



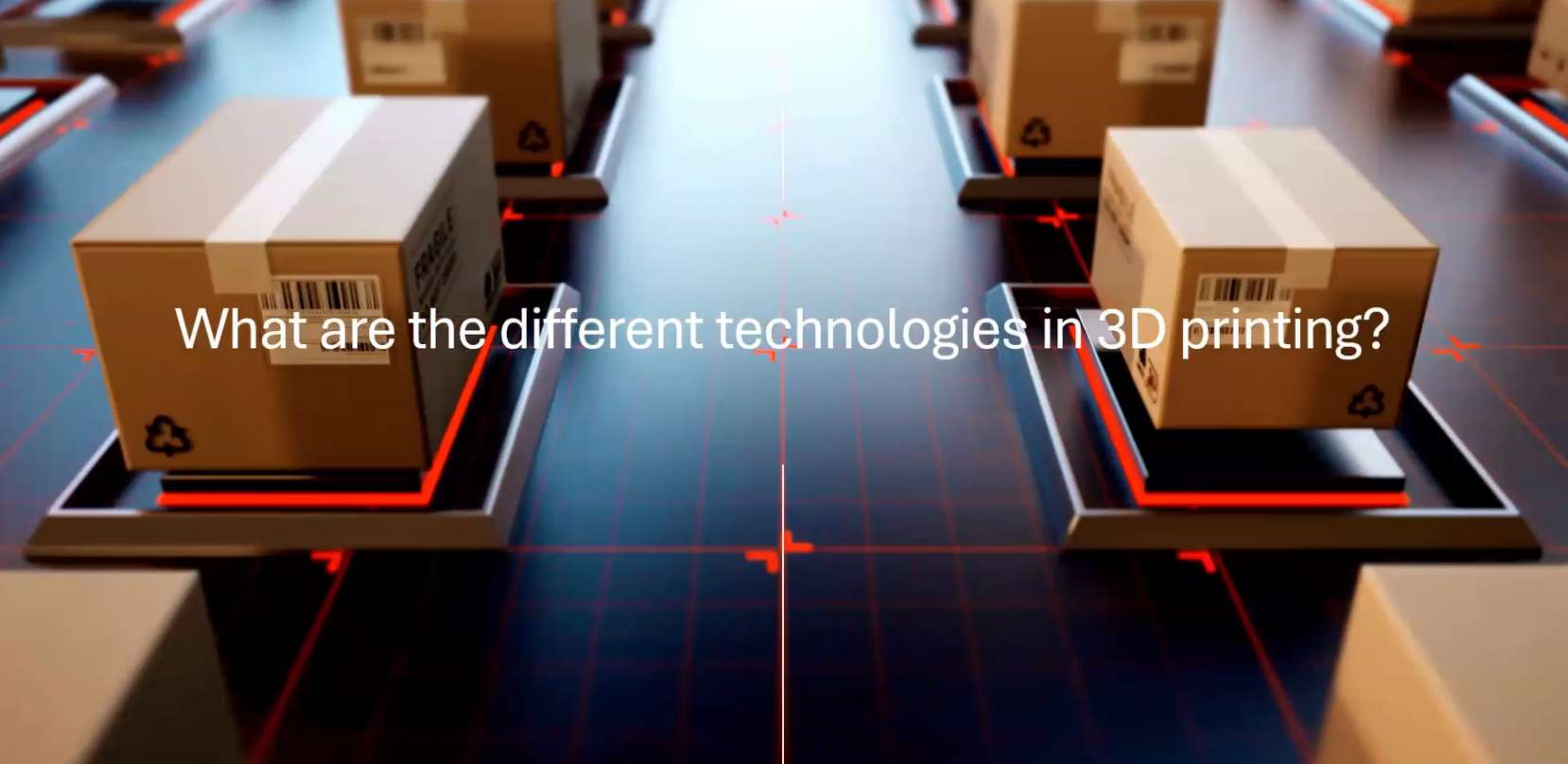
Where can Laser Powder Bed Fusion make an impact in the Pakistani Market?



Who Am I?

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- Partner Manager, Middle East and Eastern Europe
- 7+ years at EOS GmbH
- Profile
- B.Eng in Mechanical Engineering from NUST in 2015
- M.Sc Management, Majors in Business Analytics from ESMT Berlin in 2019
- Executive Advanced Business Analytics, MIT Sloan School of Management in 2021



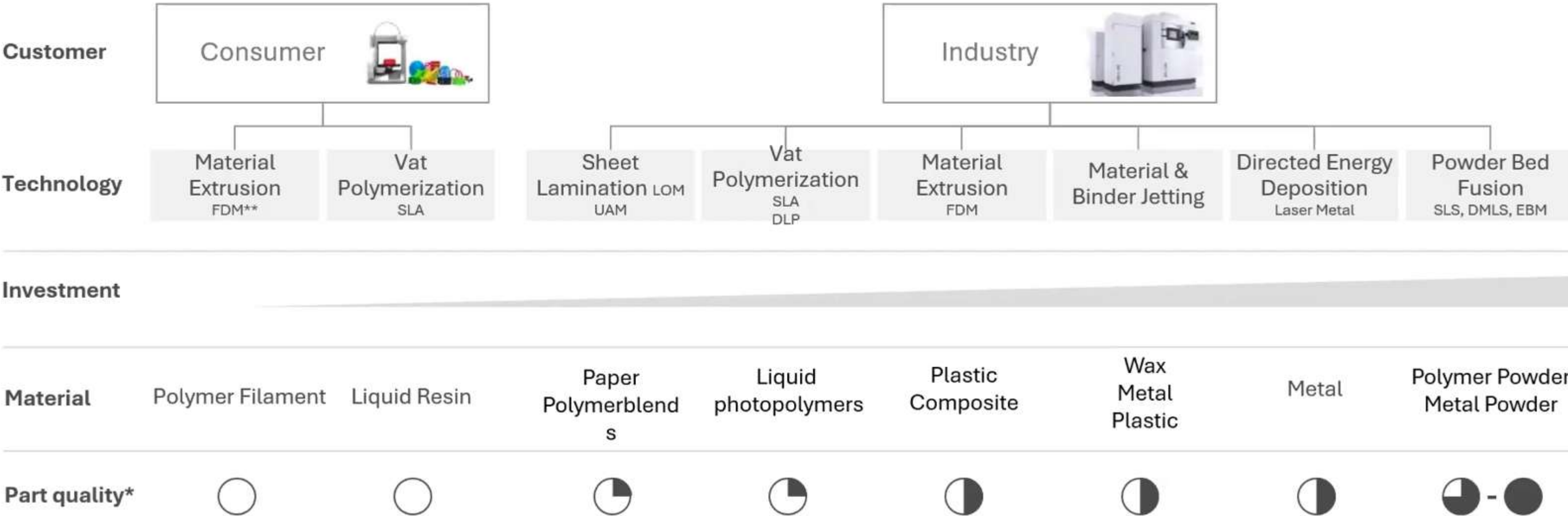
A 3D rendering of a warehouse conveyor belt system. Two cardboard boxes are shown on the belt, moving towards the viewer. The boxes are brown with white labels and recycling symbols. Red laser lines are projected onto the boxes and the belt, indicating a scanning or tracking system. The background is a dark blue grid pattern.

