Where Synthetic Biology Can Deliver Real Value

A Season for Pragmatism

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Some [platforms] will work, some won’t work…. Apple doesn’t stress about what apps are going to be the next big app in the App Store.

Jason Kelly, CEO of Ginkgo Bioworks (2021)

What applications make the most sense?

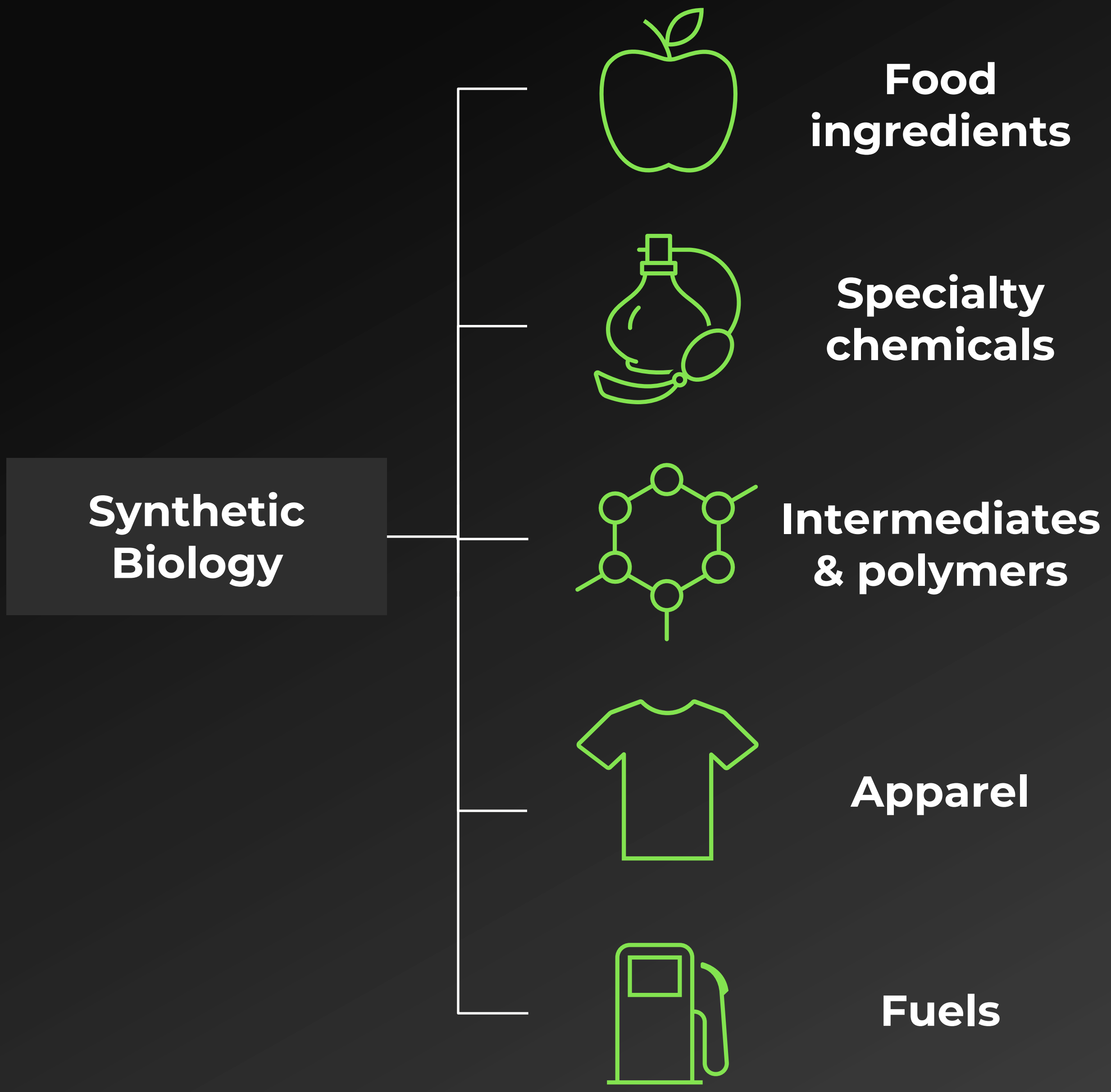
Agenda

01 | What applications are currently being pursued?

