

# AUSTIN FORUM

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ON TECHNOLOGY & SOCIETY

*Connect. Collaborate. Contribute.*™

*Welcome to the*  
***Austin Forum on Technology & Society!***

*We bring leaders, thinkers, builders, creators, and learners together to **connect, collaborate, and contribute!***

*Thank you for joining our community  
online or in-person!*



# The Technologies, Applications, and Future of 3D Printing

Oct 3, 2023

Thank you, Austin Women in Technology!



**Austin Women  
in Technology**

CONNECT. LEARN. GROW. **LEAD.**

# Our Partners Make Austin Forum Possible!

ADAPTER



arm



SXSW



whurley

*Please contact us if you want to become an annual partner!*

# Thank you to our new Austin Forum Champions!

**Nancy Giordano**  
*Mitch Jacobson*  
**Kelley Knutson**

**Roy Truitt**  
**Luke Wilson**

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## And our new Friends of the Forum!

*Bruce Bogart*  
**Don & Mary Kay Hanson**  
*Vaishali Jadhav*

*Gabe Schuyler*  
**Chris Van Loan**  
*Jarrett Webb*

# You can be an Austin Forum Champion today!



BE A CHAMPION!  
BE A FRIEND!

**With your quick help & support, we can provide great educational programming and informative experts (\$1000+)**

- Offer advice on programming topics, invited speakers, podcasts & events
- Attend the annual meeting & VIP reception
- Get a nice tax deduction!
- Get cool AF swag
- 100% of your gift goes to executing the Forum
- **THANK YOU!**



**Or be a Friend of the Forum—*forever!***

- Get cool AF swag
- Get a tax deduction!
- 100% of your gift goes to executing the Forum
- Listed on our Friends page *forever!*



# We have 6 ways to learn, share, connect!

Live monthly events	Online content
<b>Presentation + Networking events</b> <ul style="list-style-type: none"><li>• Expert presenter-focused</li><li>• In-person and online—hybrid</li><li>• Recording and slides posted online</li></ul>	<b>Slack Community</b> <ul style="list-style-type: none"><li>• Get updates and register for events</li><li>• Learn more about the Austin Forum</li><li>• Ask questions, share, etc. (Slack)</li></ul>
<b>Meetup discussion events</b> <ul style="list-style-type: none"><li>• Participatory for everyone</li><li>• In-person <b>only</b></li><li>• Never recorded—speak freely!</li></ul>	<b>Podcasts – Austin Forum Upload (<i>new episodes weekly</i>)</b> <ul style="list-style-type: none"><li>• Audio only</li><li>• Conversation formats</li><li>• Hosted in all major podcast stores, AF website</li></ul>
<b>Book discussion events</b> <ul style="list-style-type: none"><li>• Participatory for everyone</li><li>• Online <b>only</b></li><li>• Never recorded—speak freely!</li></ul>	<b>Blog – Austin Forum Update (<i>October 2023</i>)</b> <ul style="list-style-type: none"><li>• Web-based (on Medium)</li><li>• Weekly(ish) articles</li><li>• Multiple formats: “Techsplanations,” interviews, analyses/positions, and series</li></ul>



# Before we get started, join our slack

## *Why join the Austin Forum Slack workspace?*

1. Continue and deepen the conversation after Austin Forum events
2. Find new opportunities for collaboration, mentoring, working, and more
3. Promote local events and relevant Tech & Society opportunities
4. Because this gives *everyone* in our community—online and in-person—the *same* way to ask questions!

## *How?*

1. Open a web browser
2. Go to: [www.austinforum.org/slack](http://www.austinforum.org/slack)
3. Click “Join the Austin Forum Slack Workspace”
4. Enter your email address
5. Check your email to confirm Slack invitation
6. Enter your name and click “Create Account”
7. You’re in! You can use the Slack mobile app now, too.
8. Add channels to your view using + **Add channels**)

# Austin Forum Upload: New episodes out now!



## New episodes!

- **#68 – The Many Benefits of Gender Diversity in Tech Innovation**
- **#67 – Hot Summer, Hot Technologies - And the Value of Community and Networking**
- #66 – Web 3.0: It's Coming, It's Different, and Why You Should Care!
- #65 – Quantum Computing: Weird, Transformational, and Coming Sooner than You Think!

## New episodes soon with leaders in:

- **Digital Privacy (subject of Nov presentation event!)**
- Smart Infrastructure

***Q: If you could have something personal 3D-printed for you, what would it be? (30 seconds)***

1 2 3 4

11 12



19 20

27 28 29 😊

Questions for  
speakers?

Submit questions in  
the AF Slack channel

**#event-questions**

for a chance to win a  
*SXSW 2024 badge!*

*Must be in-person and  
present at ~7:45PM to win!*

*Must use your name (first  
and last) on questions!*



**SXSW** 

**AUSTIN FORUM**

ON TECHNOLOGY & SOCIETY

[www.austinforum.org](http://www.austinforum.org)

# And now, our featured presentation...

## Please:

***Respect our speakers & audience***

*Do not talk during the presentation*

*Silence your cellphones*

***Ask questions*** in the Austin Forum  
Slack in the **#event-questions**  
channel

***Learn, think, and enjoy!***

***Stay after Q&A for networking!***

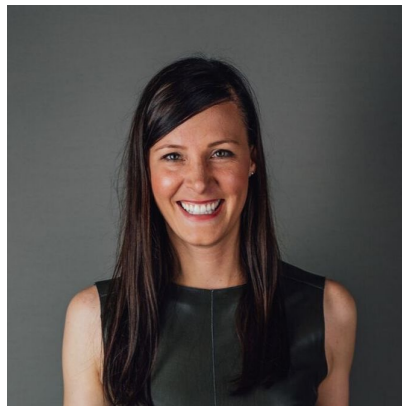


# The Technologies, Applications, and Future of 3D Printing



**Leslie Bush**

Metal 3D Printing  
Applications Engineer  
**EOS**



**Samantha Snabes**

Co-founder  
**Re:3D**



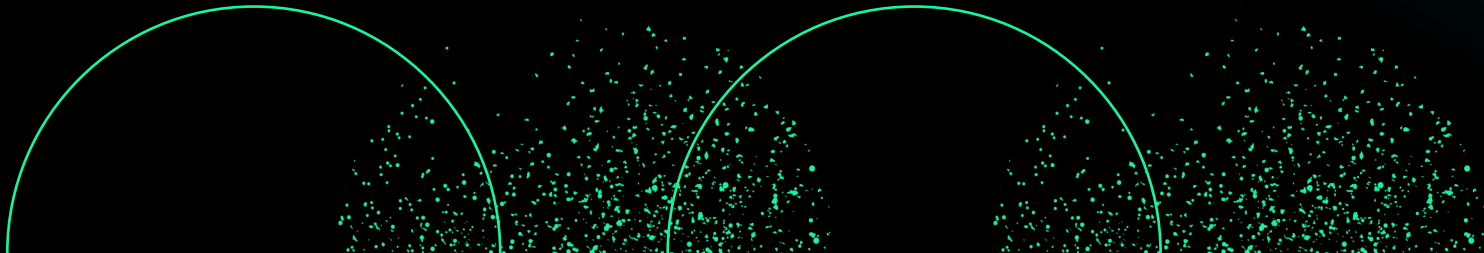
**Melodie Yashar**

VP of Building  
Design & Performance  
**ICON**



# Engineering for your Imagination

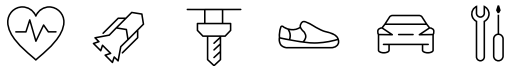
EOS provides responsible manufacturing solutions via industrial 3D printing technology to manufacturers around the world



# EOS Mission

With 30+ years of additive manufacturing experience, EOS is the leading provider of additive manufacturing solutions.

Our systems and services are essential to the digital factories of the future.



# EOS Vision & Purpose

Additive manufacturing is a key technology for advanced industrial production.

We exist to accelerate the world's transition to responsible manufacturing with industrial 3D printing.



