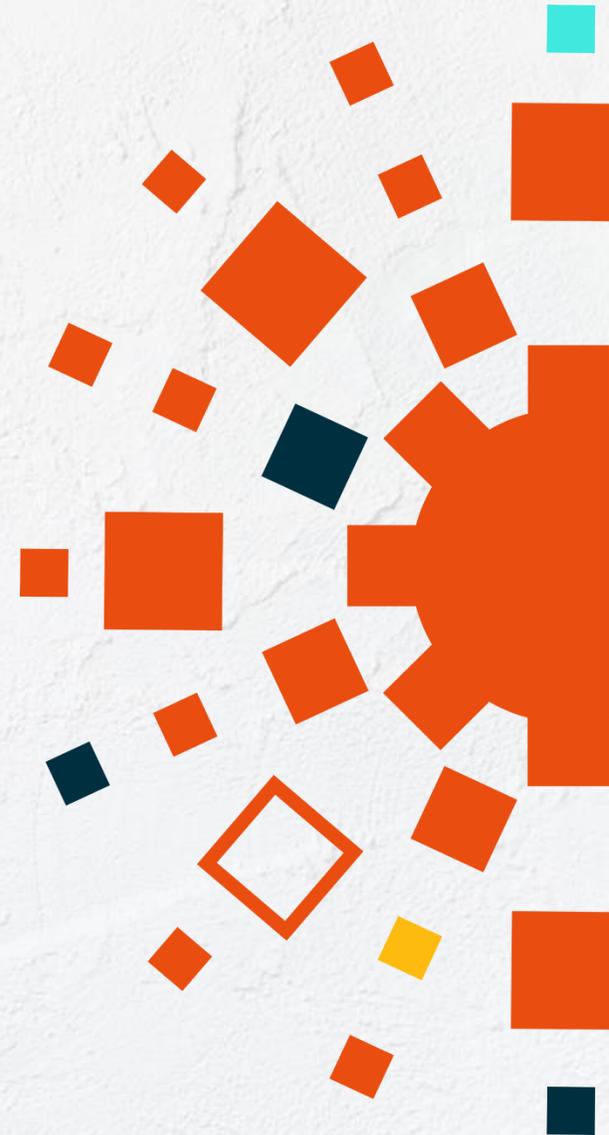




Additive Manufacturing Demonstration Program 2023/24

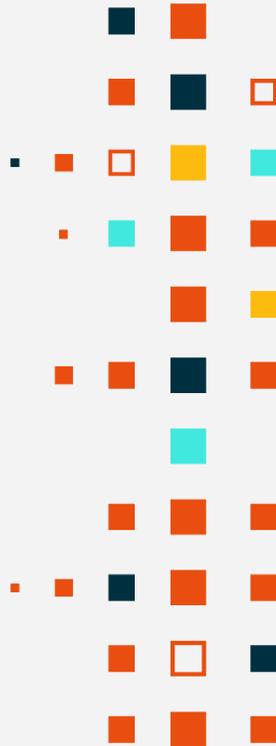
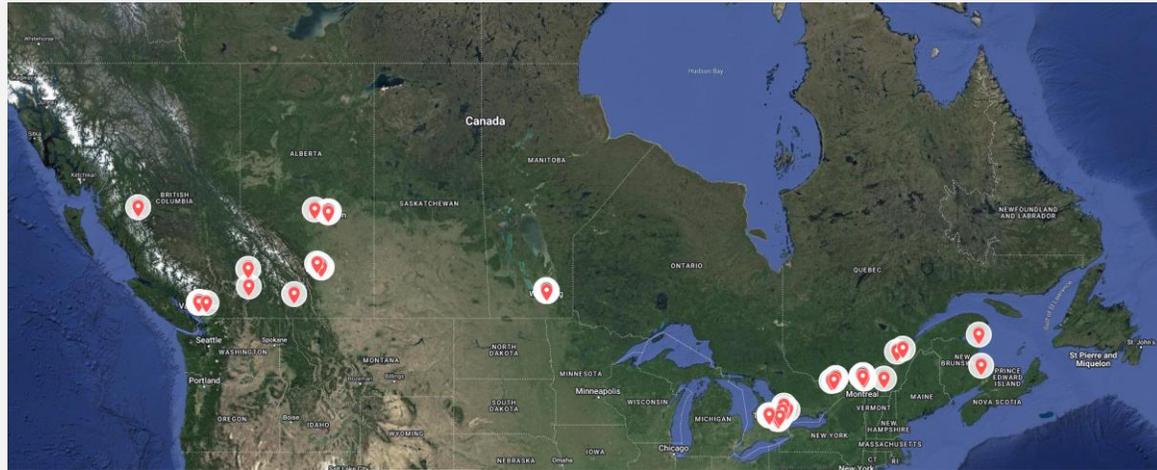
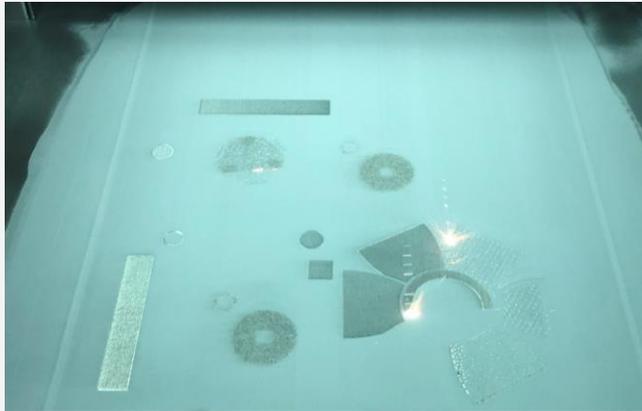