02 | What are the strengths and weaknesses of each?

03 | Key takeaways

Applications

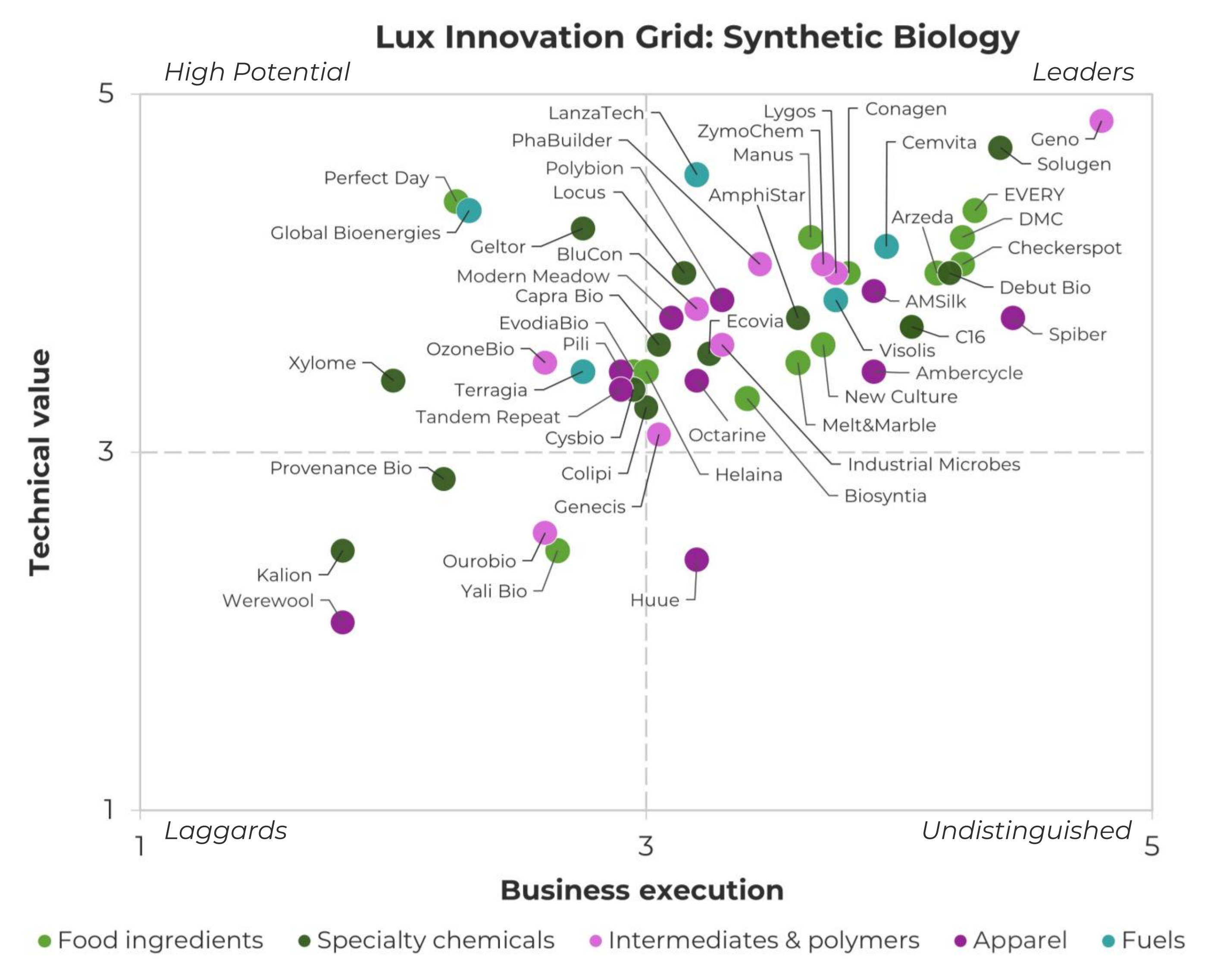


Startups by application

Lux evaluated **50 synthetic biology startups**, identifying five primary applications within the current developer landscape.

Each startup was scored based on a set of technical value and business execution criteria.

Scores were analyzed to illustrate application-level trends and viability.