What are the different technologies in 3D printing?



It is essential to know 3D Printing encompasses numerous technologies and applications

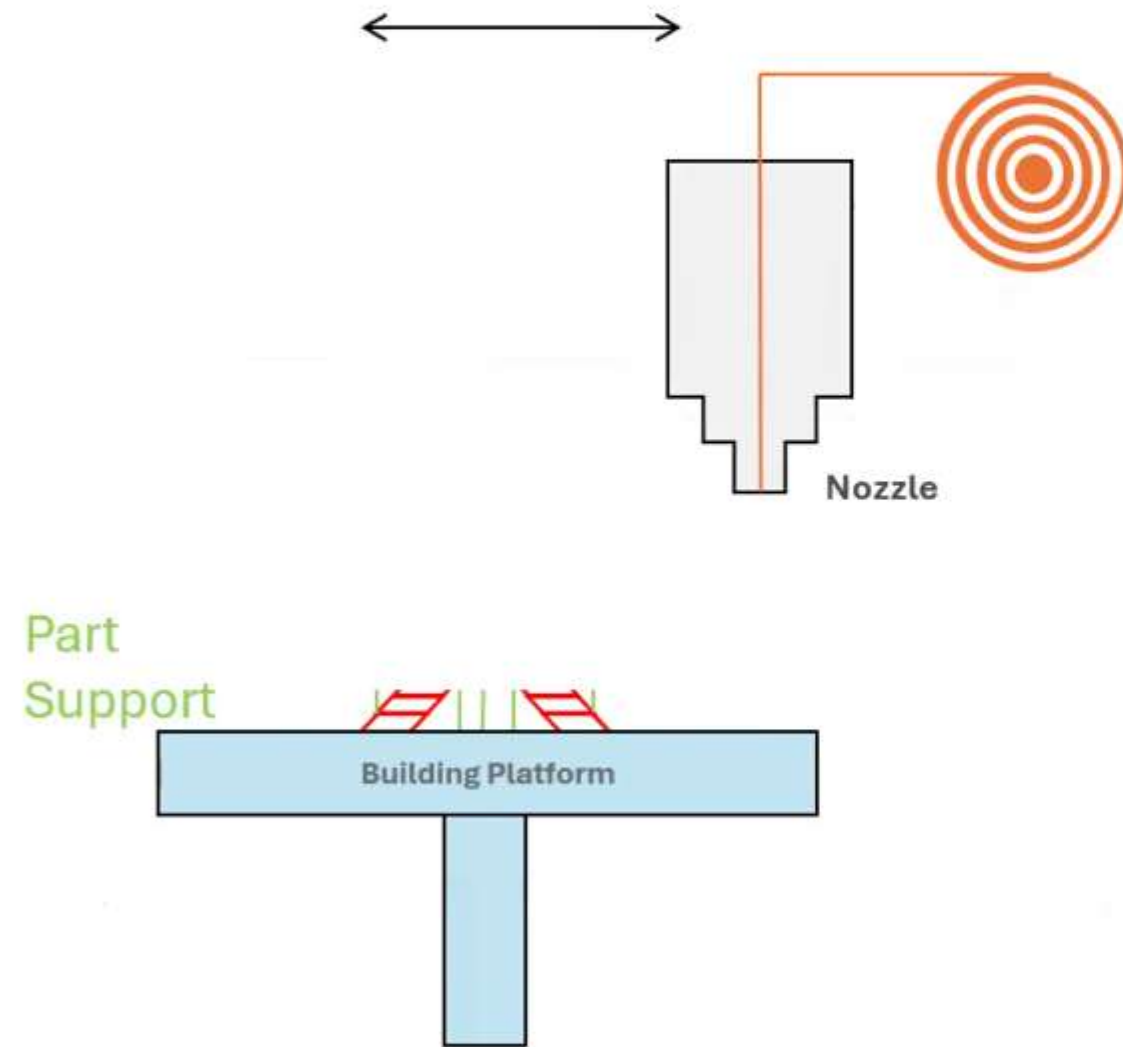
The 3D Printing Technology Landscape



* Compared to traditional (subtractive) manufacturing

** Subtechnology

Fusion Deposition Modeling is mostly known from home 3D printing



Fused Deposition Modeling

Process:

- Continuous filament
- Heated and dispensed selectively through a nozzle

Markets:

- Rapid Prototyping, Serial production

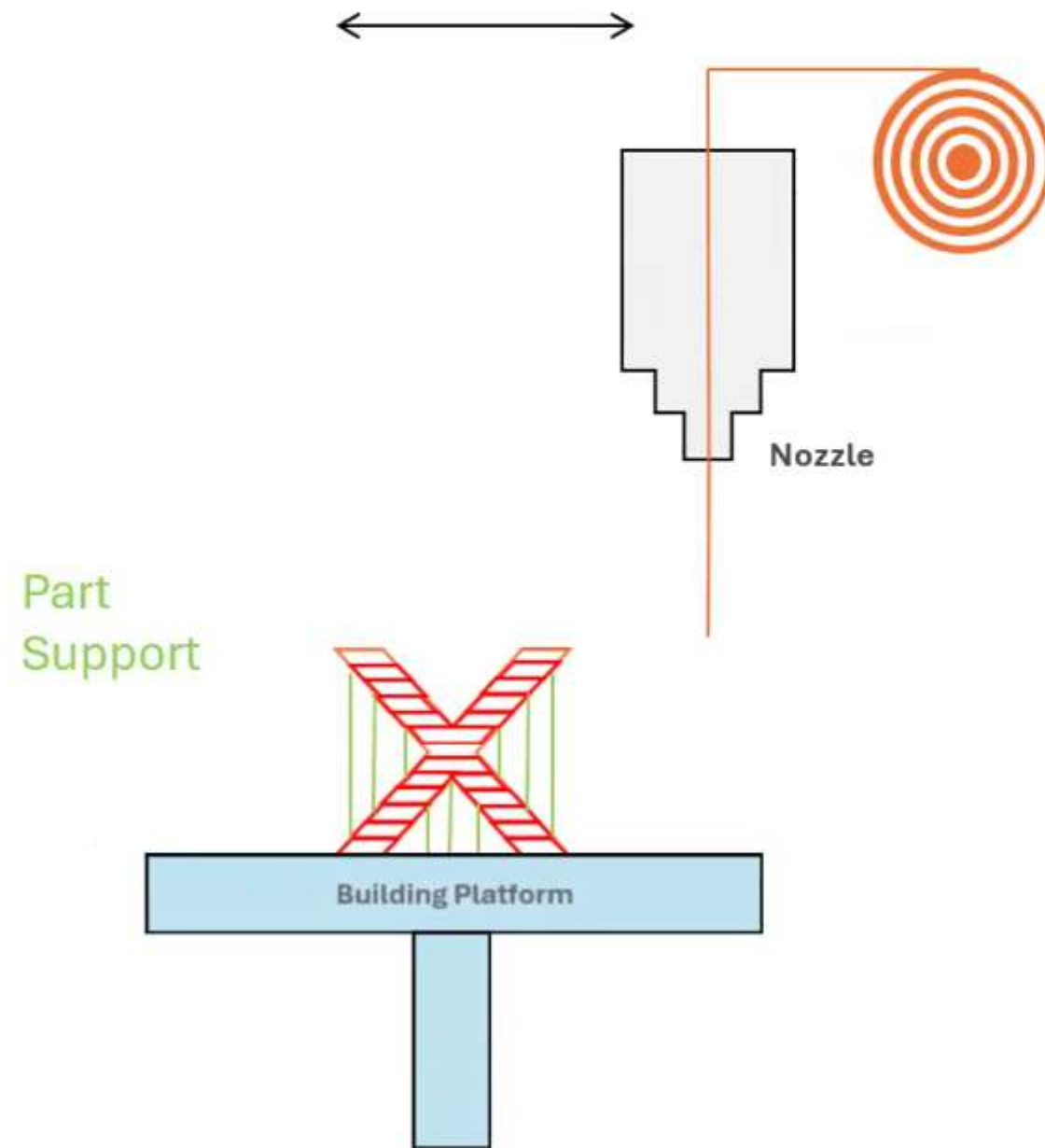
Advantages:

- Fully developed process

Disadvantages:

- Low mechanical properties
- Embrittles after some time

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Fused Deposition Modeling

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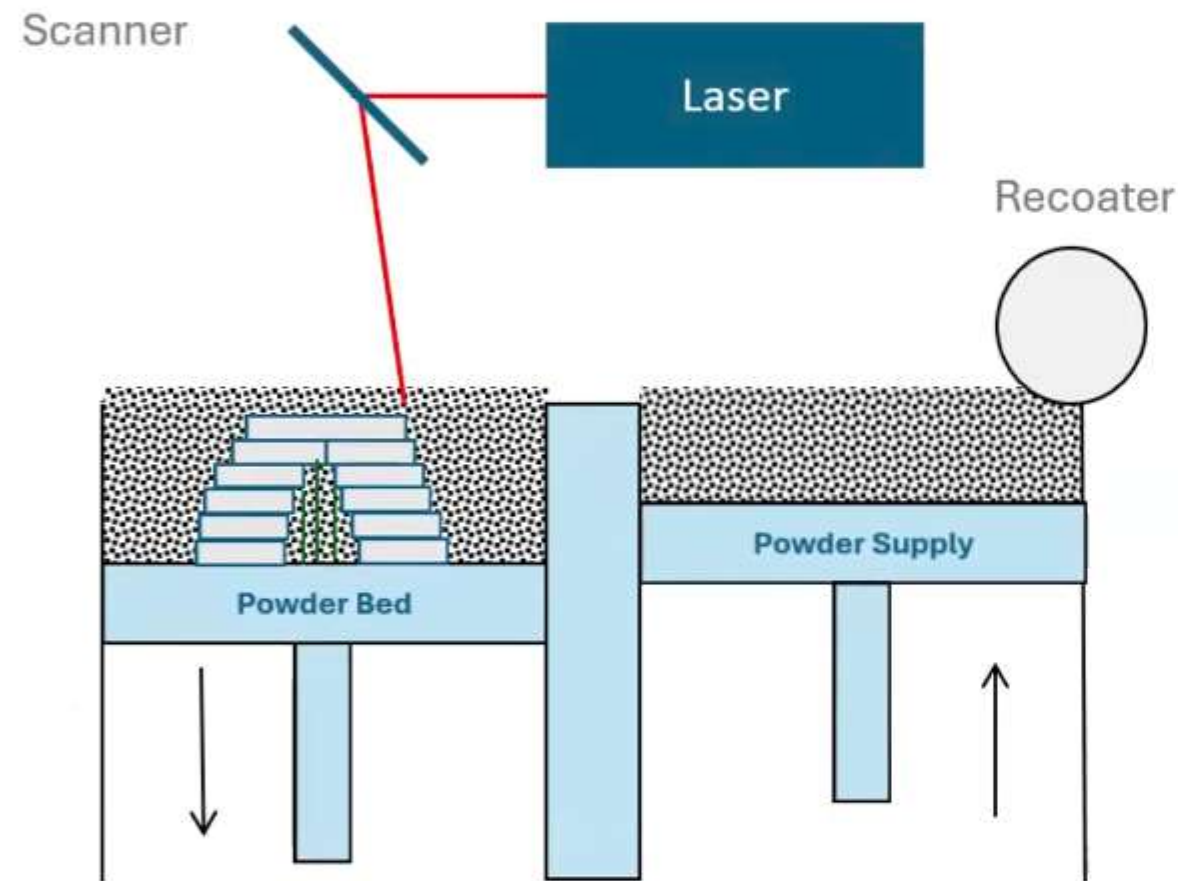
- Fully developed process

Disadvantages:

- Low mechanical properties
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Powder Bed Fusion provides the best results among Additive Manufacturing technologies



DMLS

Powder Bed Fusion

Process:

- Laser beam fuses selected areas of a powder bed

Markets:

- Rapid Prototyping, serial production

Advantages:

- High mechanical properties
- High detail resolution

Disadvantages:

- Limited build space
- High cost



Analyzing the market

MXR	690.91	804.62	113.71 ▲ 16.46%	BTU	448.23	543.07	94.84 ▲ 21.16%
LKM	763.01	910.92	147.92 ▲ 19.39%	CFO	1001.05	1193.91	192.86 ▲ 19.27%
CWW	844.58	1057.49	212.91 ▲ 25.21%	FU	262.36	309.17	56.81 ▲ 22.51%
OPJ	917.31	1067.62	150.32 ▲ 16.39%	FEQ	1184.19	1366.73	222.54 ▲ 17.40%
KDD	1338.25	1625.13	286.88 ▲ 21.44%	LC	77.74	92.09	14.35 ▲ 18.46%
JUA	124.41	156.44	32.04 ▲ 25.75%	EB	512.48	602.27	89.79 ▲ 17.52%
IKD	143.51	173.93	30.42 ▲ 21.20%	OC	189.02	232.17	43.15 ▲ 22.83%
NRS	501.77	665.23	63.46 ▲ 12.65%	NEM	712.49	816.45	103.96 ▲ 14.59%
SHC	580.74	688.55	107.81 ▲ 18.57%	KHU	263.02	312.83	49.81 ▲ 18.94%
PLM	122.28	147.85	25.57 ▲ 20.91%	FTM	88.55	105.55	17.00 ▲ 19.31%

AQJ	878.84	1040.82
YZJ	903.49	1127.46
EIY	983.99	1213.31
VDA	113.74	143.4
UVV	468.08	535.4
HJS	545.49	659.0
EQC	566.96	664.0
JGR	694.74	837.0