Responsible  
Manufacturing



# EOS – A Growing Global Company

**Founded in 1989**

Headquarters: Krailling, Germany

**1,392** employees globally

Global EOS installed base  
> **4,392** systems

**56%** metal systems,

**44%** polymer systems

EOS Sales & Service offices  
in **15** countries

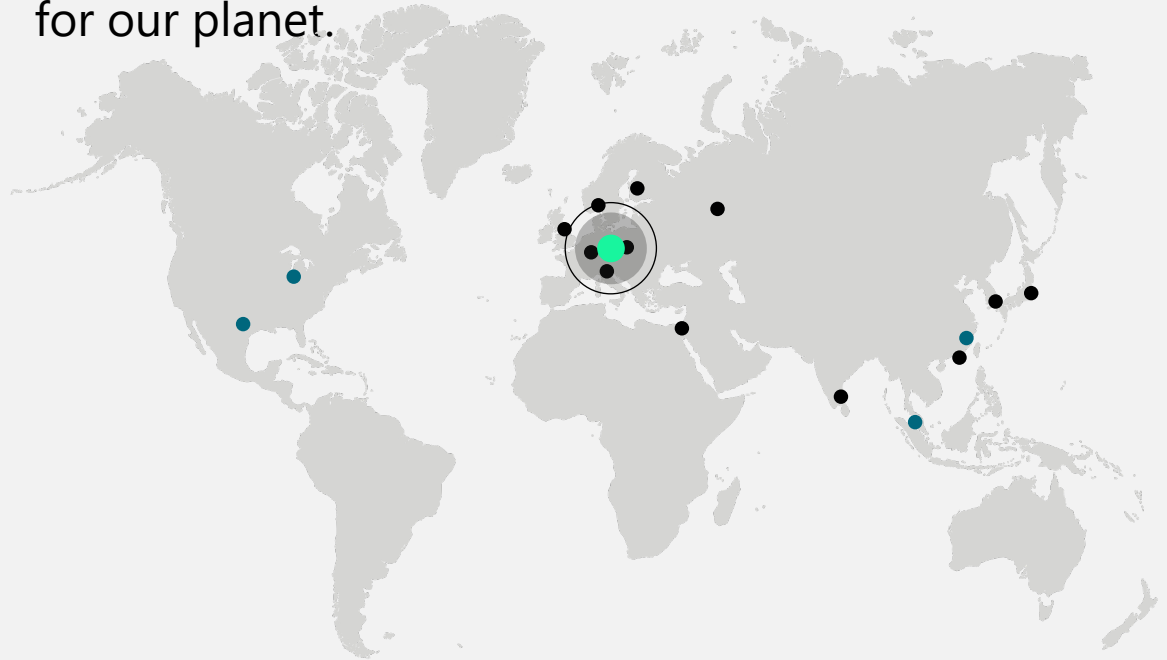
**75** distribution partners in **50** countries

Gross sales in FY 21/22: **358 m€**



Source: EOS. Installed base (includes purchased and rented systems) and staff figures as per 01/2022.

Powered by its platform-driven digital value network of machines and a holistic portfolio of services, materials and processes, EOS is deeply committed to fulfilling its customers' needs and acting responsibly for our planet.



# Additive Manufacturing Offers Unique Solutions

## Challenges of Industrial Companies



Faster **time-to-market** combined  
with **shorter lifecycle**



**Productivity increase**  
Need for cost reduction



**Flexible production**  
"factory around the corner"



**Innovation**  
Increase of customer value-add



**Customization** of products



Focus on **sustainability**



## Advantages of Additive Manufacturing



### **Freedom of design**

Lightweight enables highly complex structures



### **Customization**

Customer-specific adaptations, cost-efficient  
small series



### **Functional integration**

Embedded functionality without assembly

### **Increased productivity**

Rapid prototyping and serial applications

# Additive Minds Consulting

The World's Largest Consulting, Engineering, & Training Unit for Additive Manufacturing



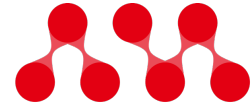
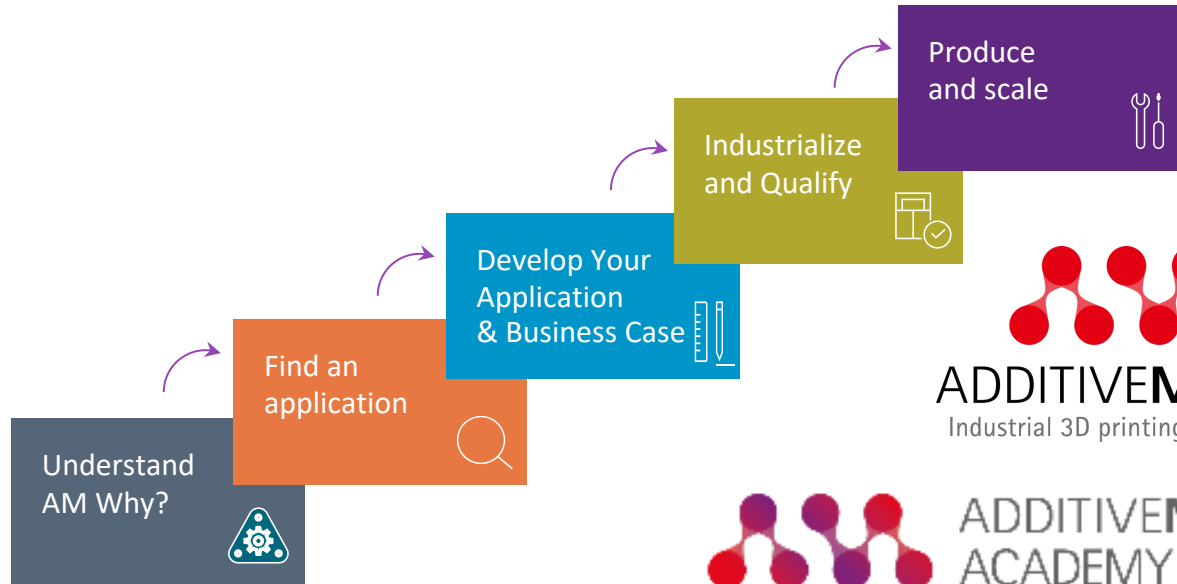
Consulting



Applied Engineering



Training & Education



**ADDITIVEMINDS**<sup>®</sup>  
Industrial 3D printing excellence



**ADDITIVEMINDS**  
ACADEMY

# The Additive Minds Academy accelerates learning curves

Customized in  
person  
classes:

From part  
identification  
workshops to co-  
engineering  
programs

3+  
learning  
paths:

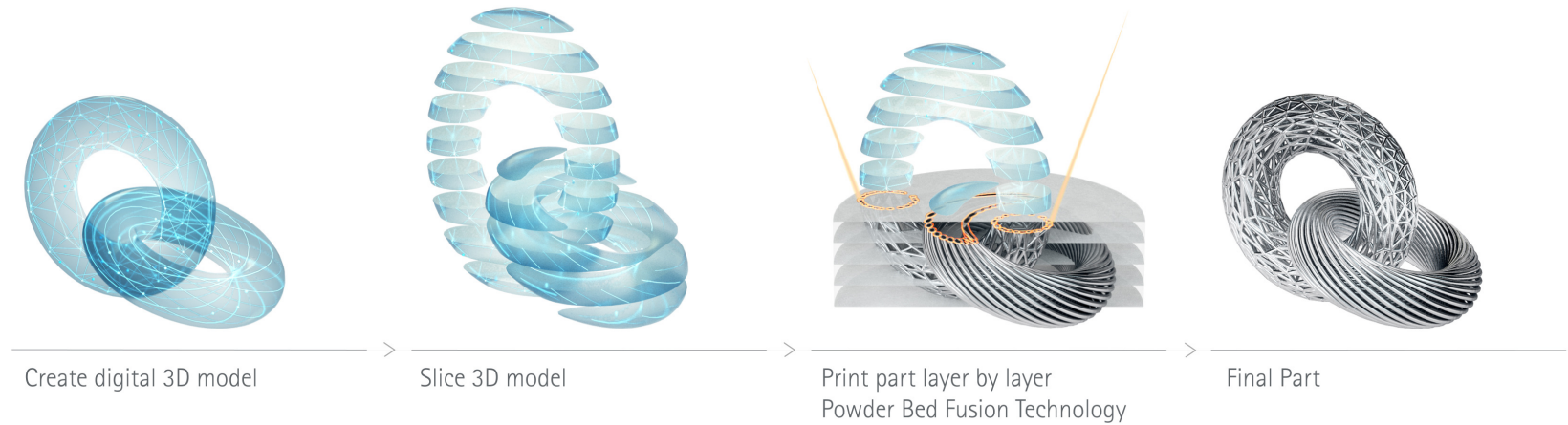
6-week DMLS and  
SLS educational  
blended learning  
programs

20+  
E-Learnings:

