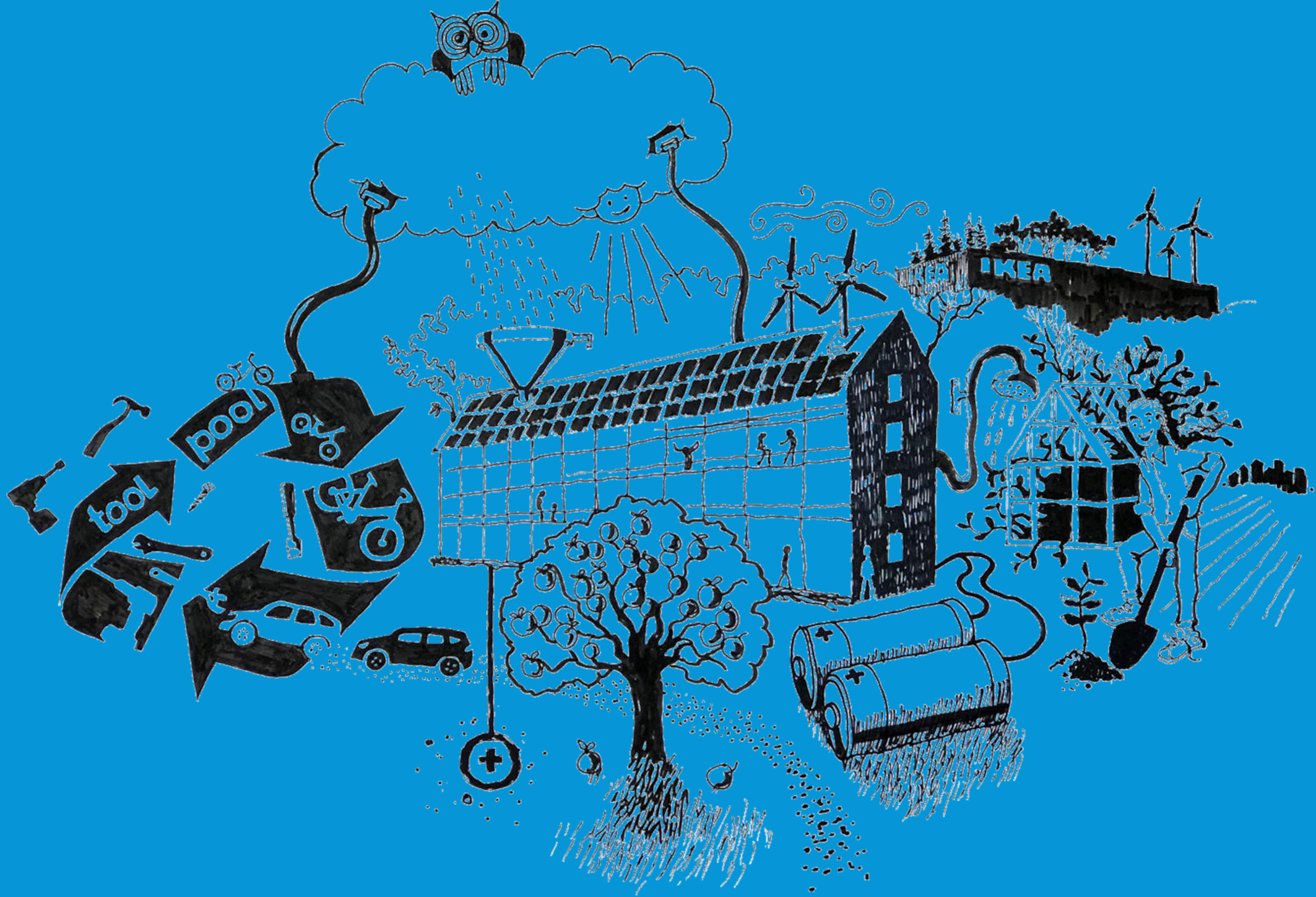
- Follow projects after completion & track performance
- Study data and research trends
- Optimization and quality assurance

## Globally Focused

- Businesses in UK, Sweden, Finland & Norway
- Aligned with UN Standards for sustainability & equality