AM Demo Program 2023/24

SUMMARY

The Government of Canada has invested over \$100m in additive manufacturing capability across the country. NGen's AM Demo Program with support from the NRC Industrial Research Assistance Program (IRAP) provides the Canadian ecosystem with approximately \$0.5m per year to accelerate development of additive applications and stimulate industry demand and adoption.

This past year NGen funded 73 projects and engaged with an additional 52 companies to complete the program.



AM Demo Program 2023/24

Additive manufacturing has grown from a \$4Bn industry in 2014 to \$24Bn in 2023. Despite a growth rate of 27% over 2 decades, additive still represents less than 1% of global manufacturing. During this period the Canadian government has invested more than \$100m in additive infrastructure and programs.

Some notable examples are the HI-AM network which was a \$20m+ multi-year collaboration between Canadian universities, and the recently announced PacifiCan \$20m initiative.

Nearly every academic or research facility in Canada with advanced additive equipment has received Federal and/or provincial funding, eg CFI grants, to help procure the high capital cost equipment.

Wohler's Report, 2023



Figure 1 Example of Canada's investment in additive manufacturing capability - HI-AM network of academia and industry

AM Demo Program 2023/24

To see economic benefits from Canada's high investment in additive capability the biggest lever is accelerating the development of good applications for additive manufacturing. The AM Demo program was established to provide exactly this stimulus.

The program was initially launched circa 2014 with just 10 projects and 100k funding. In 2023/24 the program has delivered 70 projects with a 500k budget. The program funds demonstration projects to de-risk adoption of additive by Canadian companies new to the technology. De-risking is critical for any business looking at new technology, and the demo program allows the Canadian ecosystem of additive providers to have productive conversations with companies who would otherwise not take those critical first steps.

Government of Canada announces over \$20.8 million in funding for job creation, expansion, and access to 3D printing

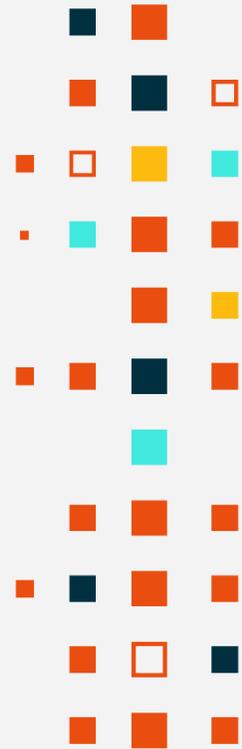
"PacifiCan is proud to be a partner in helping Burnaby build a thriving, inclusive economy."

BY OLIVER JOHNSON 2 AUGUST 2023 13:29



The Government of Canada has announced that seven businesses and organisations in life sciences, manufacturing and technology based in Burnaby, British Columbia will receive 20.8 million CAD to provide them with access to 3D printing technology, helping to scale-up operations and create jobs.