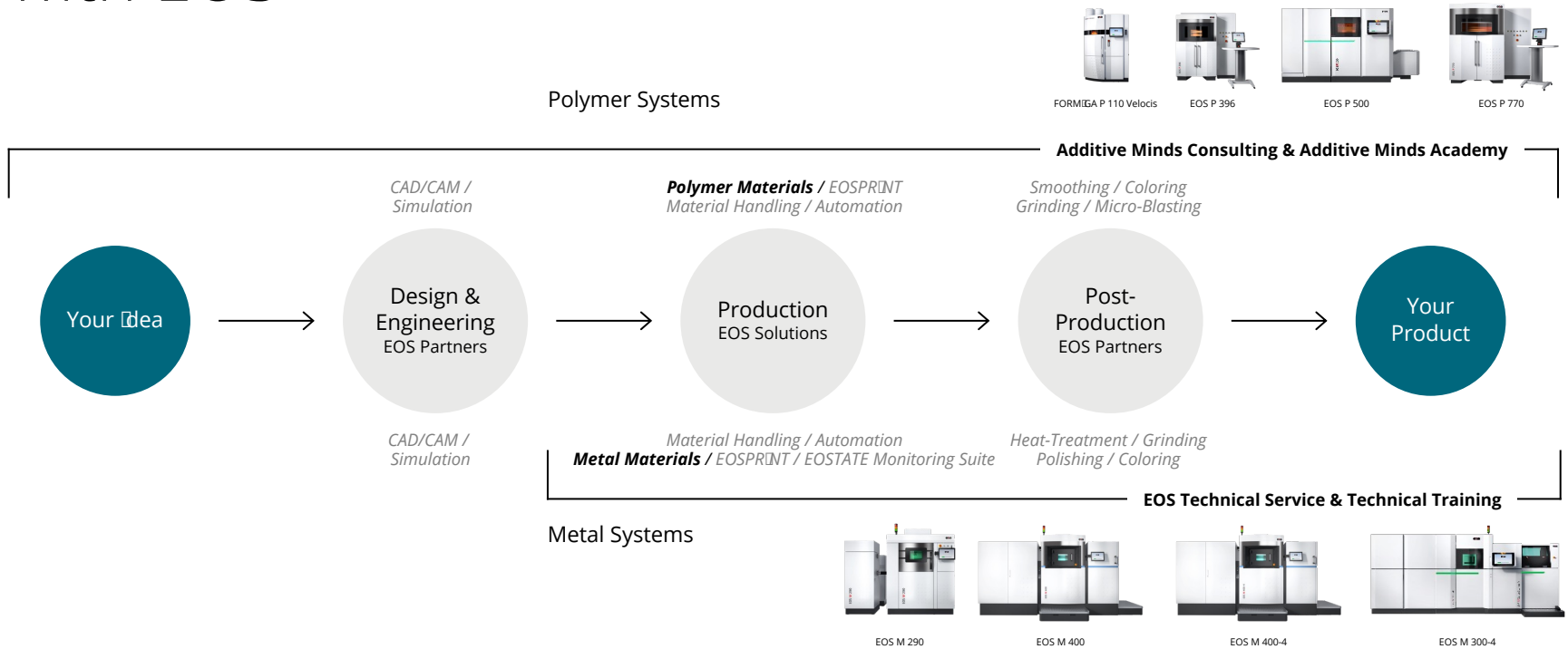
From part screening  
and selection to  
support-free DMLS

# EOS Additive Manufacturing How it Works

## General functional principle of laser sintering



# From Idea to Product with EOS



# EOS Offers Solutions for a Wide Range of Industries

Rapid Prototyping



Aerospace



Medical



Industry



Tooling



Lifestyle



Automotive



## Products

### Design

Application-specific  
(e. g. lightweight)



## Solutions

### Build

Systems Material  
Software Processes  
Service Consulting



## Services

### Finish

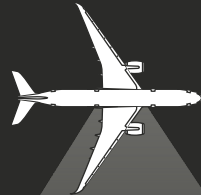
Surface  
Engineering

# Airbus A350 XWB From Ten to One 3D Printed Component

**AIRBUS**

## One AM part – Latch shaft

Weight: 45 % lighter, about 4 kg per aircraft  
Cost: 25 % less expensive to produce  
Traditional 10 parts vs. 3D printed 1 part  
Each A350 requires 16 latch shafts



## CO<sub>2</sub> reduction potential

> 3 000 kg CO<sub>2</sub> per plane, per year

## Fuel cost reduction potential

Lightweight part design could equate to significant savings of fuel costs per plane



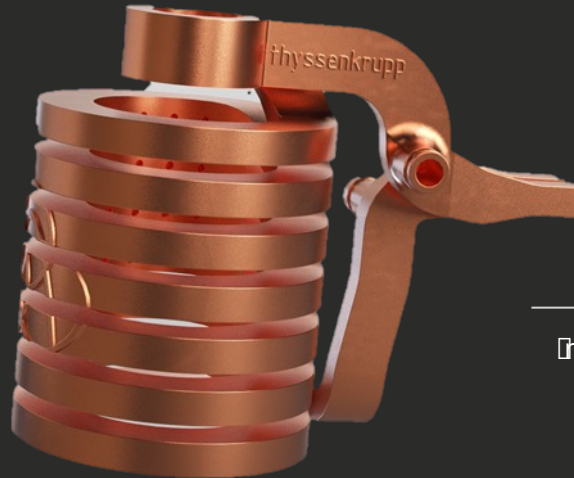
# Dual Function Inductor

## Less power consumption

During use, this dual function inductor needs up to 60 % less energy

## Additional benefits

Functional integration of heating and quenching, flow optimized cooling channels, up to 58 % reduction of part cost



## Higher productivity

Increased lifetime of 2.5 x leads to increased output per inductor compared to conventional inductors and needs less material for reproduction



YOU MAWO

# Custom Made 3D Printed Eyewear Frames Produced by YOU MAWO

## Customization

Custom made 3D printed eyewear based on a 3D scan - designed and produced in Germany.

“Make to order”



## Dedicated AM production company

Ramp-up and enablement strongly supported by EOS and Additive Minds

## Sustainability

Local production “Made in Germany” and more sustainable than conventional production

# Lightweight 3D Printed Component for Aviation

**LIEBHERR**

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Conventionally  
manufactured  
valve block



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## Reduction potential

Optimized component reduces  
**fuel consumption** as well as  
**CO<sub>2</sub> and NO<sub>x</sub> emissions**



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## Improved design

New 3D printed design offers the  
same performance but is 35 %  
lighter and made from fewer parts

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Optimized metal  
3D printed valve block

# Production of Orthoses with 3D Scanning & 3D Printing

**ottobock.**

## **Bespoke design**

---

Tailor-made using 3D scan data to fit unique patient anatomy

## **Improved comfort**

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Design freedom allowed for thinner walls and perforations for breathability and comfort



## **Standardized Production**

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Consistent and repeatable production quality. Any orthosis can be reproduced with the same structure and characteristics

# Thank you!

*EOS®, Alumide®, AMQ®, CarbonMide®, DirectMetal®, DMLS®, e-Manufacturing®, EOSAME®, EOSINT®, EOSIZE®, EOSPACE®, EOSPRINT®, EOSTATE®, EOSTYLE®, FORMIGA®, PrimeCast® and PrimePart® are registered trademarks of EOS GmbH in some countries. For more information visit [www.eos.info/trademarks](http://www.eos.info/trademarks).*

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icón

# Slides redacted by company policy

By **Melodie Yashar**  
03 October 2023

Austin Forum

# BEYOND THE HYPE: THE FUTURE IS GARBAGE



®



**re:3D's waste  
printing journey**

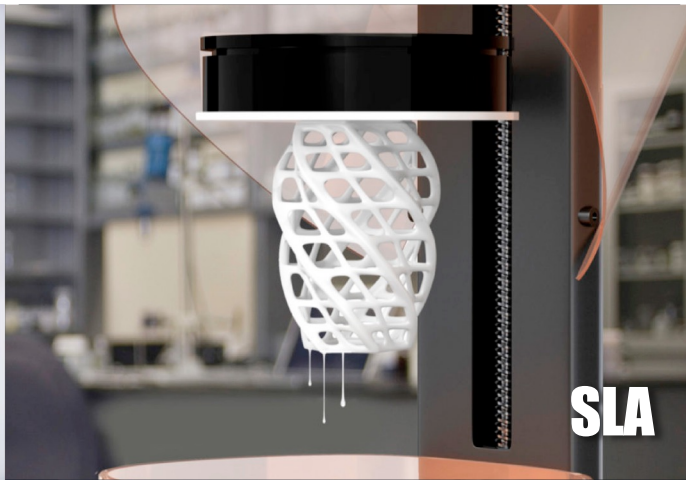
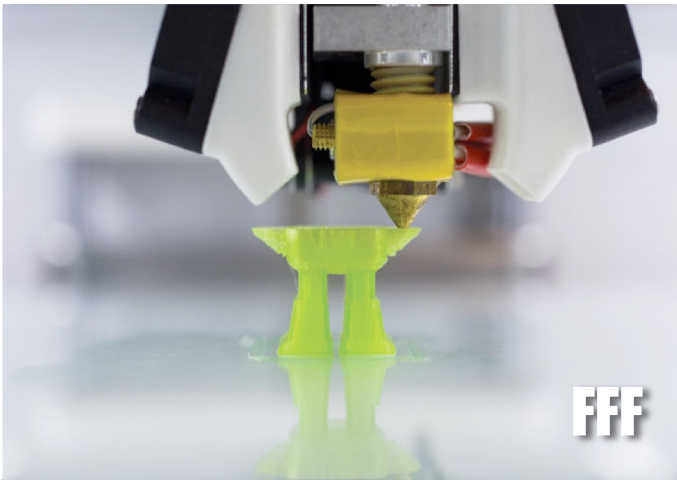