Additive Manufacturing market to reach almost EUR 18 billion in 2025

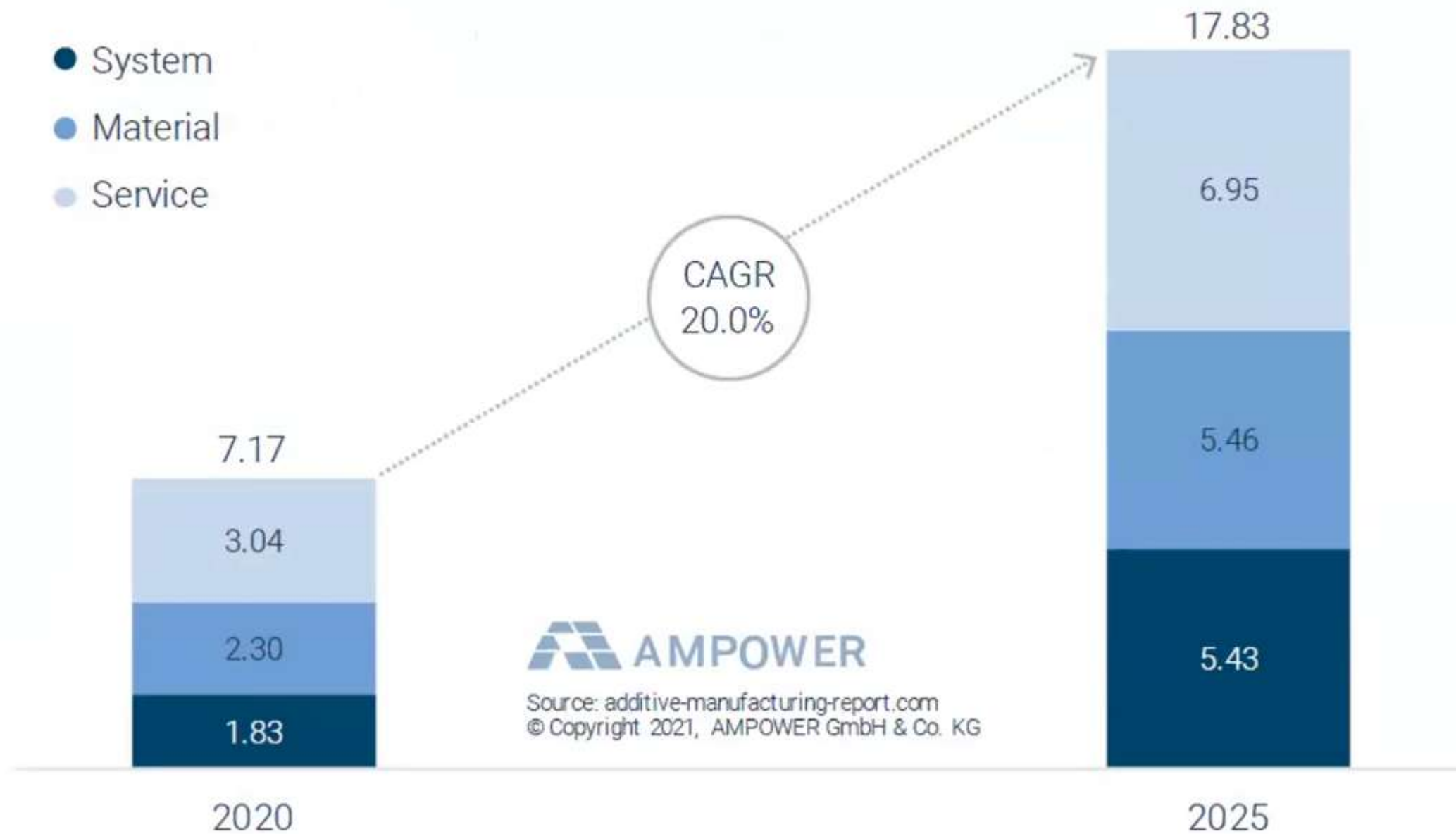


FIGURE 4 GLOBAL METAL AND POLYMER ADDITIVE MANUFACTURING MARKET 2020 AND SUPPLIER FORECAST 2025 [EUR BILLION]



REGIONAL DISTRIBUTION OF METAL AND POLYMER SYSTEM
REVENUE IN 2020 AND 2025

USA stays largest AM market

We see a growing
Trend

Asia to Follow?