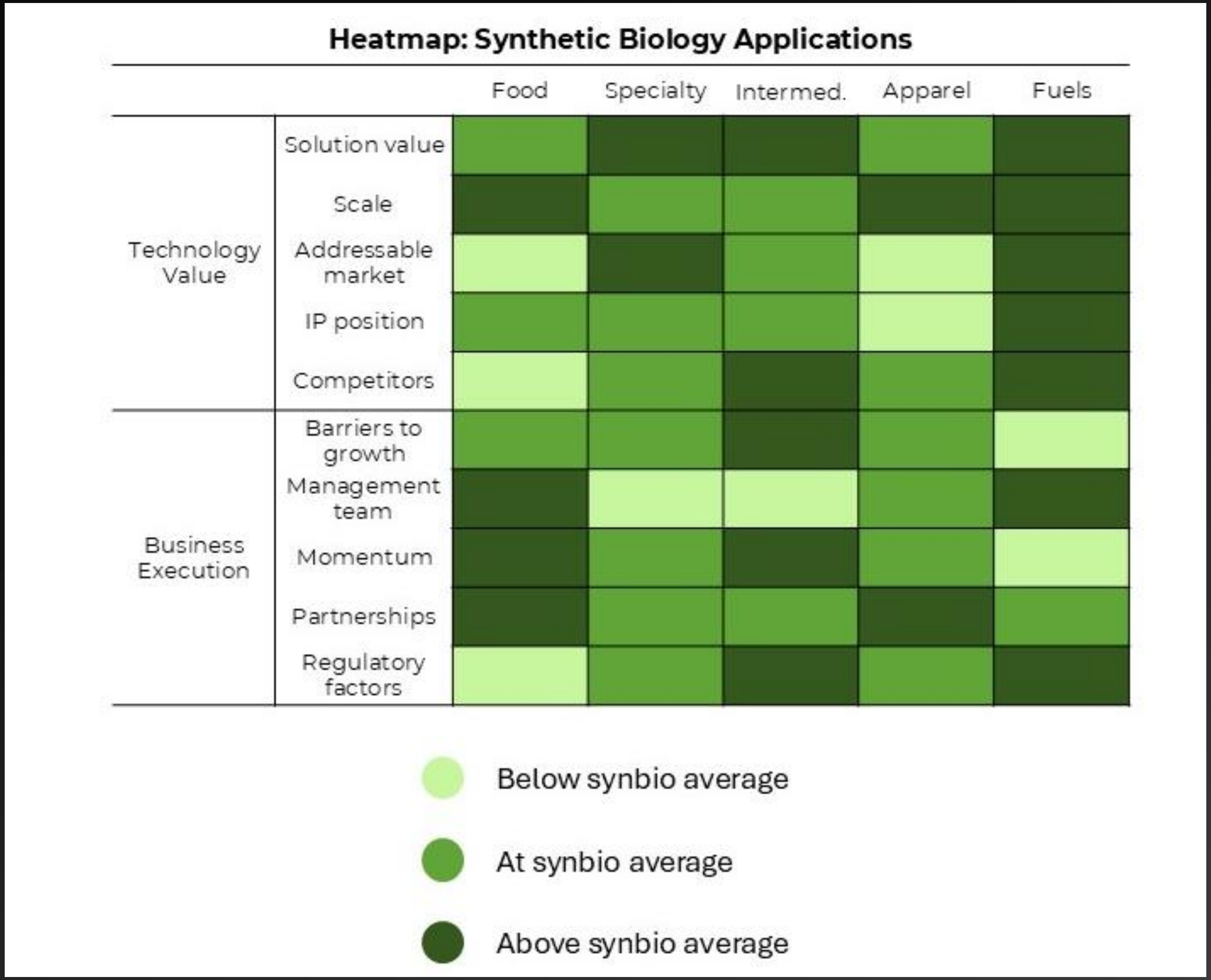


Application-level averages

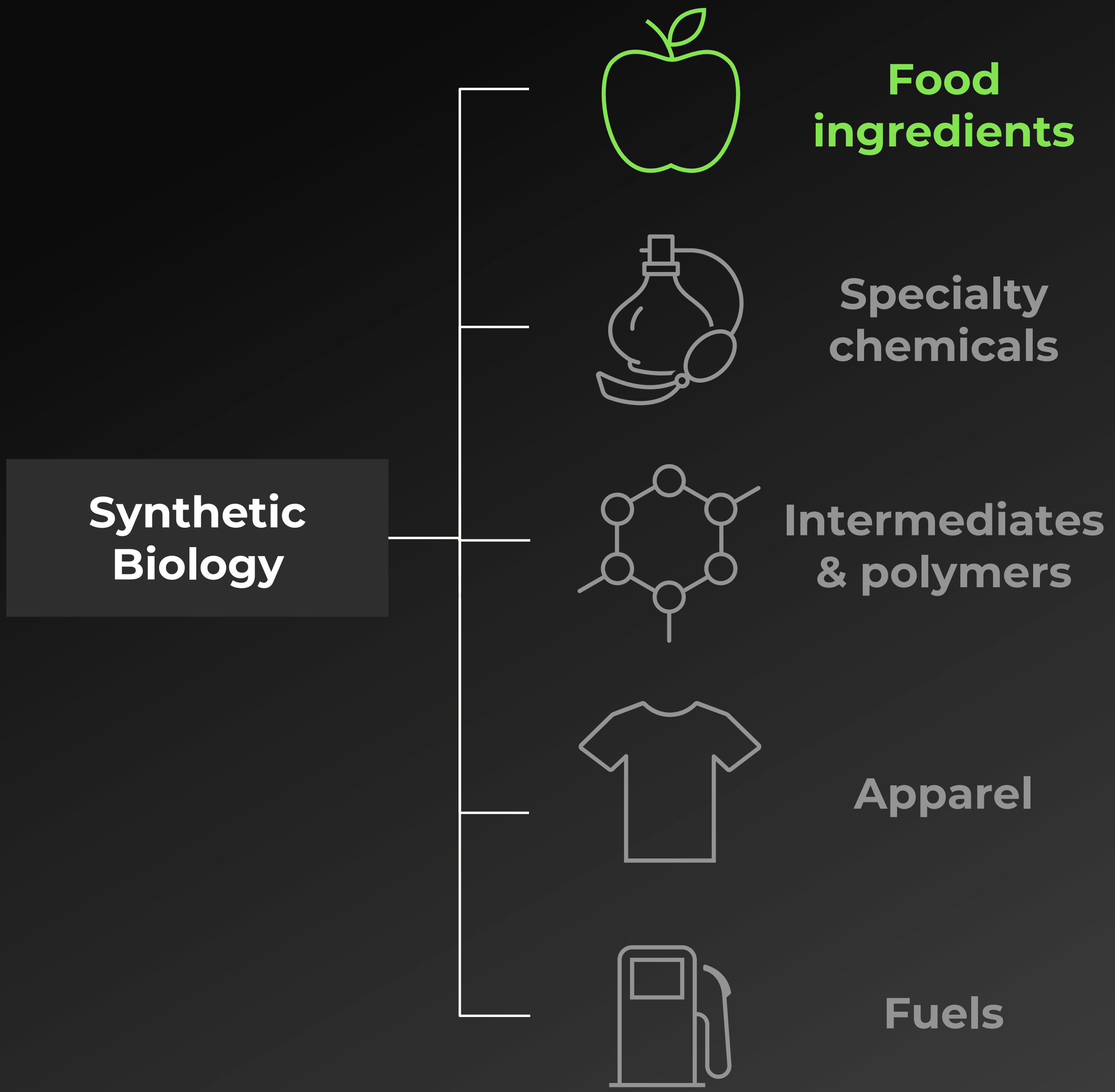
First, we averaged startup scores within each category to develop application-level takeaways.

Then, we color-coded each relative to the overall synbio average.

This highlights the pros and cons of targeting a given application with synthetic biology.