Figure 2 PacifiCan investment (Aug 2023), ongoing additive support by government



AM Demo Program 2023/24

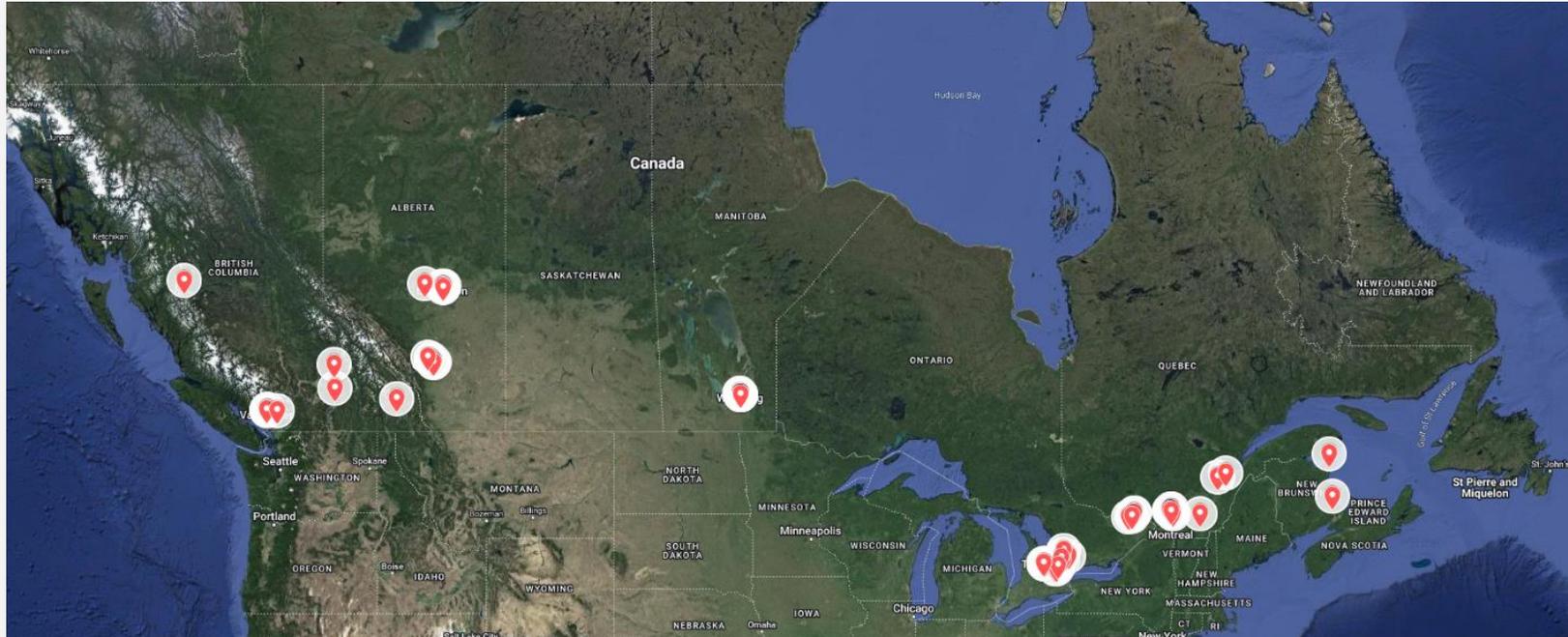
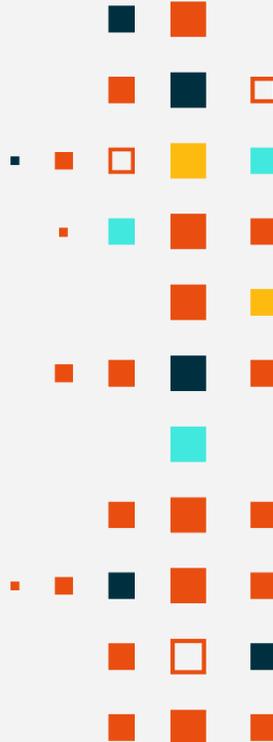


Figure 3 Map showing where AM Demo programs were conducted during 2023/2024

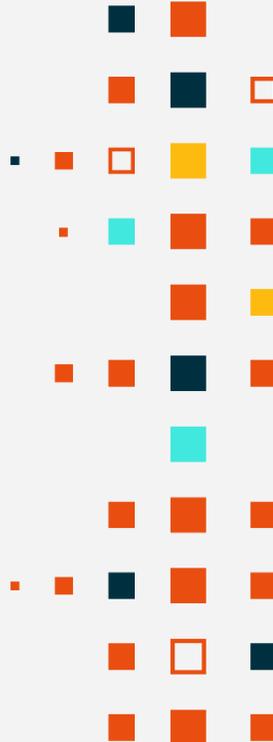
The AM Demo program is truly nationwide, as the map above shows. Projects involve all forms of 3D printing technology, with materials from metals to polymers, and applications from biodegradable planters to electric hydrofoils.



AM Demo Program 2023/24

The demo program receives industry enquiries via ITA referrals and will often post the opportunity on its Network Portal tool, inviting ecosystem members to a virtual discovery meeting with the company interested in additive. This process provides a democratic way to match the best partners, and efficiently introduces potential customers and new applications to the Canadian supply base.