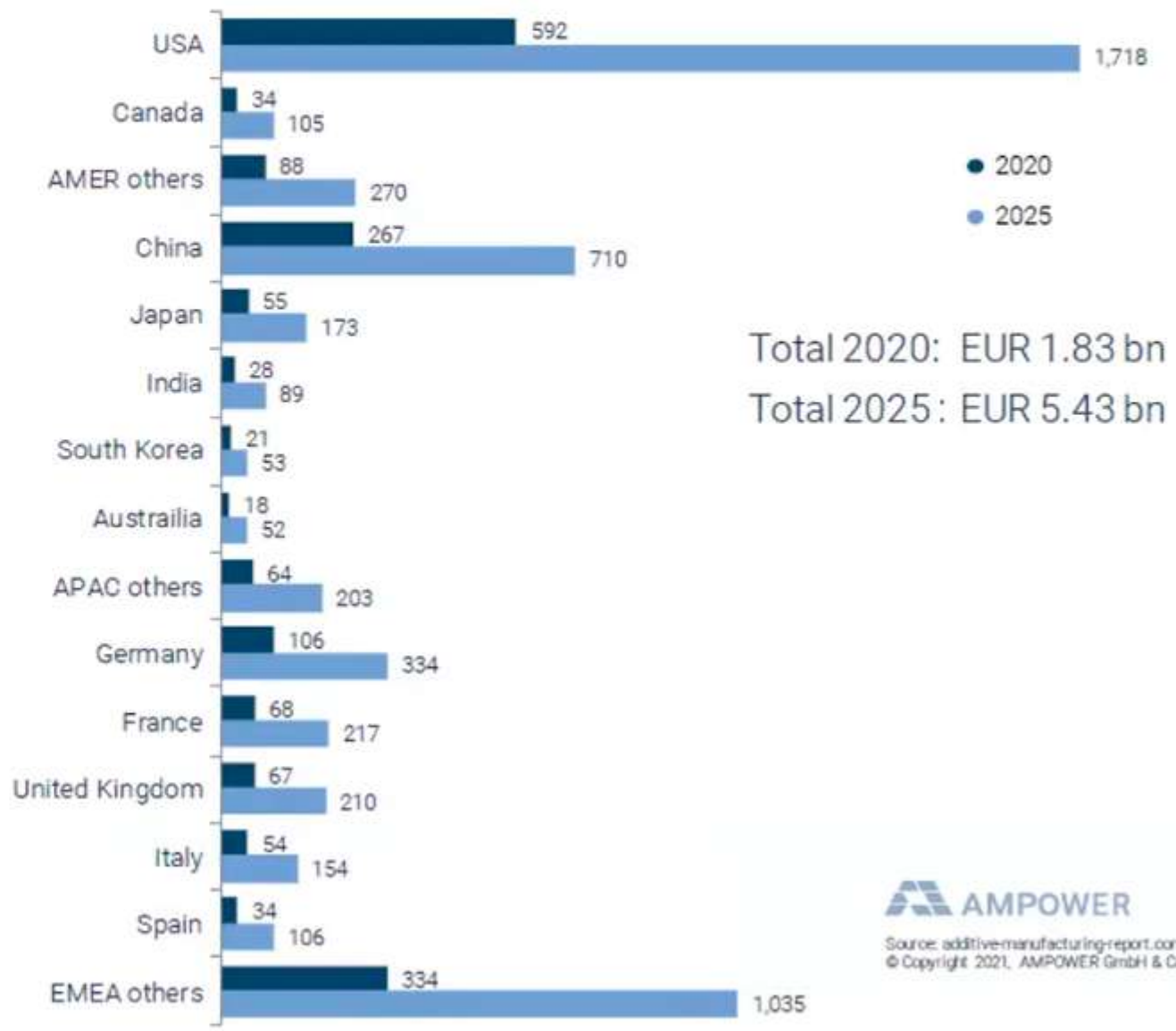


FIGURE 7 GLOBAL DISTRIBUTION OF BUYERS BY METAL AND POLYMER SYSTEM SALES REVENUE 2020 AND FORECAST 2025 [EUR MILLION]



Competitive Landscape of Pakistani Market



3D Printing in Islamabad Pakistan

4.9 ★★★★★ (9) 3D printing service
Pakistan · +92 333 5466155
Closed · Opens 10:30 am Fri



Print 3D Pakistan

4.6 ★★★★★ (31) 3D printing service
Karachi, Pakistan · +92 21 37120681
Closed · Opens 9 am Fri



Arc3D Technologies | 3D Printers & 3D Printing servi...

5.0 ★★★★★ (22) 3D printing service
Gujranwala, Pakistan · +92 324 0101424
Closed · Opens 8 am Sat



HANPRO - 3D Printing & Model Making Services in L...

4.9 ★★★★★ (149) 3D printing service
Lahore, Pakistan · +92 304 0654912
Open 24 hours



Axis 3D

5.0 ★★★★★ (20) Commercial printer
3+ years in business · Lahore, Pakistan · +92 332 2000506
Closed · Opens 9 am Fri



Browide3D: Premium 3D Printing in Pakistan

5.0 ★★★★★ (16) 3D printing service
Islamabad, Pakistan · +92 345 5322796
Closed · Opens 9 am Fri

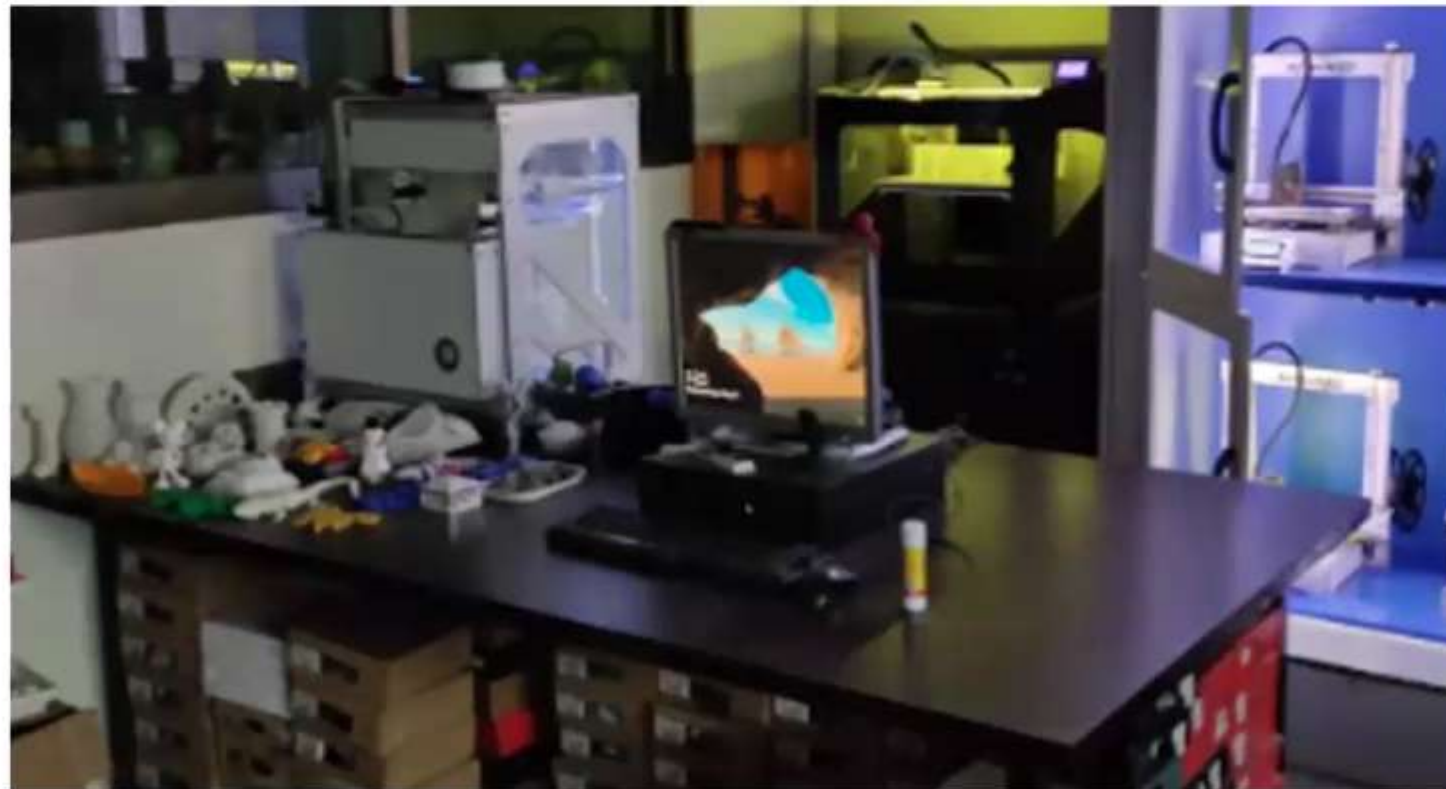


SLANTY STICKERS- First 3D Lenticular Printing Lahore Karachi...

4.0 ★★★★★ (2) Digital printing service
5+ years in business · Lahore, Pakistan · +92 300 4526191
Closed · Opens 8 am Fri



- 10+ vendors operating in Pakistan only on FDM low end quality market
- No vendor in Laser powder bed fusion
- No vendor in high end FDM market
- No manufacturing company owns or has a 3d printer in-house
- No process plants in Pakistan owns a 3d printer in-house
- Confined to service provider business and university projects and that too only focused on FDM low end quality
- Medical market untapped – implants still imported





Neighbouring Market



Are we not even in the same league?