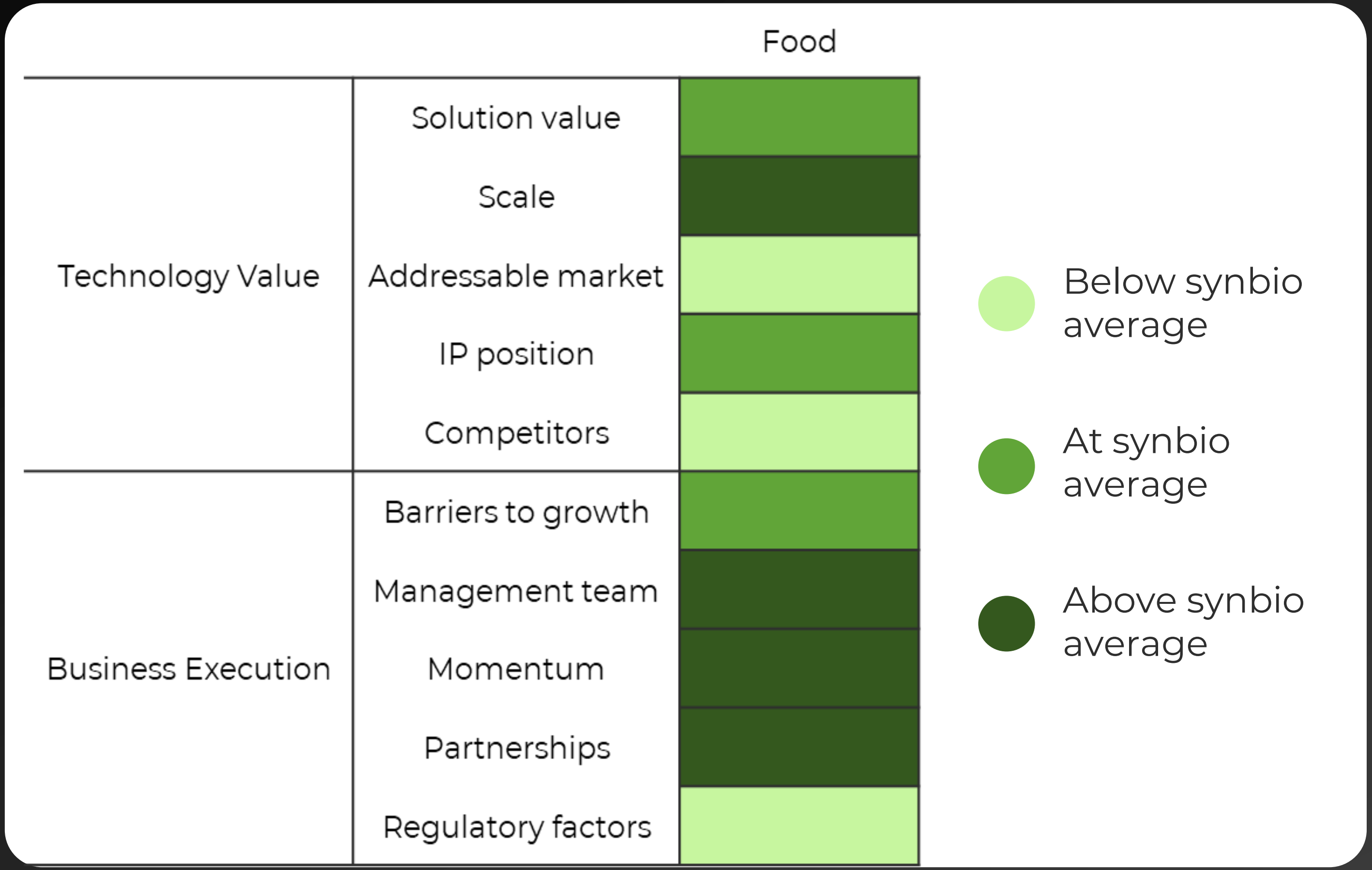
Food ingredients



Food ingredients

Startups struggle to access markets due to competitive and regulatory pressures

- The use of established precision fermentation enables scalability but crowds the competitive landscape with adjacent platforms.
- Many **struggle to convert early momentum into lasting revenue, as regulatory hurdles slow approval** across global markets.
- Demand is often miscalculated due to volatile consumer trends and market conditions.