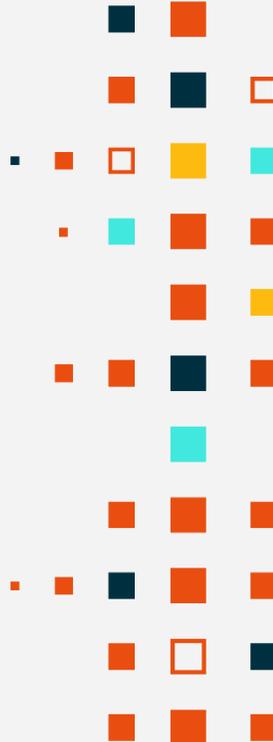
The screenshot displays a web portal interface for a job posting. The main heading is "Tooling plugs for assembly improvement". Below the heading, there is a "Title" field containing "Tooling plugs for assembly improvement". To the right, the "Network" is listed as "Canada Makes". The "Publish Date" is "13/07/2023" and the "Response By Date" is "17/07/2023". A "File Upload" section is present with a dashed box and the text "Choose a file or drag it here". Below this, the "Content" section contains a browser window showing a technical drawing. The drawing includes a circular cross-section with a diameter of $\phi 2.50$ and a thickness of 0.05 , with four equally spaced holes. A side view shows a plug with a diameter of $\phi 2.150$ and a length of $2.125-10$ STUB ACME (P). The drawing also indicates a $0.060 \times 15^\circ$ chamfer and $4 \times$ equally spaced holes.



AM Demo Program 2023/24



Figure 4 Network process used to promote demo opportunities to additive ecosystem



AM Demo Program 2023/24

Some recent examples of AM projects we funded that are crucial to each company's future.

Dominis, an Ottawa propeller maker with advanced CNC capabilities, fabricate propellers for global customers including Canada's frigate fleet. Sourcing castings for their propellers is becoming increasingly problematic for Dominis even to the extent of sourcing from a competitor.

We introduced Dominis to Apollo-Clad who are trying to diversify into AM. They were able to print a near net shape propeller using Directed Energy Deposition and Dominis did the post-processing. See the results below.

Both companies are very pleased with the results and want to take the next step and do a full-scale propeller. The potential is large, as Canada would not need to import and wait for castings in this strategic sector.