BO KLOK®

SKANSKA & IKEA


tool
pool

# Målbild Grönhult – Current Design

## Off Grid Ready

Able to be operational for 1 week disconnected from grid

## Water Reduction

60% less water usage through technology & rainwater collection

## Solar Heavy

Solar cells, solar collectors & battery storage included in every unit

## Above Standard

90% improvement on Swedish regulatory requirements

## Wind Turbines

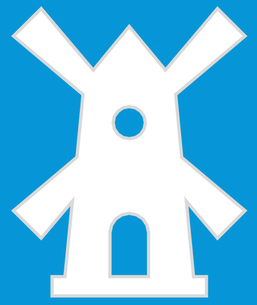
Wind energy collected & stored

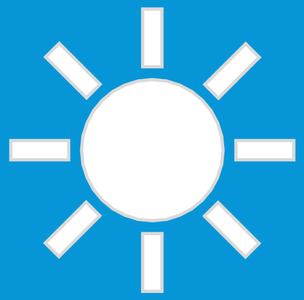
## Climate Neutral

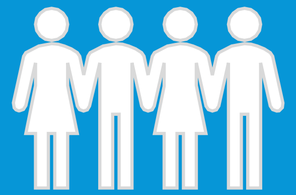
Likely to be net zero carbon

## Community Focused

Affordable housing, community gardens, car & bike pool





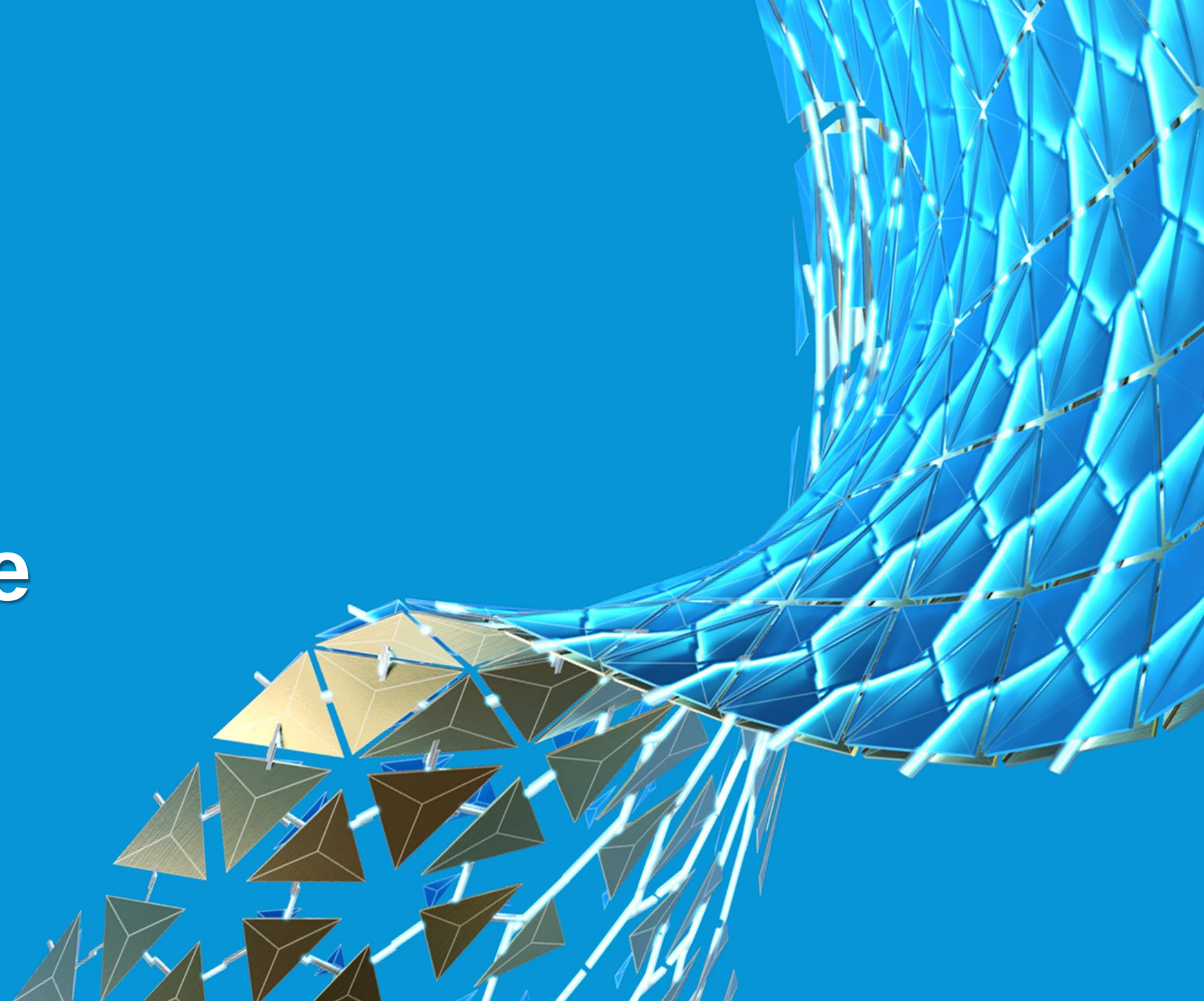


# The question was, this is Futuristic right?

# Not Really….

# 04

# Shifting the Paradigm



# What's the point?

1. The climate is an emergency, but there is still time to make a difference.
2. Construction is BAD, and I mean bad when it comes to sustainability.
3. Technology, innovation, and investment is the key to a brighter future.
4. Go check out and support USGBC, DBIA, Living Building Challenges and all the organizations out there that are driving green building practices
5. There is money to be made off sustainable tech and green buildings

# Think about the environment as a business

Think about the environment as a business, particularly when it comes to the allocation of resources. Even if you're a start up, you don’t go using all your money and manpower without a company mission or goal you are looking to achieve. Even if you're using all your resources to grow, if  not used thoughtfully eventually they run out and you crash and burn. But if you manage those resources by  making informed decisions while keeping the future in mind, you have a much higher chance of being successful. I don’t care what your company mission or goal is, if you work at a for profit business, you are here to make money, and to be successful for a long time..... Just like a new business venture, a sustainable future is going to take an investment to get started, along with a decent amount of buy in and manpower, But if we managed in this way I honestly believe we can all survive and more importantly prosper for generations to come.

# Acknowledgements!!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Director Of Innovation at AECOM UK

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**Sara Brantvall**
Senior Environmental Engineer & Energy Consultant at Boklok

# Thanks for Listening!!


# Any Questions?

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