Perfect Day

Engineered yeast to produce animal-identical alternative dairy proteins

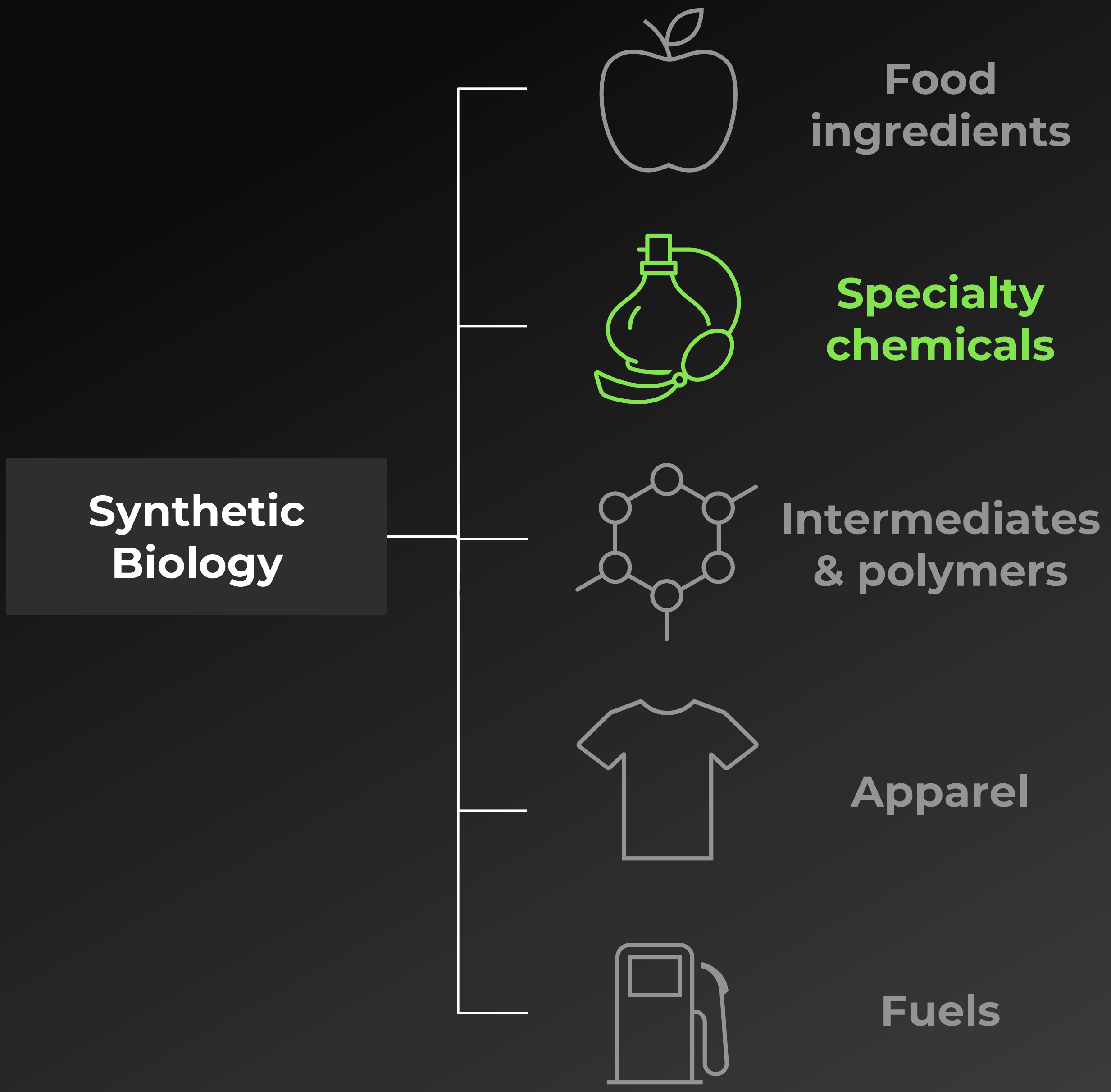
- The company remains at a significant premium over larger brands and lacks offtake for existing capacity.
- By 2023, it began missing major manufacturing milestones.
- It has since sold its consumer brands, pivoting away from a partial B2C strategy amid a lengthy legal battle with Olon.

LUX TAKE

Perfect Day illustrates that rapid growth and hype in food ingredients can be overshadowed by stiff competition, demand miscalculation, and execution challenges.