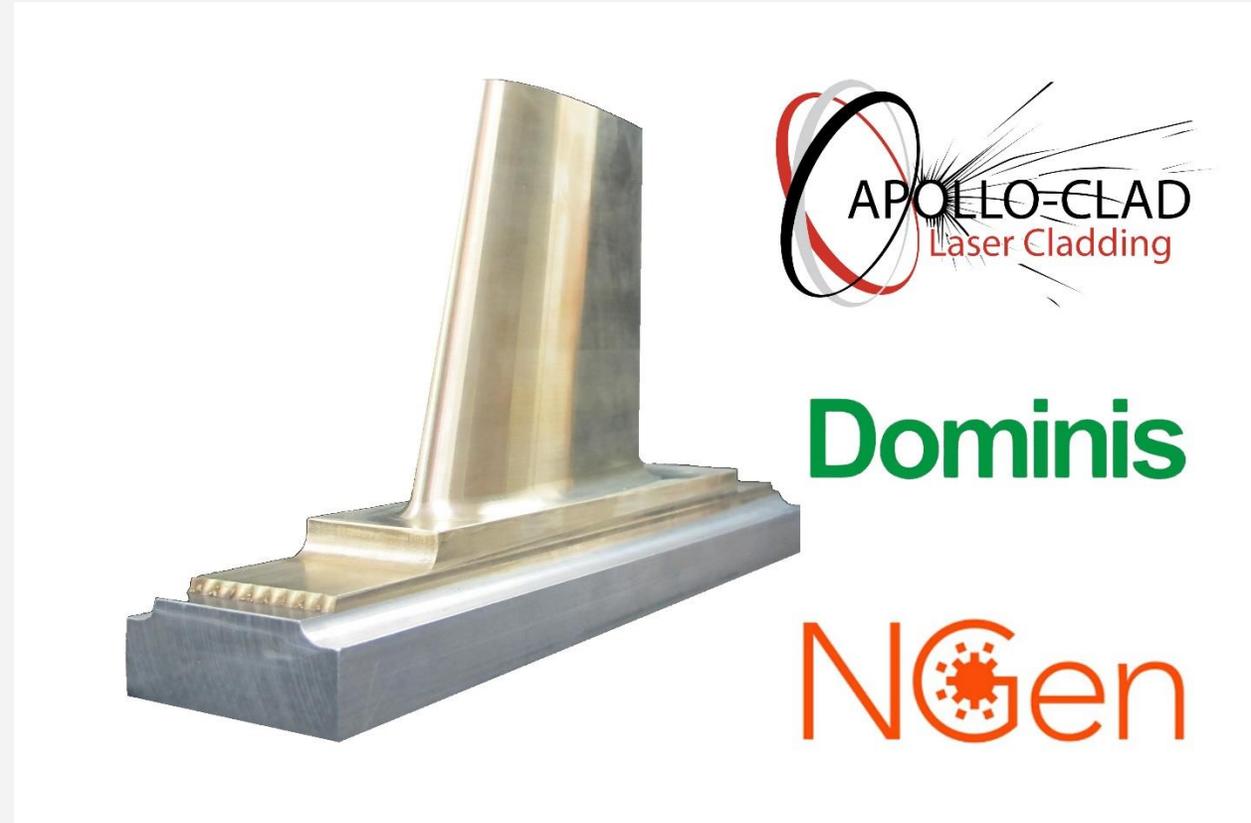


Figure 5 Near net shape propeller using DED

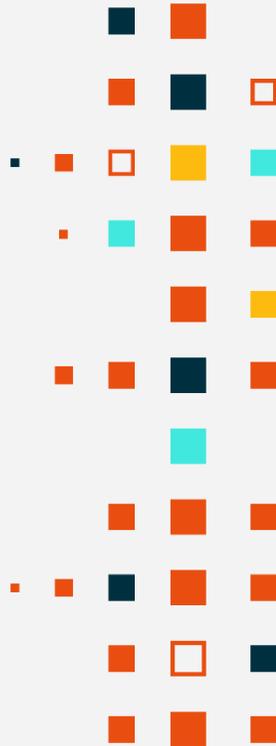
AM Demo Program 2023/24

The demo program has also addressed innovative healthcare concepts, from personalized gynecological prosthetics to neurological helmets.

The example shown here is a high-fidelity PAD helmet model printed for human trials pre-approval in the US. This helmet device will feature in a soon to be released healthcare movie special by Amazon Studios.



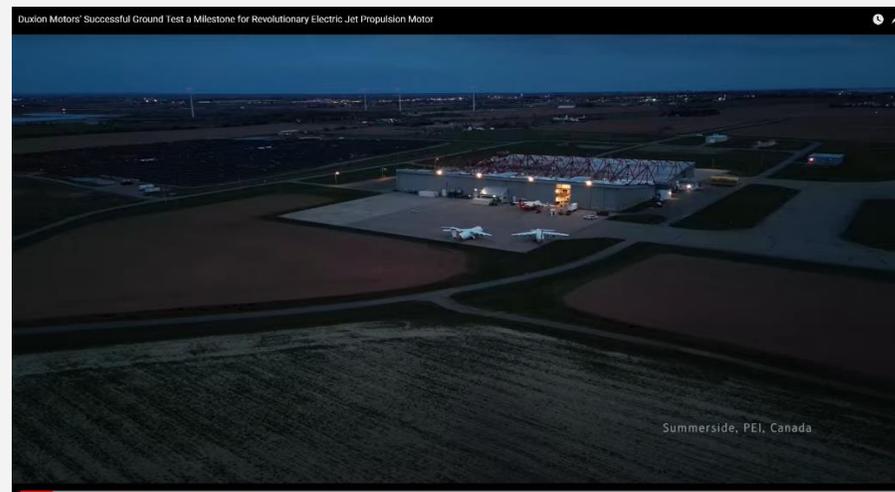
Figure 6 Neurological PAD helmet produced for Amazon Studios healthcare feature film



AM Demo Program 2023/24

An excellent example of how the demo program has a powerful leveraging effect is the project with NL company Duxion, who are developing novel electric propulsion solutions for aircraft and marine applications.

Duxion worked with PEI based Tronos using the demo programme to de-risk complex blading within the test engine. The engine has now run successfully - see the video on YouTube here:



<https://www.youtube.com/watch?v=TNdP0mATc5s>



AM Demo Program 2023/24

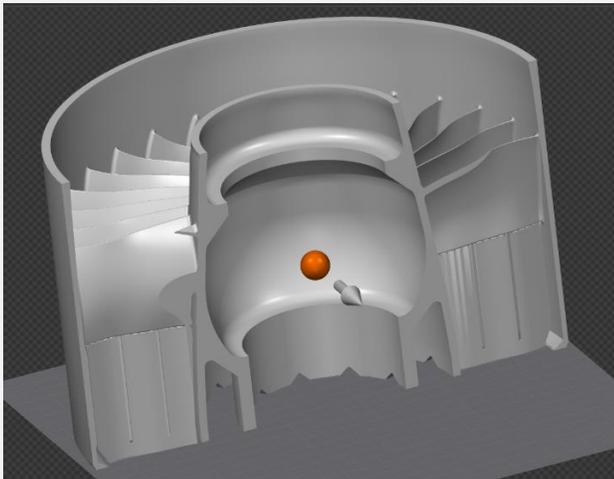
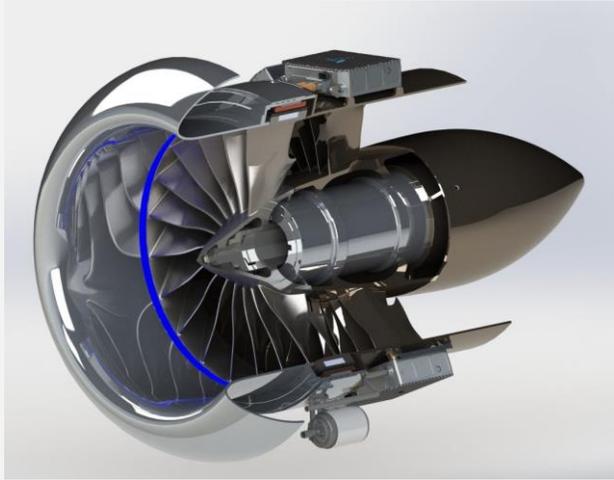
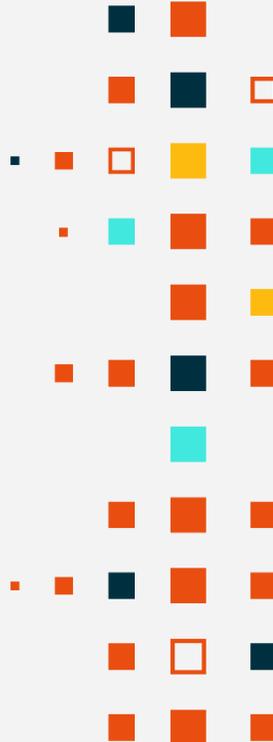


Figure 7 Duxion's revolutionary electric engine concept



AM Demo Program 2023/24

Demanding conditions in Canada's oil and gas operations were directly addressed by Rapidia working with Suncor. An intensive development programme was undertaken with Demo program funding to create cemented carbide materials that can be printed using specially formulated slurry using Rapidia's water-based metal paste deposition (MPD) approach.

This research and development significantly expands the capability of the Rapidia metal AM system to make cutting tools and wear parts opening up new markets in the mining, oil, and gas industries.