# VIEWING TRASH AS A RESOURCE





## **TYPES OF 3D PRINTING**

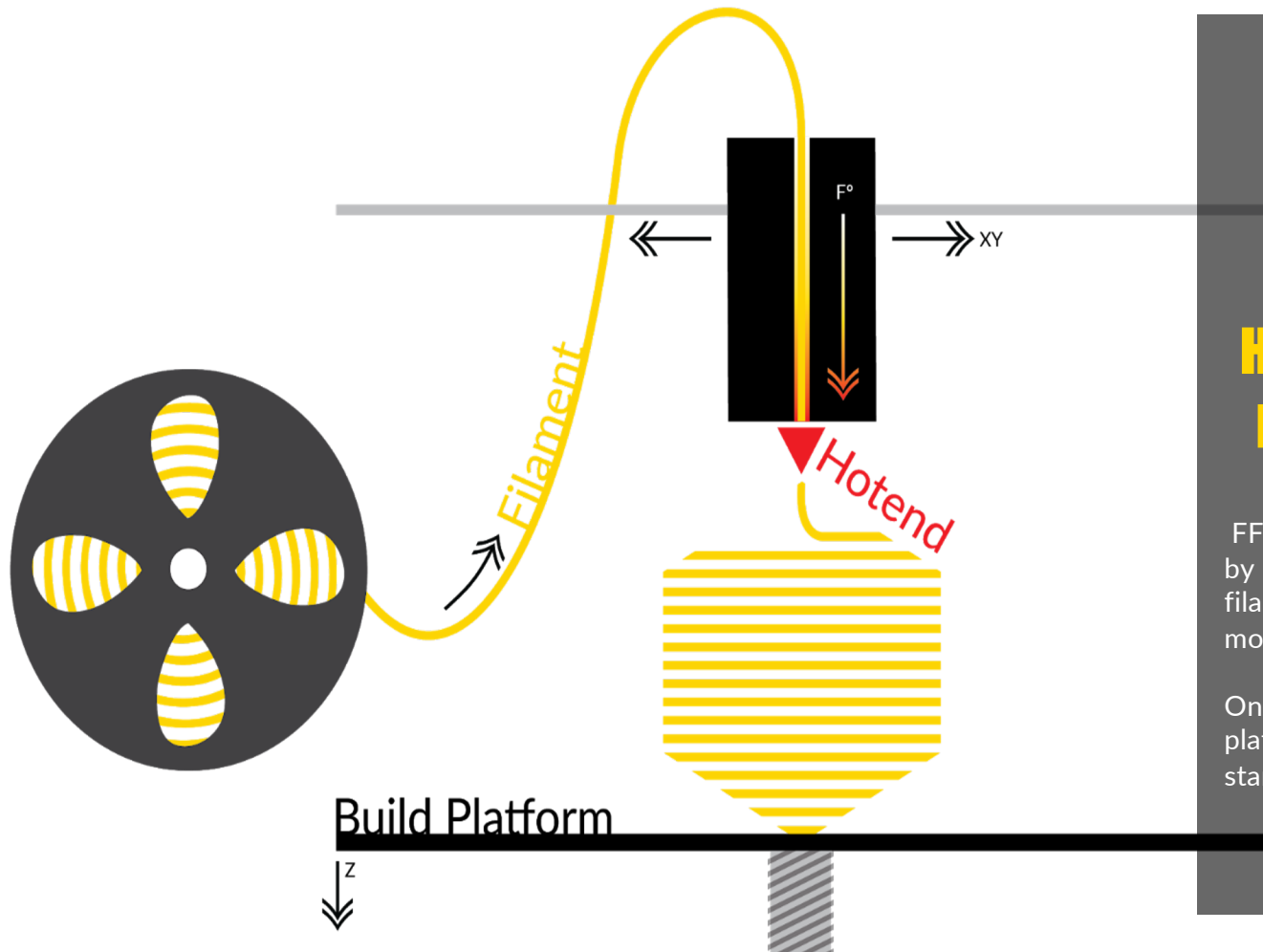
Starting from 1984 with the invention of photopolymer additive manufacturing “SLA”, many kinds of 3D printing technology are available such as: SLS (laser + powder), FFF (thermoplastics) and MJF (heat + powder).



## How does FFF 3D printing work?

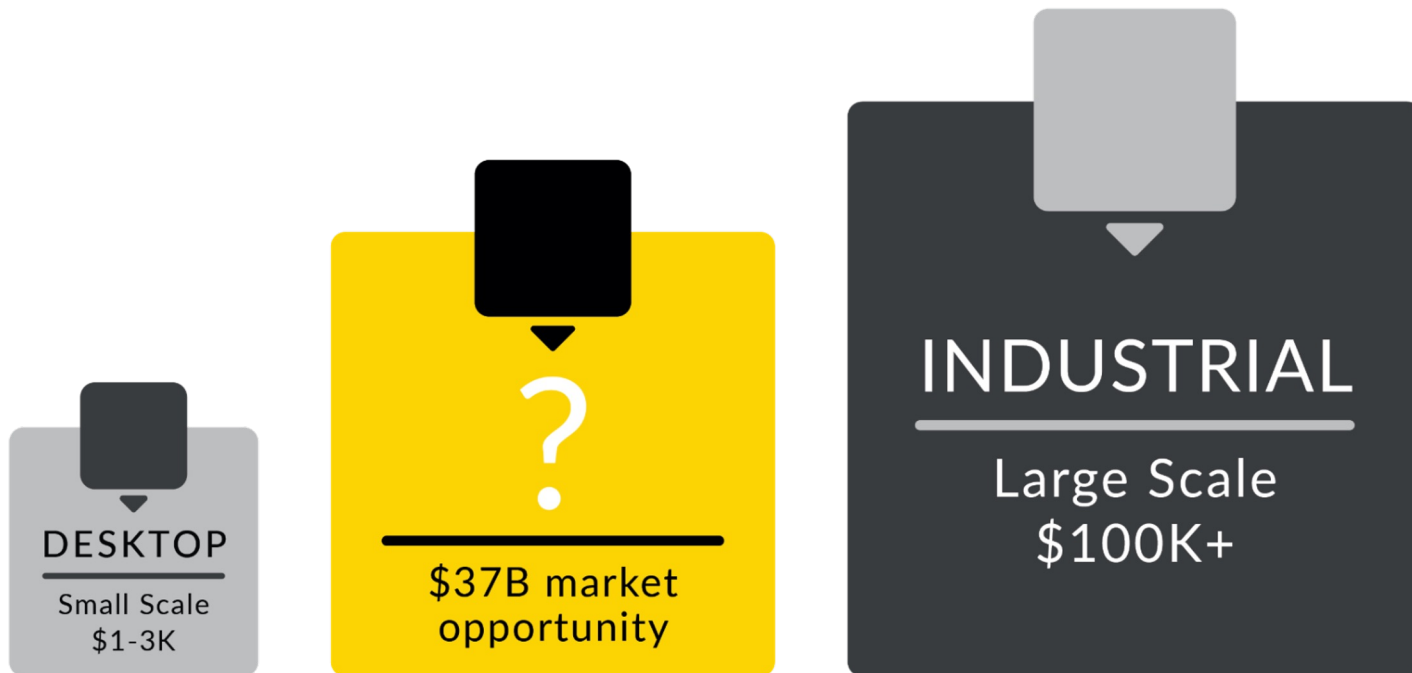
FFF 3D printers create objects by melting and extruding plastic filament through a hotend while moving on a X & Y direction.

Once the layer is finished, the platform moves downwards to start the next layer.