- India has already surpassed 100M€ only in spending on 3d printer machines – this number is already on the rise and expected to be 150M€ end of 2024
- India has 10k+ FDM machines and 200+ L.PBF machines
- China is another league matching European and US market
- China has spent 1B€+ only in spending on 3d printers
- Pakistan has not even reached 1M€ in machine sales
- This represents Pakistan's inactive presence in purchasing of 3d printers
- No information found on a laser powder bed fusion machine in Pakistan
- All FDM machines

India's 3d printing market on the rise

China already a leader in 3d printing

We are already too far behind but it is never too late... More delays will take us completely out of the game



AM Power Top-Down Analysis



FIGURE 12 REGIONAL DISTRIBUTION OF METAL SYSTEM, MATERIAL AND PART MANUFACTURING SUPPLIER SALES REVENUE 2019 TO 2022 AND SUPPLIER FORECAST 2027 (EUR BILLION)



FIGURE 13 REGIONAL DISTRIBUTION OF METAL SYSTEM, MATERIAL AND PART MANUFACTURING SUPPLIER SALES REVENUE SHARE 2022 AND SUPPLIER FORECAST 2027

- 1.09B in 2022 expected to go up to 3.39B in 2027 in EMEA (see fig on left)
- With 35%-part manufacturing share (see fig on left, AMPower) -> 0.38B€ in 2022 expected to go up to 1.19B€ in 2027 in EMEA
- Pakistan's share is not accounted for but if we assume a 0.5% share stake -> 1.9M€ in 2022 expected to go up to 5.9M€ in 2027 in EMEA