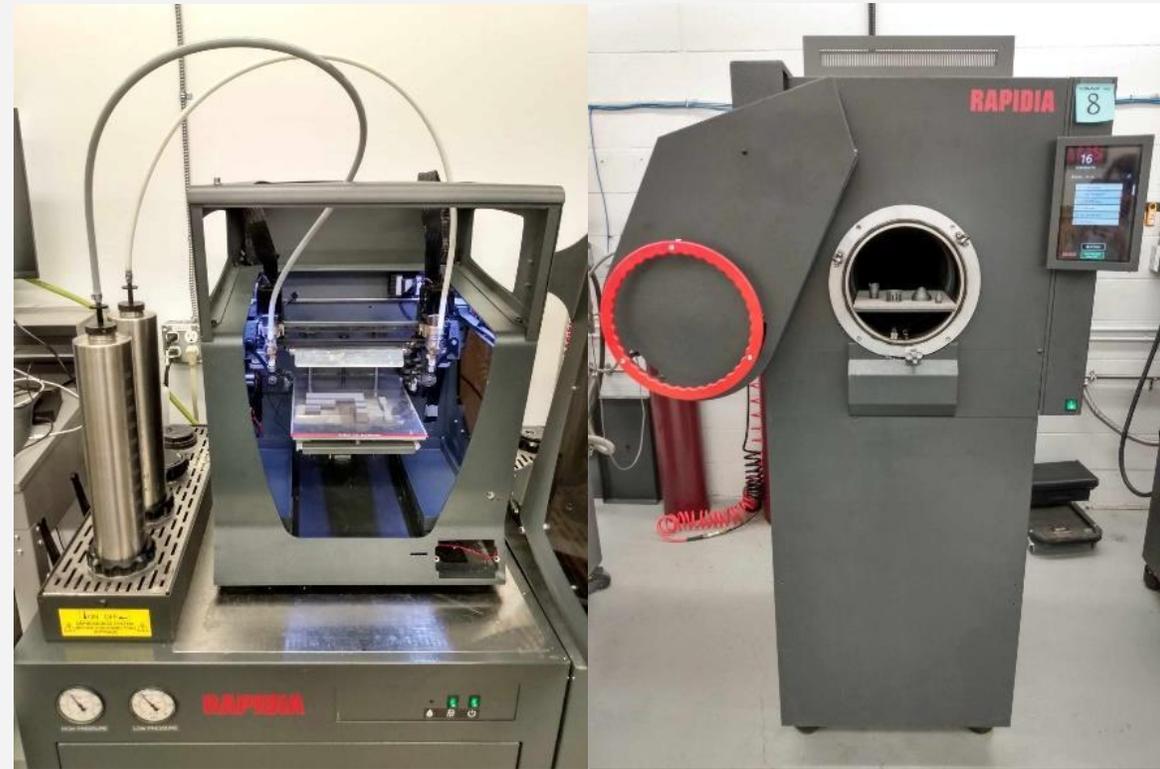


Figure 9 High wear parts developed using Tungsten Carbide in Cobalt matrix, using metal paste deposition by Rapidia



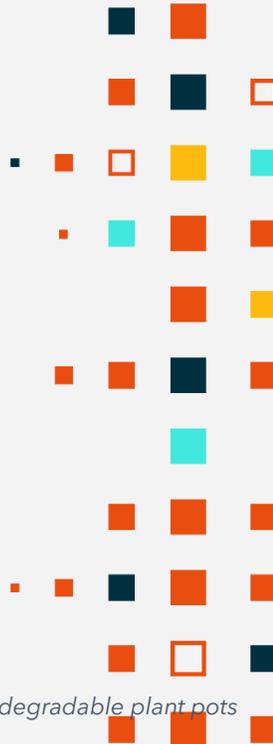
AM Demo Program 2023/24

Another potential application for additive, to improve manufacturing of biodegradable plant pots was de-risked with the production of prototype mold inserts. This should reduce scrap rates and improve quality for the New Brunswick based manufacturer, and is a good example where the benefits of 3d printing need to be calculated over the lifecycle of the process and not simply the price of the printed part.

The customer was unfamiliar with the capability of additive manufacturing, as is often the case with Canadian companies. There was considerable uncertainty whether the 3d printed solution would work, and the demo program allowed the customer to commit to trials in their facility with a technology they would otherwise not have considered. Equally the demo program has created a customer/supplier relationship that can now grow. Each year the demo program introduces literally hundreds of new companies to the AM ecosystem, an enduring value that can be much greater than the dollar value of the first demo project together.



Figure 10 Production of green products with reduced scrap rates - biodegradable plant pots



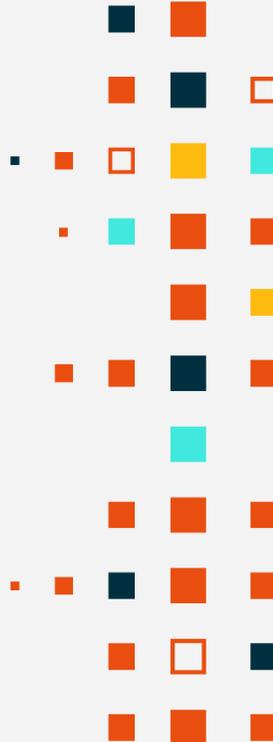
AM Demo Program 2023/24

As a final example of the diversity of demo projects and market applications, Ontario based Biome Renewables was able to manufacture and test their novel tidal turbine in conjunction with Nova Scotia Community College (NSCC). Biome's core market is wind turbines, and they looked to leverage their IP in this field to a new market, currently lagging the wind industry but with good potential.

NSCC were able to manufacture the turbine in sections using one of the very first laser powder bed machines in Canada. These sections were then manually welded together to form the large turbine, which was successfully tested offshore.



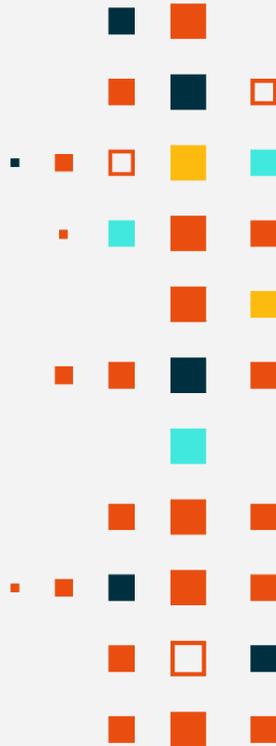
Figure 11 Tidal turbine manufactured by NSCC for Biome Renewables