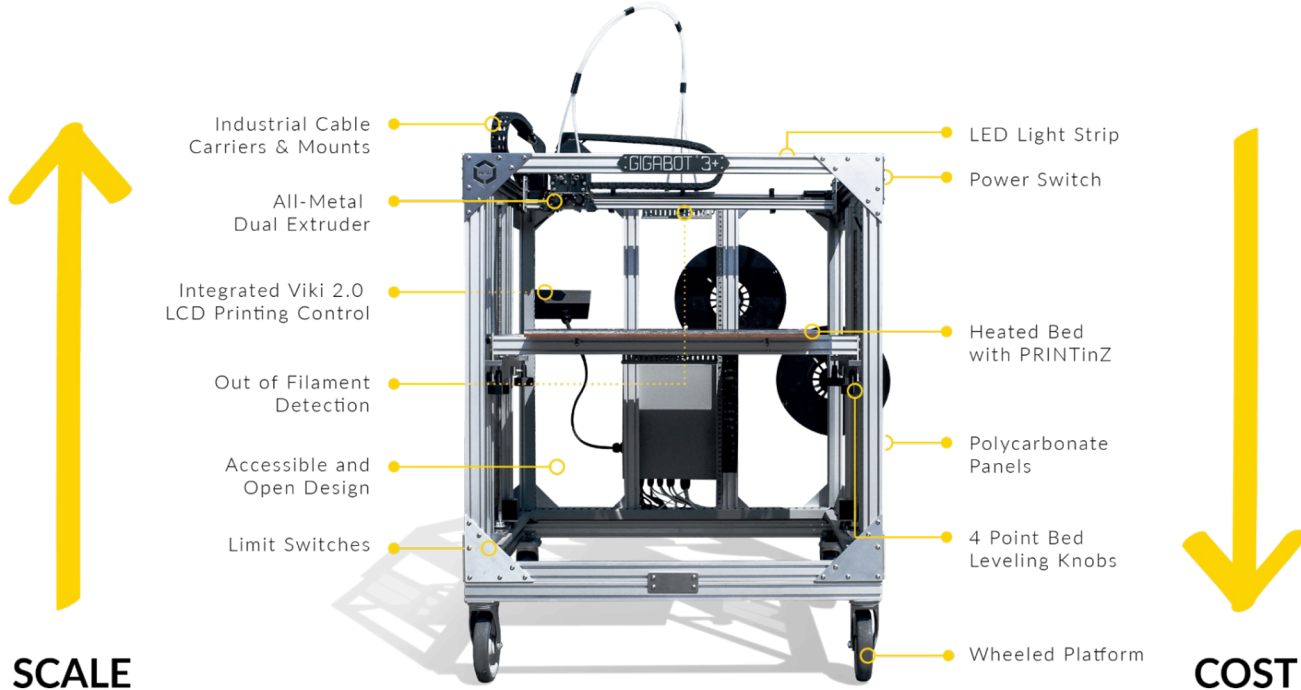
# HUMAN SCALE 3D PRINTING OPTIONS







# GIGABOT (LAUNCHED ON KICKSTARTER 2013)




**Your Factory for <\$10K**



# WHAT UNITES US: SOCIAL RESPONSIBILITY


FOR EVERY 100 PRINTERS SOLD, WE DONATE 1 TO SOMEONE MAKING-A -DIFFERENCE



**Tunapanda**



NAIROBI  
KENYA



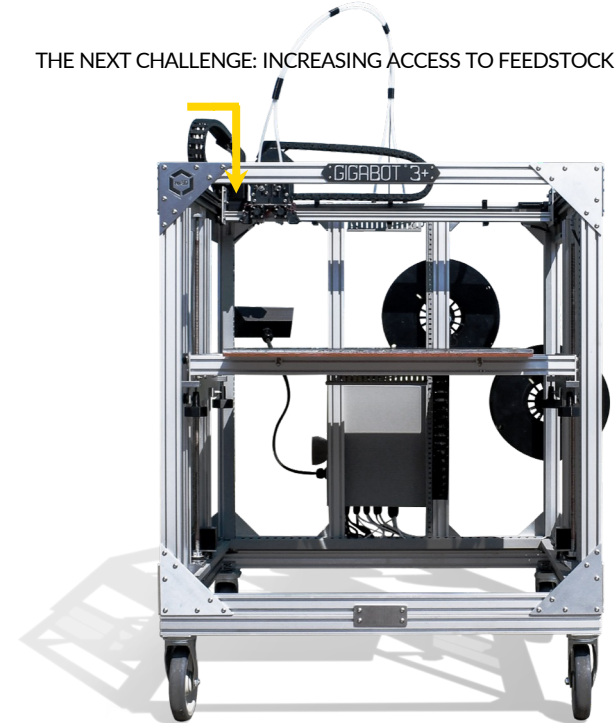
**e-NABLE**



ROCHESTER  
NY, USA



THE NEXT CHALLENGE: INCREASING ACCESS TO FEEDSTOCK





# **3D waste printing pioneers**



# EARLY INSPIRATION



Voices of Africa Foundation: <https://voicesofafrica.info/2016831techfortrade-thunderhead-pet-filament-extruder-technical-feasibility-study>

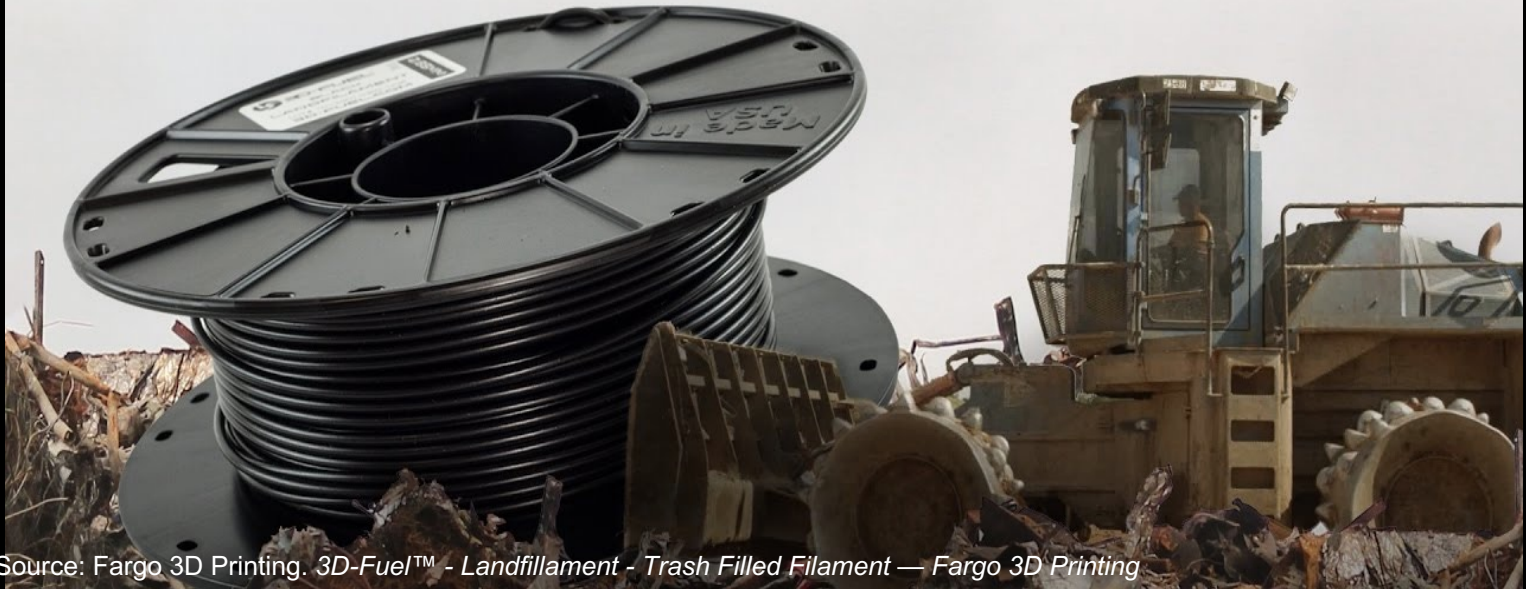
Transformemos  
el futuro  
del plástico

as del futuro  
OCIMIENTO  
CURSO  
CITY MANAGER  
CAL MEDA



# LANDFILLAMENT™

## PRINT WITH TRASH!



Source: Fargo 3D Printing. 3D-Fuel™ - Landfillament - Trash Filled Filament — Fargo 3D Printing



Source: *International Business Times UK*: [www.ibtimes.co.uk/3d-printed-mud-houses-use-plant-seeds-inside-grow-roots-support-1492865](http://www.ibtimes.co.uk/3d-printed-mud-houses-use-plant-seeds-inside-grow-roots-support-1492865)