FIGURE 15 METAL ADDITIVE MANUFACTURING TECHNOLOGY MAP



Industries in Focus



Maturity Index – L-PBF is on top

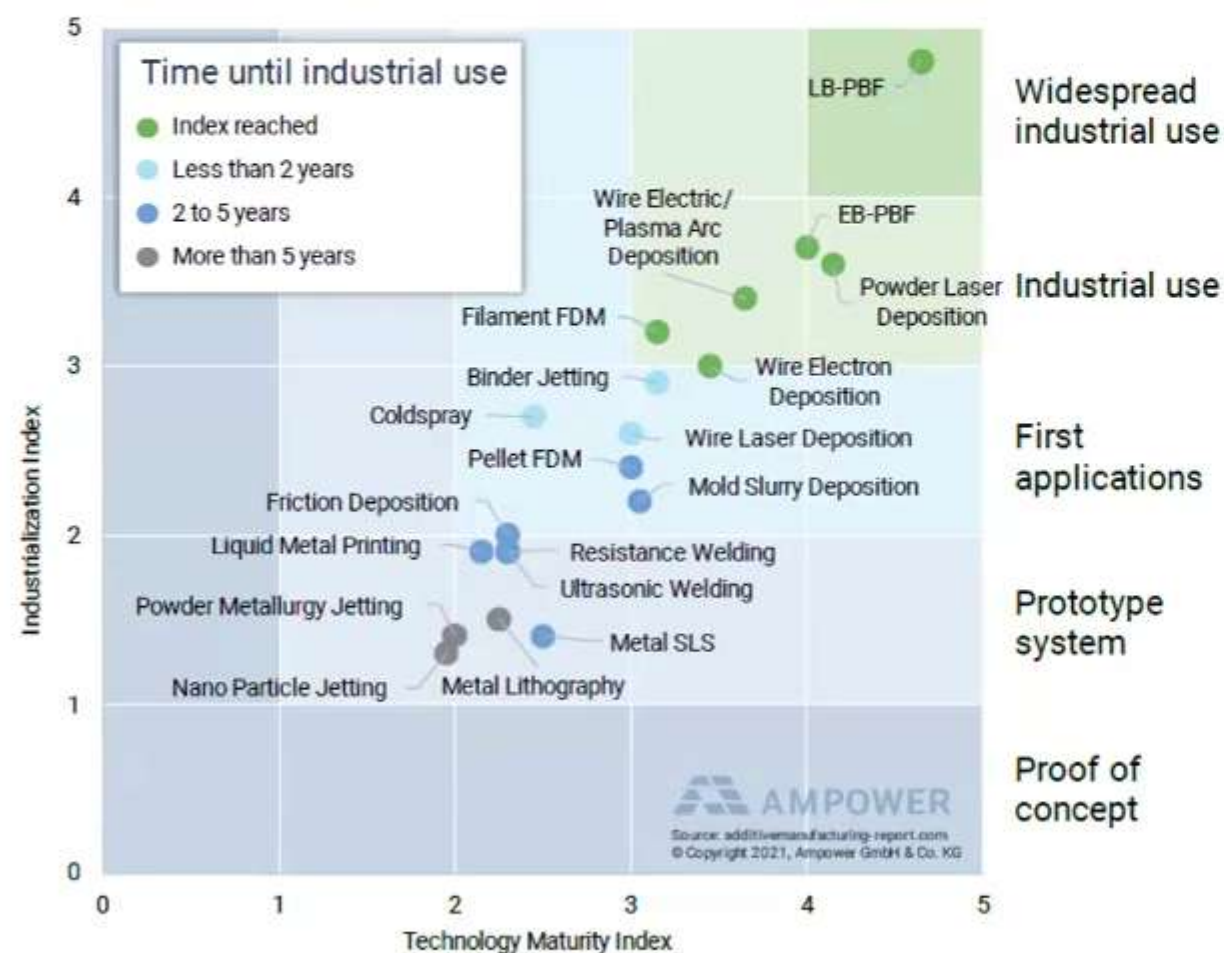


FIGURE 18 METAL AM MATURITY INDEX 2021

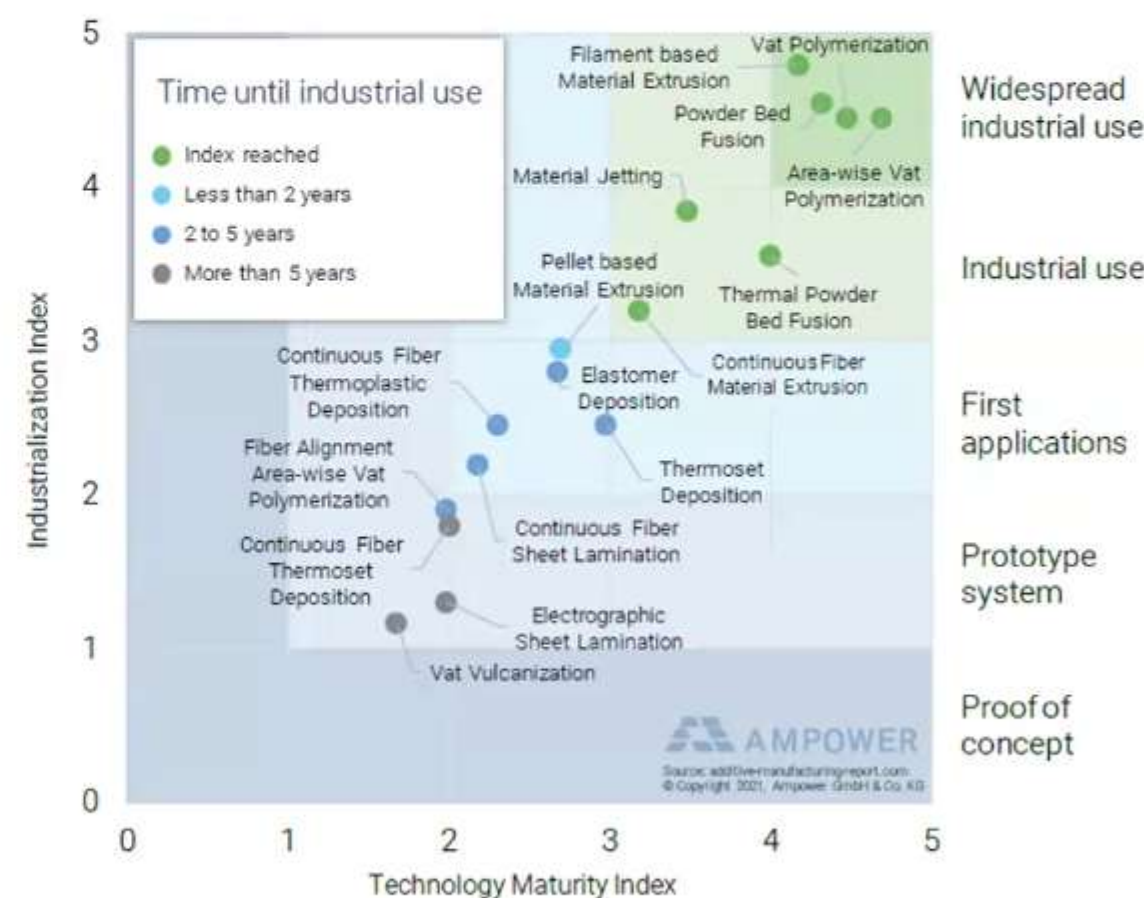


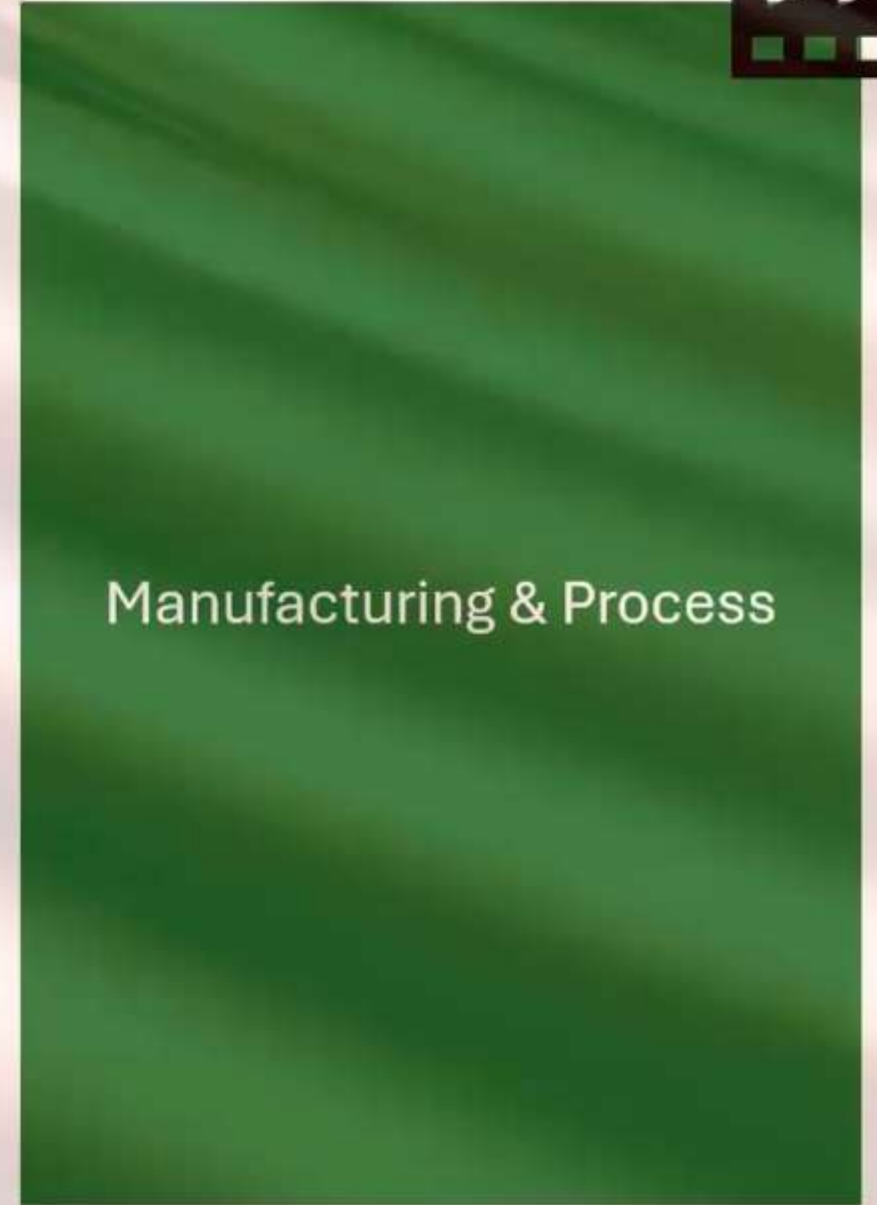
FIGURE 19 POLYMER AM MATURITY INDEX 2021