AM Demo Program 2023/24

Full list of completed projects

Company/Project	Service provider	Company/Project	Service provider
3D Space Terraform Inc. 3DST	Red Deer Polytechnic	Gastops	PADM
AeroRecip	PADM	GE	PADM
Alstom	Axis Prototype	General Conveyor Inc.	AMM
Appollo Machine	Appollo Machine	Howmet	Axis Prototype
Aro Robotic Systems	Sarcomere	Illuminix AI	Innotech Alberta
Bell helicopter	Nanogrande	Jackalope Bikes	AMM
Biosa	Lacite College	Jiffy	Tronos
Canadian Additive	Jesse Garant Ass.	Kanata Energy Group	PADM
Carbon Upcycle	Red Deer Polytechnic	Liberty Springs	Université du Québec à Rimouski
Chrysalabs	Nanogrande	Maya HTT	Maya HTT
Conception inc.	Axis Prototype	MDA	Burloak
Cosm Medical	Mosaic	Messen Furniture	Exergy
Custom Prototype	Custom Prototype	Mirador Design Inc	Nanogrande
Delkotech	AMM	MSLR Electric E-Foil	PADM
Divergent/Gbatteries	Mosaic	Myant	Mosaic
Dominis	Dominis	Nada Cycles	Canadore
Dunedin Energy	PADM	Nanogrande	Nanogrande
Eagle Aerospace	Exergy	Nemak	Burloak
Elementiam	CMQ	Nexans	Axis Prototype
Martinrea	Equispheres	NURO	Custom Protoype
Exergy	Exergy	Onstream	PADM
Fingerprint Technologies Corp	Forgelabs	OptiFab	OptiFab



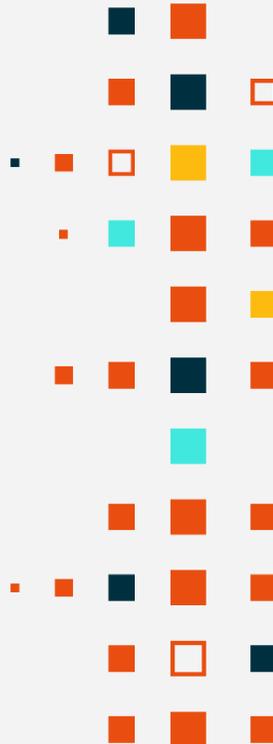
AM Demo Program 2023/24

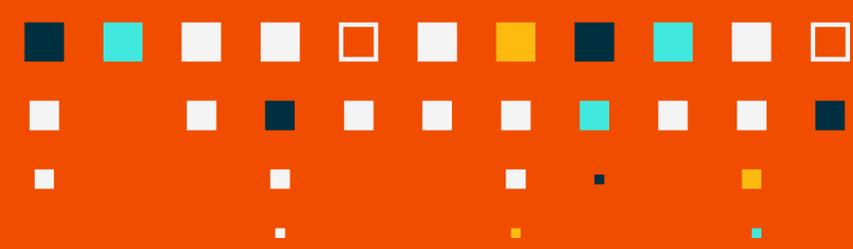
Full list of completed projects, continued.

Company/Project	Service provider	Company/Project	Service provider
PADM	PADM	Spherical Rotors	Exergy
Pantheon Design	Pantheon Design	Spinduction	Agile
PlaEx	UoW	Spinologics	PADM
Polycontrole	Polycontrole	StimStixx Technologies Inc.	AMM
Press Lock	AMM	Suncor	PADM
PWC	PADM	Suncor	Polycontrole
RF Wireless	AMM	Suncor	Rapidia
Rogue Solutions Group	PADM	TEKAD	CMQ
Roswell DHT	PADM	Tekna	Burloak
Sarcomere	AMM	Tesla	AMM
Skytrac	Canadore	Top Grade Molds	AMM
Solar Earth	Custom	Vanquish Hockey	CMQ
Solarsteam	Exergy	Voltera	Voltera
Sparrow Downhole Tools Ltd.	Exergy	Wishmedia - Fern & Petal	Forgelabs
		Zero Point Cryogenics ZPC	University of Alberta

The examples above show how the AM demo program has been a catalyst allowing Canadian companies to develop novel new products, improve processes and enter new global markets. Additive manufacturing would not have been considered, and the conversations with Canada's AM ecosystem suppliers would not have happened without the demo program opening the door and de-risking the first step.

The Demo Program funding creates lasting relationships and applications for the new technology and supports the growth of Canada's AM eco system at a critical competitive time for industry adoption.





NGen