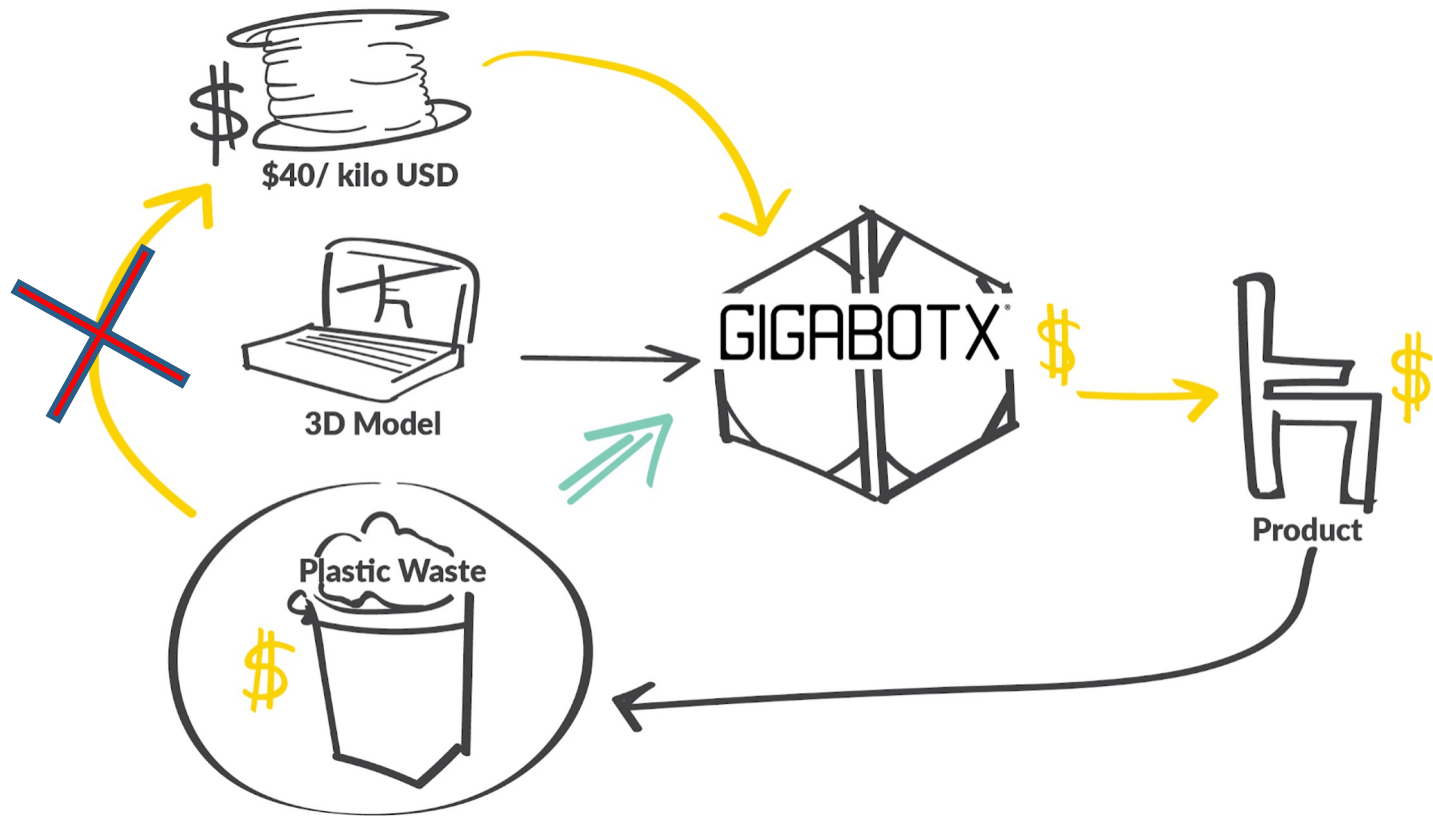




FAD Magazine: [fadmagazine.com/2013/05/29/awesome-3d-chairs-created-using-the-endless-process-by-dirk-van-der-kooij/..](http://fadmagazine.com/2013/05/29/awesome-3d-chairs-created-using-the-endless-process-by-dirk-van-der-kooij/)





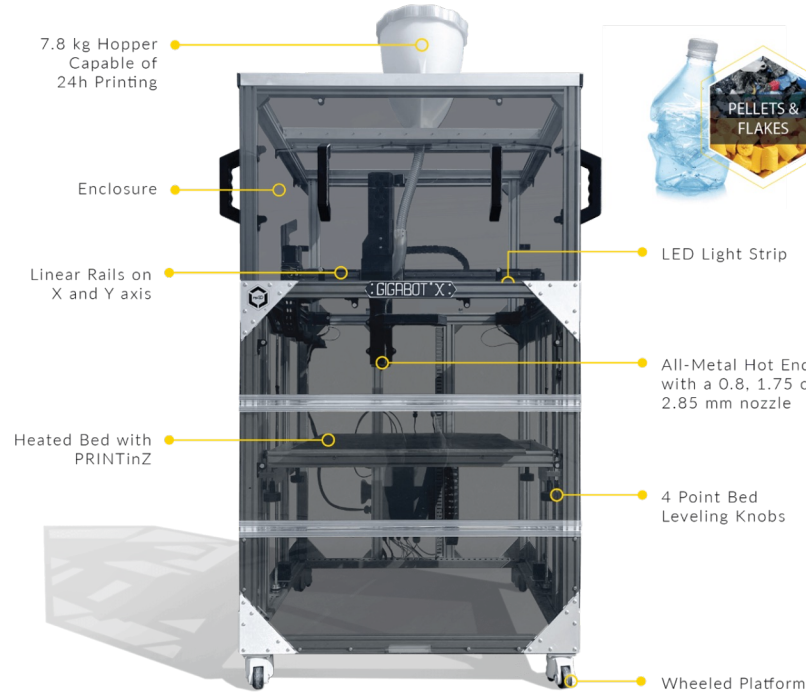




# GIGABOT X: A PELLET PRINTER THAT TAKES FLAKE



SCALE



COST

## FEED SYSTEM

Gravity fed from  
overhead hopper with  
auto-loader available  
for continuous feeding

## EXTRUSION SCREW

16:1 L/D with 1.75:1  
Compression that  
accepts common 1-5mm  
commercial resin pellets



## EXTRUDER MOTOR

Nema 23 with All-Metal  
Planetary Reduction

## HEATING SYSTEM

Three zone independently  
controlled barrel heaters  
capable of printing  
thermoplastics melting  
below 280C.

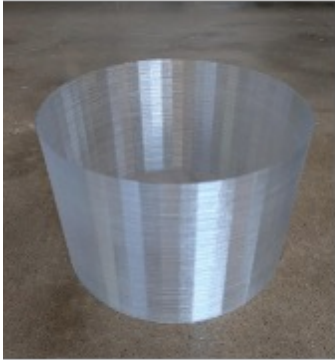
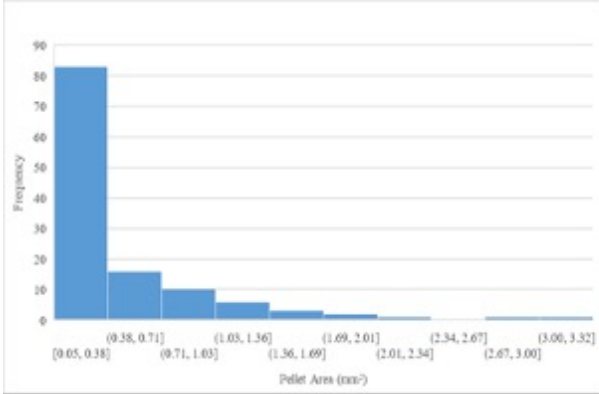


## NOZZLE

Nozzle with 0.8, 1.75 or  
2.85mm orifice, available  
in nickel coated brass or  
hardened steel



# MORE THAN JUST AN IDEA



1/30/2018

El Nuevo Día

STARTS  
17 de enero de 2018

EMPRESAS Y EMPRENDEDORES / 23

EL NUEVO DÍA • [www.nuevo dia.com](#)

## Gana \$1 millón para crear impresora 3D que utilice basura

●●● Startup re:3D apuesta a Puerto Rico como destino piloto para su proyecto de usar botellas plásticas como materia prima para imprimir diversidad de objetos y soluciones



**\$8,550**  
PRECIO MÍNIMO

La impresora Gigabit de acción industrial es desde una gran inversión \$12,000.



Samantha Sánchez, CEO de re:3D, explica a que en menos de 30 meses se ha ido desarrollando una nueva versión de su impresora 3D industrial, que sea capaz de usar botellas plásticas como materia prima.

**Diana Mendi Pizar**  
@dianamendi

re:3D, una de las startups de la cuarta generación de la aceleradora PuertoRico360, se dio a esta tarea con el objetivo de re:3D, una startup que se centrará en crear soluciones que cambien otras generaciones de la industria.

Los socios: Samantha Sánchez, CEO y cofundadora de re:3D, se propuso de desarrollar una impresora 3D de acción industrial, a gran escala y que sea capaz de usar botellas plásticas como materia prima para crear todo tipo de soluciones, equipos

que, según dice el ingeniero de la universidad del estado.  
"El objetivo de re:3D es crear una solución que sea capaz de usar botellas plásticas como materia prima. Este equipo será la nueva generación de la industria de impresión 3D Gigabit, que fabricará en su sede de Aguas, con una inversión de \$12 millones y la ir

de adquirir en más de 30 países. La nueva versión, según sus cálculos, utilizará 30,000 botellas de agua a la hora de ser operada. Este equipo se centrará en Gigabit se dedicará a hacer dispositivos en su sede. "Nos encanta Puerto Rico y creemos

"Nos encanta Puerto Rico y creemos en hacer este proyecto en la isla"

**SAMANTHA SÁNCHEZ**  
CEO de re:3D

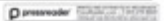
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de la NADA que está en una versión beta con los socios de la industria. Los socios de la industria de la NADA que está en una versión beta con los socios de la industria. Los socios de la industria de la NADA que está en una versión beta con los socios de la industria.

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La impresión de la NADA que está en una versión beta con los socios de la industria. Los socios de la industria de la NADA que está en una versión beta con los socios de la industria.