Perfect Day™

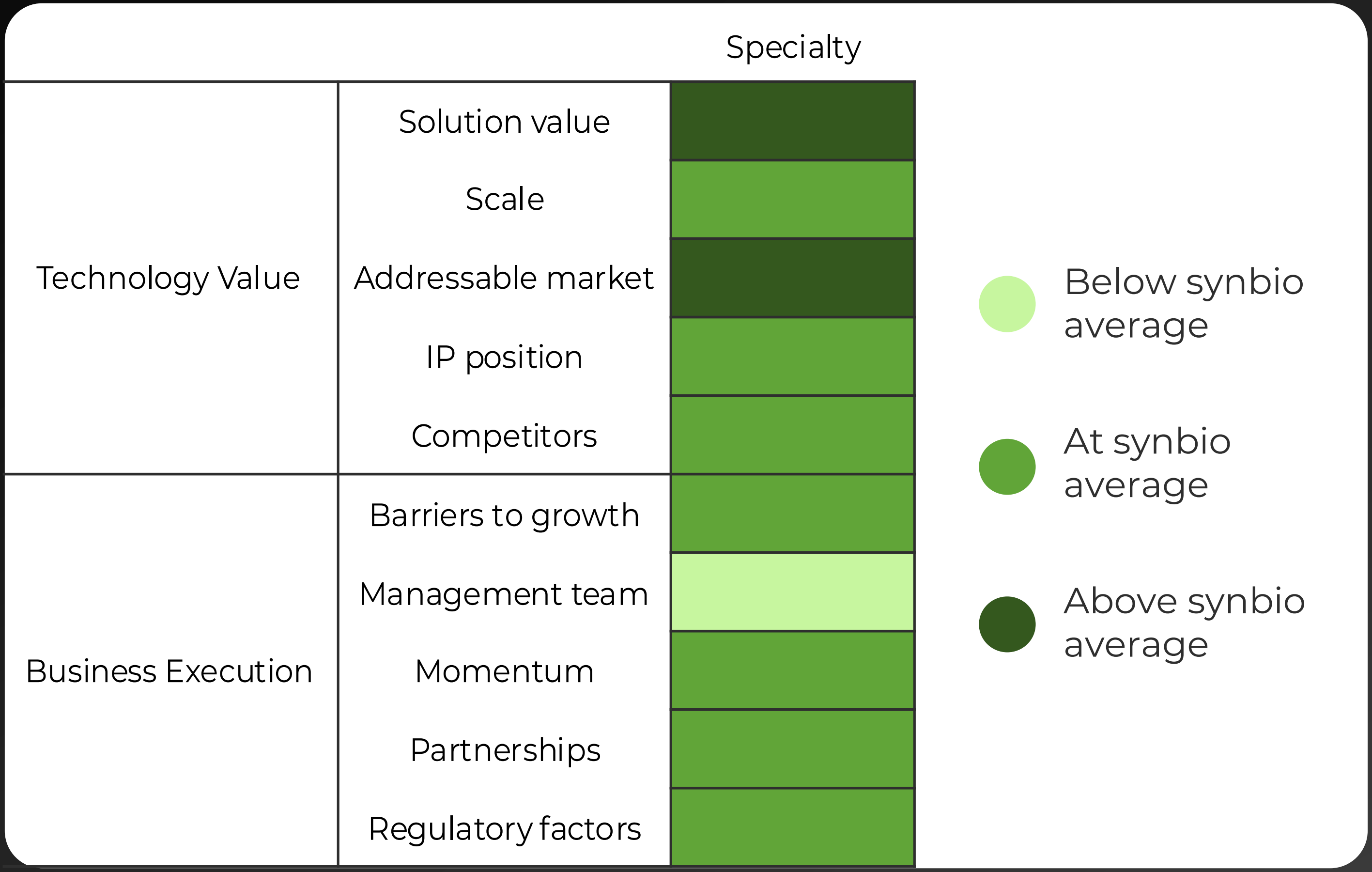
Specialty chemicals



Specialty chemicals

Startups are drawn to large markets but fail to execute on B2B relationships

- This subcategory houses the highest number of lab- and development-stage startups.
- Developers often deliver on performance but rarely achieve cost parity with incumbents.
- Startups **mistakenly chase perceived margins and consumer value propositions** over creating tangible incentives for downstream formulators.