Medical



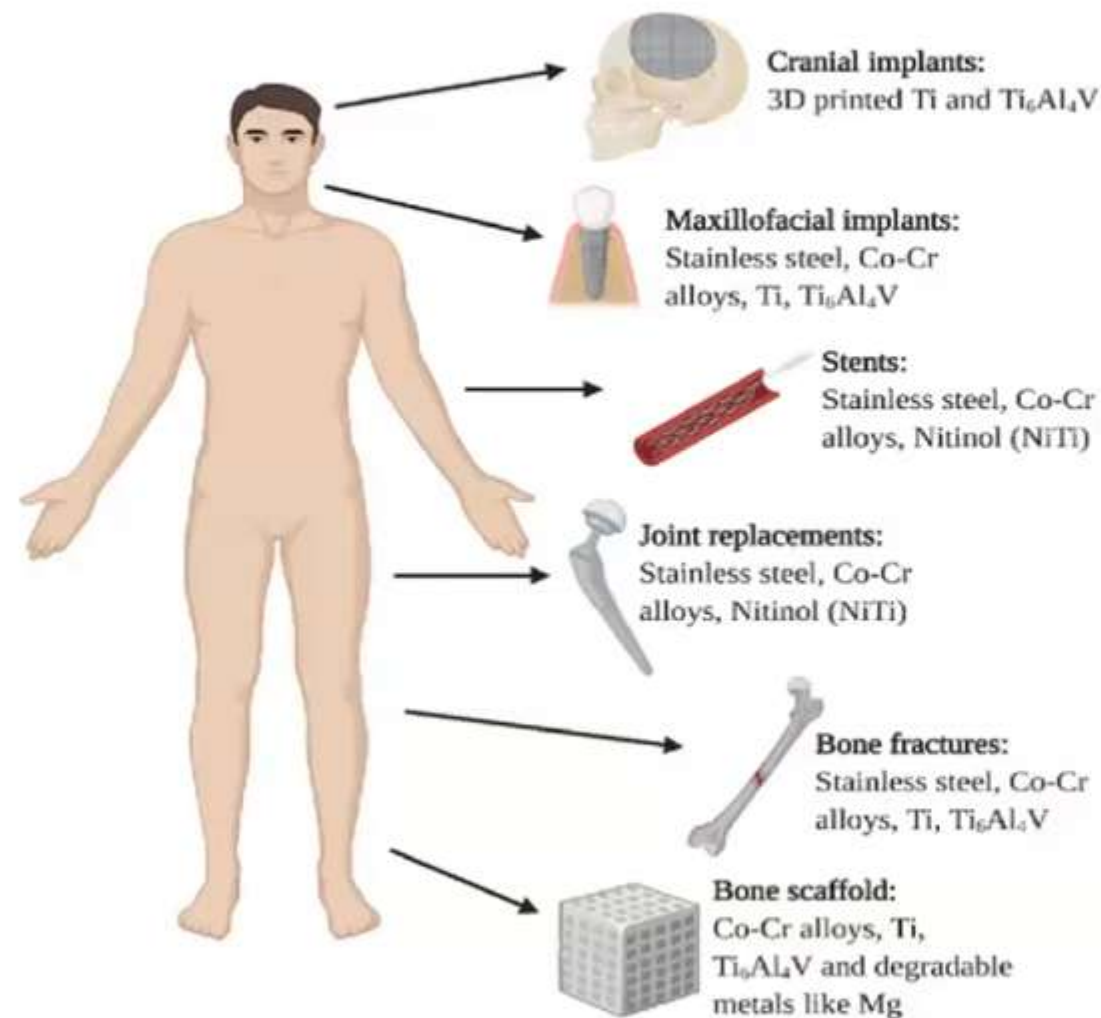
Defense



Manufacturing & Process



Potential of Pakistani Market?



Types of metal implants used in the human body.

More than 200,000 hip replacement surgeries occur in Pakistan per each year

One Implant can cost around 500\$

All via either traditional methods or export as 3d printed metal implant market is non existing in Pakistan

In one hospital: (LNH)

- 14,875 people had total knee replacement
- 5,167 people had total hip replacement



Orthosis & Prosthesis



More than 1,000,000 people in Pakistan are physically disables

One prosthetic limb can roughly cost around Rs350,000 /-

All via either traditional methods or export as 3d printed prosthetics and orthotics market is non existing in Pakistan

According to Dr Sarwar, with a population of 45 million people, Sindh is estimated to have about 450,000 people in need of prosthetics and orthotics services.

Defense



<https://pigeonis.in/blog/the-impact-of-drones-on-future-of-military-warfare/>

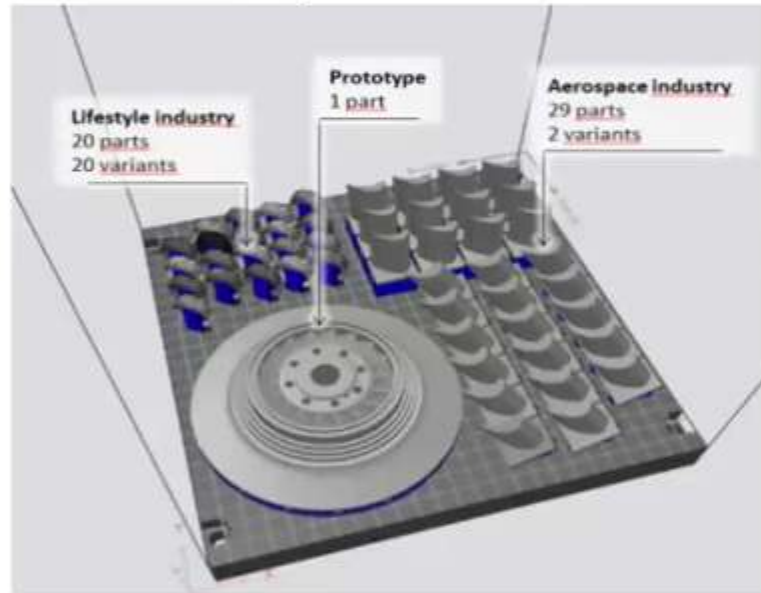
<https://www.alloutdoor.com/2018/04/03/thermal-defense-solutions-3d-printed-steel-sound-suppressors/>

<https://www.armyonlinestore.com/de/US-Army-military-4-Point-ACH-MICH-PASGT-ACU-Chin-Strap-coyote-brown-marines-usmc-marine-helm-helmet-kinnriemen-armyshop-armyonlinestore-.html>



Spare Parts will be a focus point!

Faster production & adaption to changing market requirements

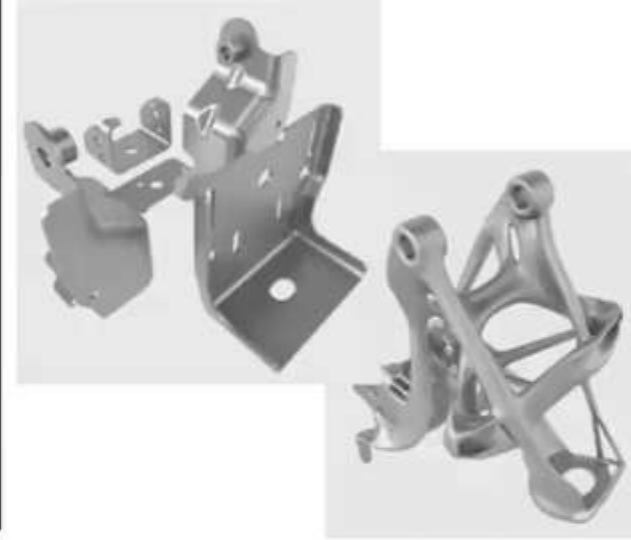
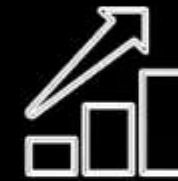


One production run - several different parts

Leadtime reduction/
Time to market



Reduction of
Assembly steps



Asset-light
Production



Reduction of
Inventory



Digital Spare Parts

Operations Efficiency



Why has Pakistan not yet Achieved its Potential?

Lack of Government Support

- Export Control Issues (Material)
- No Competence Centers
- No proper feasible AM policy

Lack of Knowledge

- Mismanaged Expectations
- Unknown Potential
- Capacity to learn lacking

Lack of Strategy

- Investment Mindset
- Barriers to entry
- High Risk investment due to higher initial CAPEX



Key Messages



AM is growing and
Pakistan can tap into
this potential as well



Pakistan can target L-
PBF as has potential
especially in Medical,
Defense and Spare
Parts



Government support
and awareness
amongst industries will
be key to achieve this
potential



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Thank You

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