**Printing from  
garbage is hard**

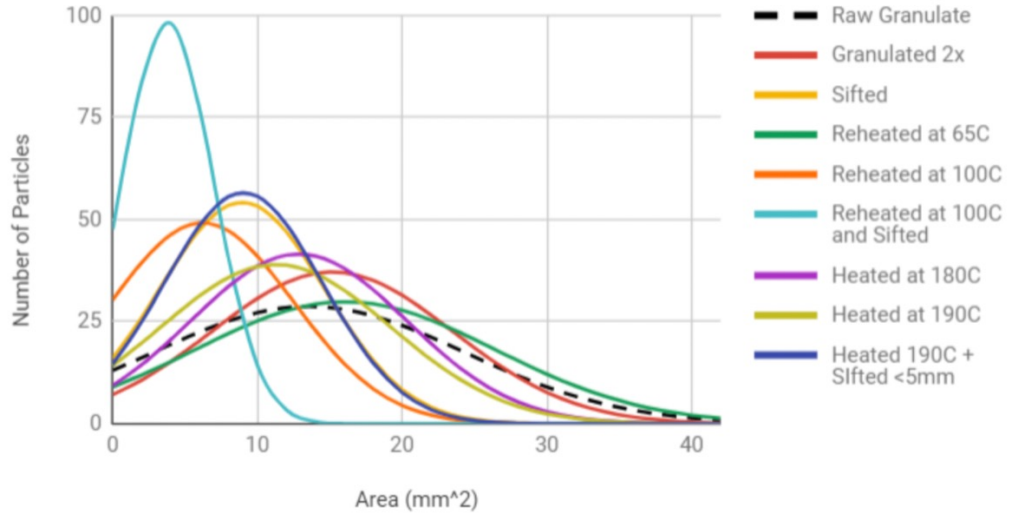


# ALL WATER BOTTLES ARE NOT ALIKE



## Effect of Processing Methods on Particle Size

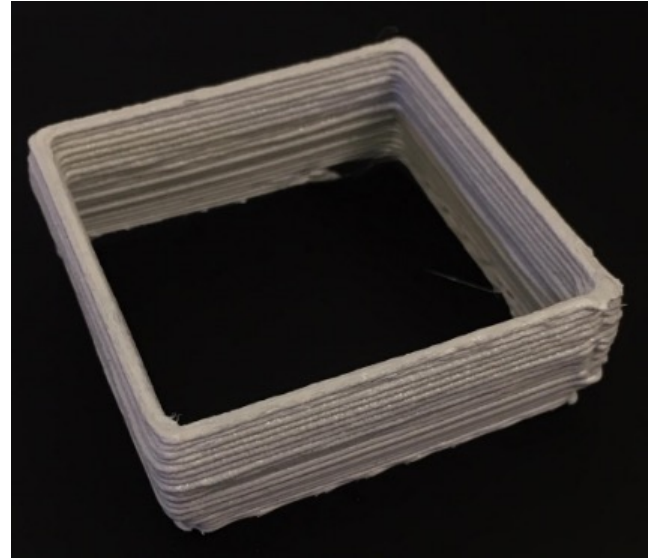
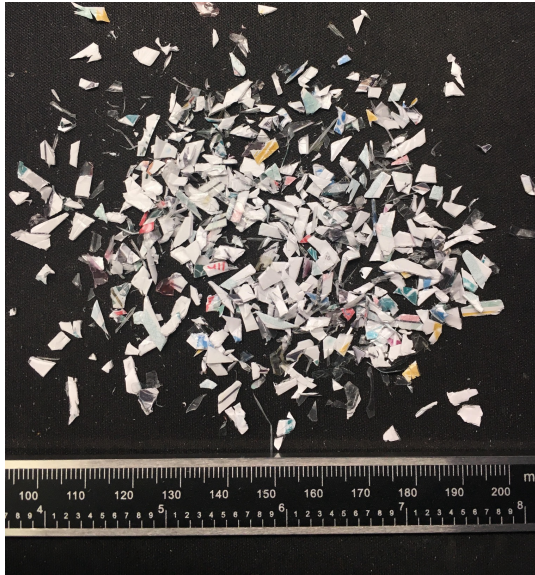
Normal Distributions Curves for PET Water Bottle Granulate



PARTICLE ANALYSIS IS CONDUCTED WITH OPEN SOURCE SOFTWARE IMAGEJ. OPTIMAL FLAKE SIZE IS 1 - 5MM.

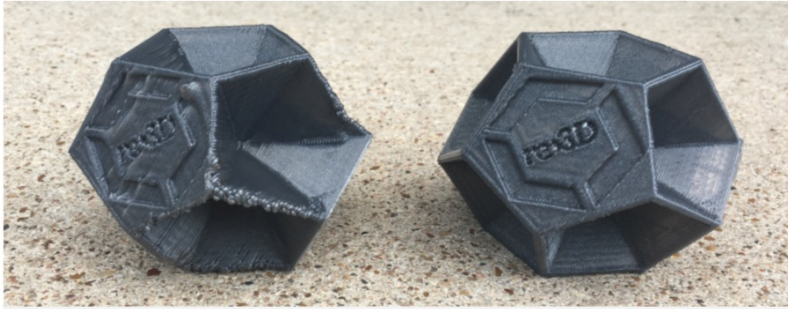


# GETTING TO PRINT IS A SLOW PROCESS





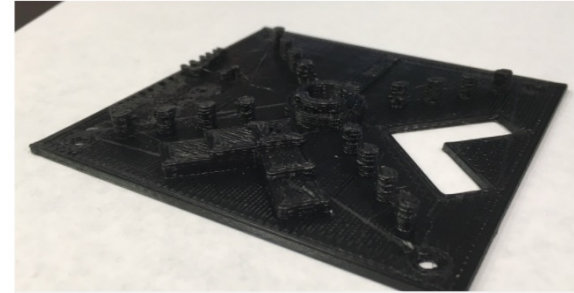
# ALL MATERIALS ARE DIFFERENT



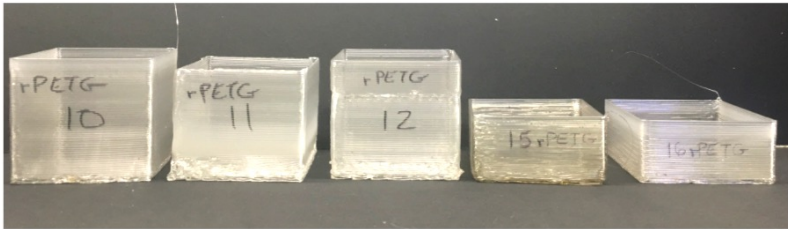
PLA



POLYPROPYLENE



POLYCARBONATE



PETG

- HDPE
- PLA
- PET
- Polycarbonate
- PETG
- Polypropylene

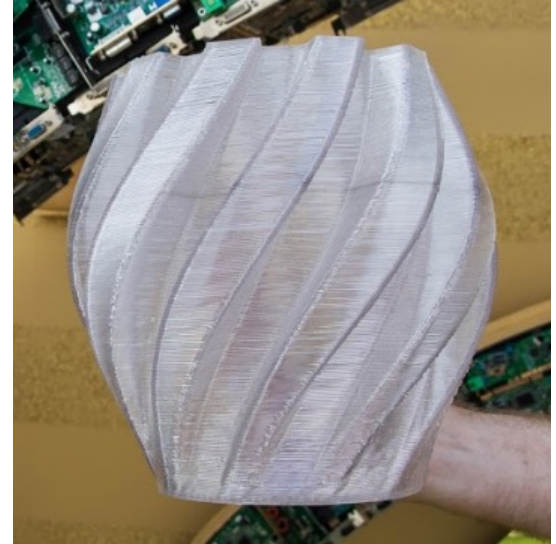
AND MORE!

**What can you  
print?**





# SIMPLE SHAPES PRINT BEST





# DESIGNING FOR 3D PRINTING+ WASTE MANUFACTURING



it through advertising and shopping links. If you purchase using a shopping link, we may earn a commission. [Learn more](#)

Close the Loop!

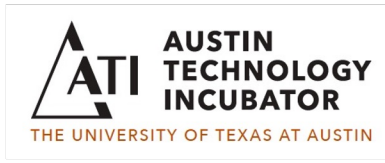
## 3D Printing From Plastic Waste: 10 Successful Projects



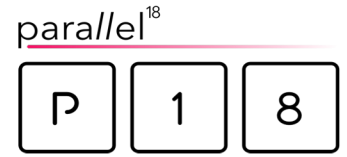
by Ille Kauppila  
Published Sep 20, 2021



# STRATEGIC PILOTS WITH RECLAIMED MATERIALS



Puerto Rico  
Science, Technology  
& Research Trust





# UNLIKELY END USERS



## Possibly millions of water bottles meant for Hurricane Maria victims left on tarmac in Puerto Rico

The images of huge stacks of bottled water began circulating on social media Tuesday, the same day President Trump called the government's response to Maria an "unsung success" during a meeting on hurricane preparedness in the Oval Office.





# EARLY ADOPTERS

CONCEPTS DESIGN

## This Adidas 3D-printed sneaker is made from ocean waste

*Although it's just a prototype for now*

By [James Vincent](#) | Dec 11, 2015, 7:36am EST

Source [Adidas](#) | Via [Design Boom](#)


[f](#) [t](#) [SHARE](#)



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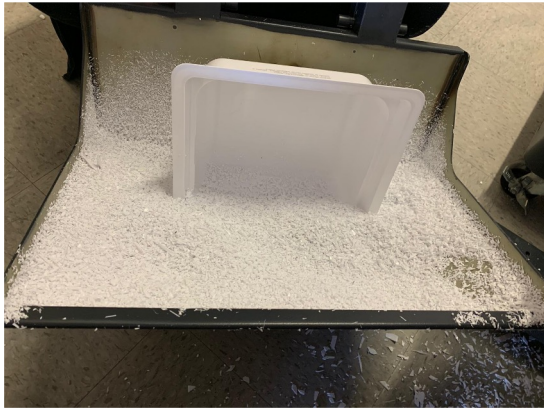
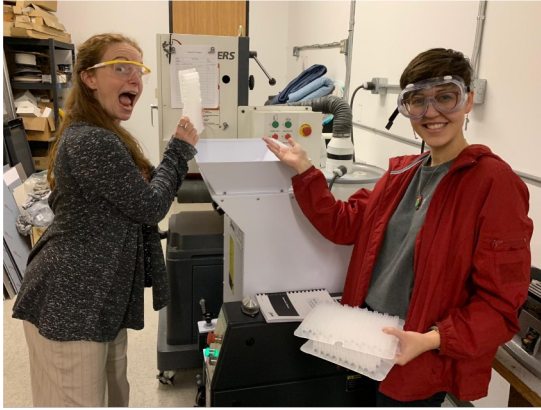


[shopify](#)

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**Exploring  
market  
opportunity:  
near term**



**Double Value  
Add: printing  
with regrind  
from  
manufacturing  
operations**



# ON DEMAND MANUFACTURING



[https://www.army.mil/article/234840/going\\_green\\_eco\\_friendly\\_plastic\\_to\\_replace\\_soldiers\\_supplies\\_in\\_battle](https://www.army.mil/article/234840/going_green_eco_friendly_plastic_to_replace_soldiers_supplies_in_battle)



Courtesy of Precious Plastics

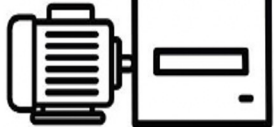




# PRINTING FROM TRASH REQUIRES A LOT OF EQUIPMENT



PLASTIC SORTING



GRANULATOR



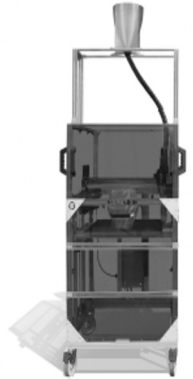
SIFTER



WASHER



DRYER





# OFF GRID 3D PRINTING



## re: cycling Lab

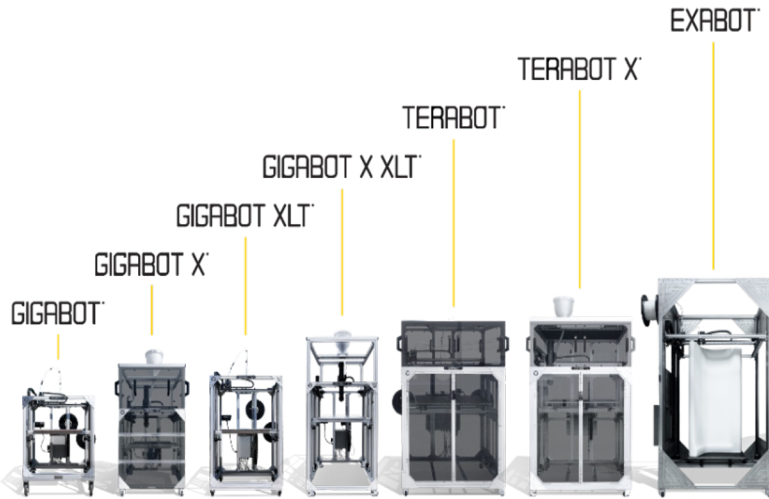




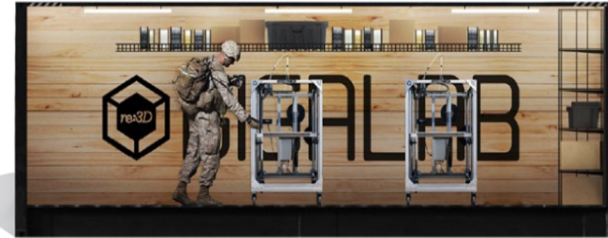
# SCALING BY DEMAND



COST



# GIGALAB<sup>®</sup>

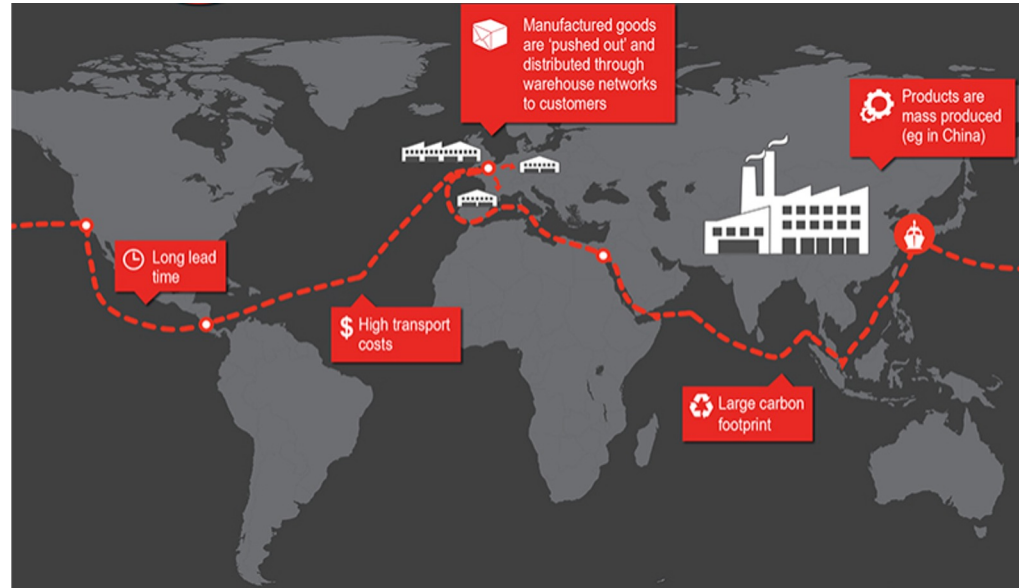
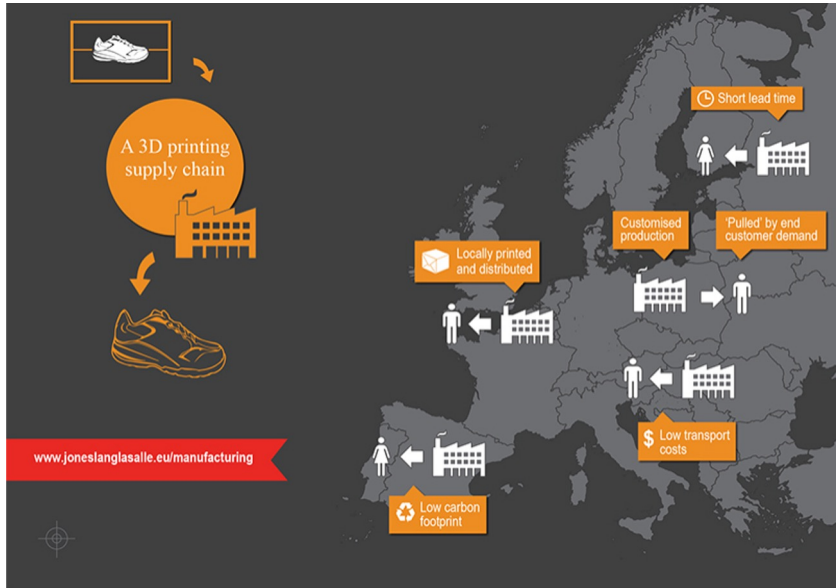


SCALE

**Exploring  
market  
opportunity:  
long term**



# DECENTRALIZED SUPPLY CHAINS





# USING WASTE FOR INTERNAL OPERATIONS



A technician at Audi holds up a manufacturing tool and the plastic packing waste it was 3D printed from.  
(Source: Audi)



# CREATING COMMUNITY VALUE FROM WASTE

Home / Sustainability / KLM is 3D printing aircraft tools from recycled plastic bottles

[3D Printing Filaments](#) [Aerospace](#) [Sustainability](#)

## KLM is 3D printing aircraft tools from recycled plastic bottles

The airline hopes to reduce its waste by 50% by 2030



Tess Boissonneault · October 24, 2019

2 minutes read





# 3D PRINTING IN AUSTERE ENVIRONMENTS

## NASA wants your ideas to reuse trash and waste on a Mars mission

By [Elizabeth Howell](#) published January 19, 2022

You have until March 15 to submit your Red Planet innovations.







# SCALING THE ECOSYSTEM NEEDS YOUR HELP!



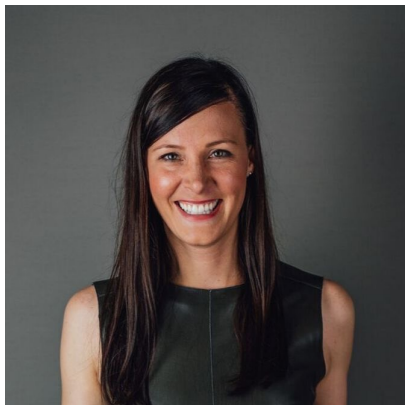
**What would you  
3D print from  
garbage?**

# The Technologies, Applications, and Future of 3D Printing



**Leslie Bush**

Metal 3D Printing  
Applications Engineer  
**EOS**



**Samantha Snabes**

Co-founder  
**Re:3D**



**Melodie Yashar**

VP of Building  
Design & Performance  
**ICON**



**Jessica Sager**

Former Managing  
Director  
**Austin Forum**

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  - Tech for health & happiness (holiday event)
  - Cybersecurity
  - Health & precision medicine
  - And more!



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***Q: What is the best thing you learned tonight?***

(30 seconds)

1 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19 20

21 22 23 24 25 26 27 28 29



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Corner of 3<sup>rd</sup> St and Nueces St—an easy walk from here

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