Capra Biosciences

Continuous fermentation platform leveraging biofilms for retinol production

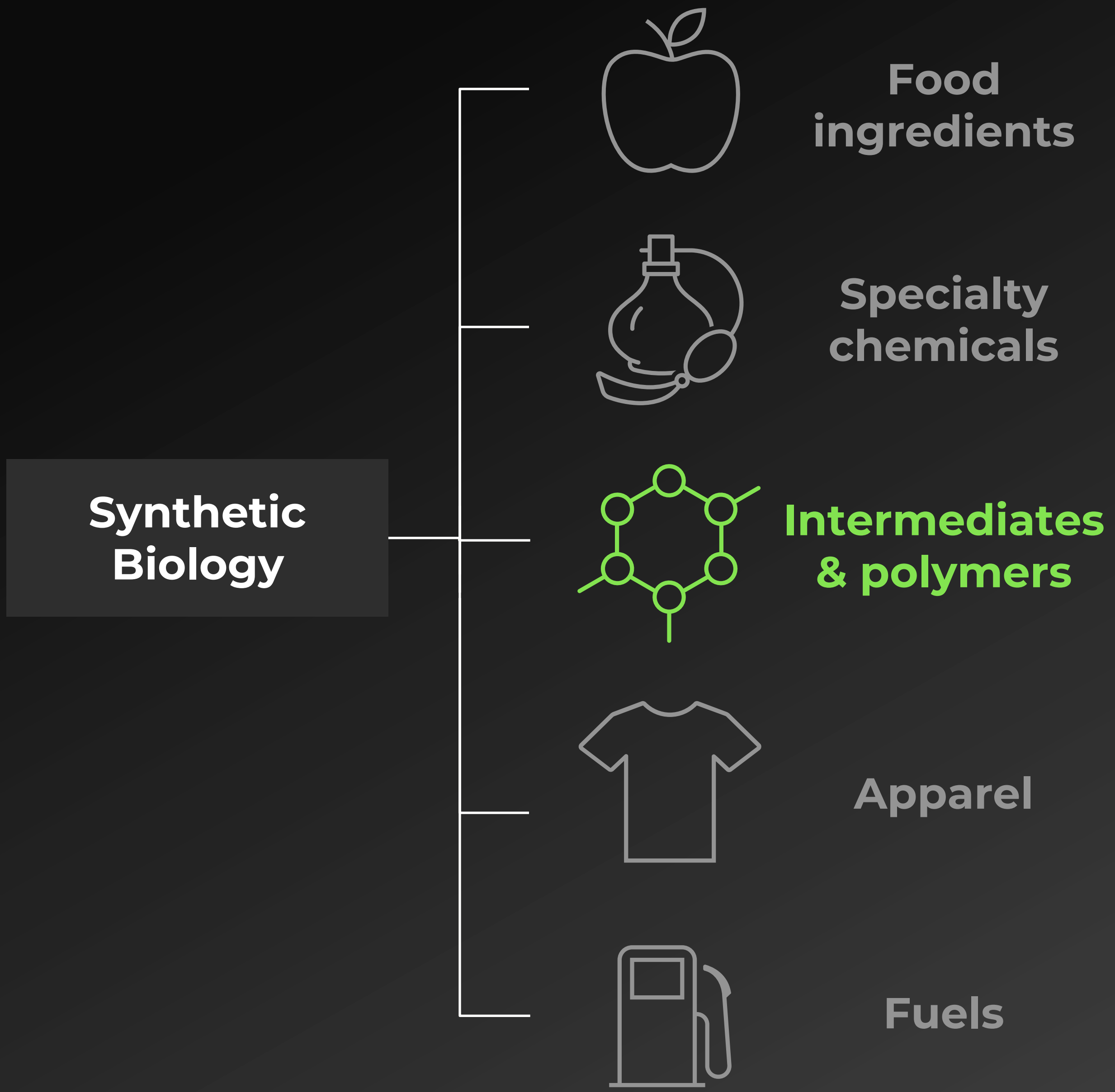
- The platform houses thirty 1,000-L reactors instead of one large pilot, allowing distributed, low-volume production.
- This strategy aligns scale-up with customer demand before committing to capacity expansion.
- The company secured two letters of intent covering its 200-kg/y pilot output.

LUX TAKE

Capra shows how early stage specialty chemicals players can de-risk scale-up by aligning output volume, performance, and distribution with partner demand.

CAPRA BIOSCIENCES

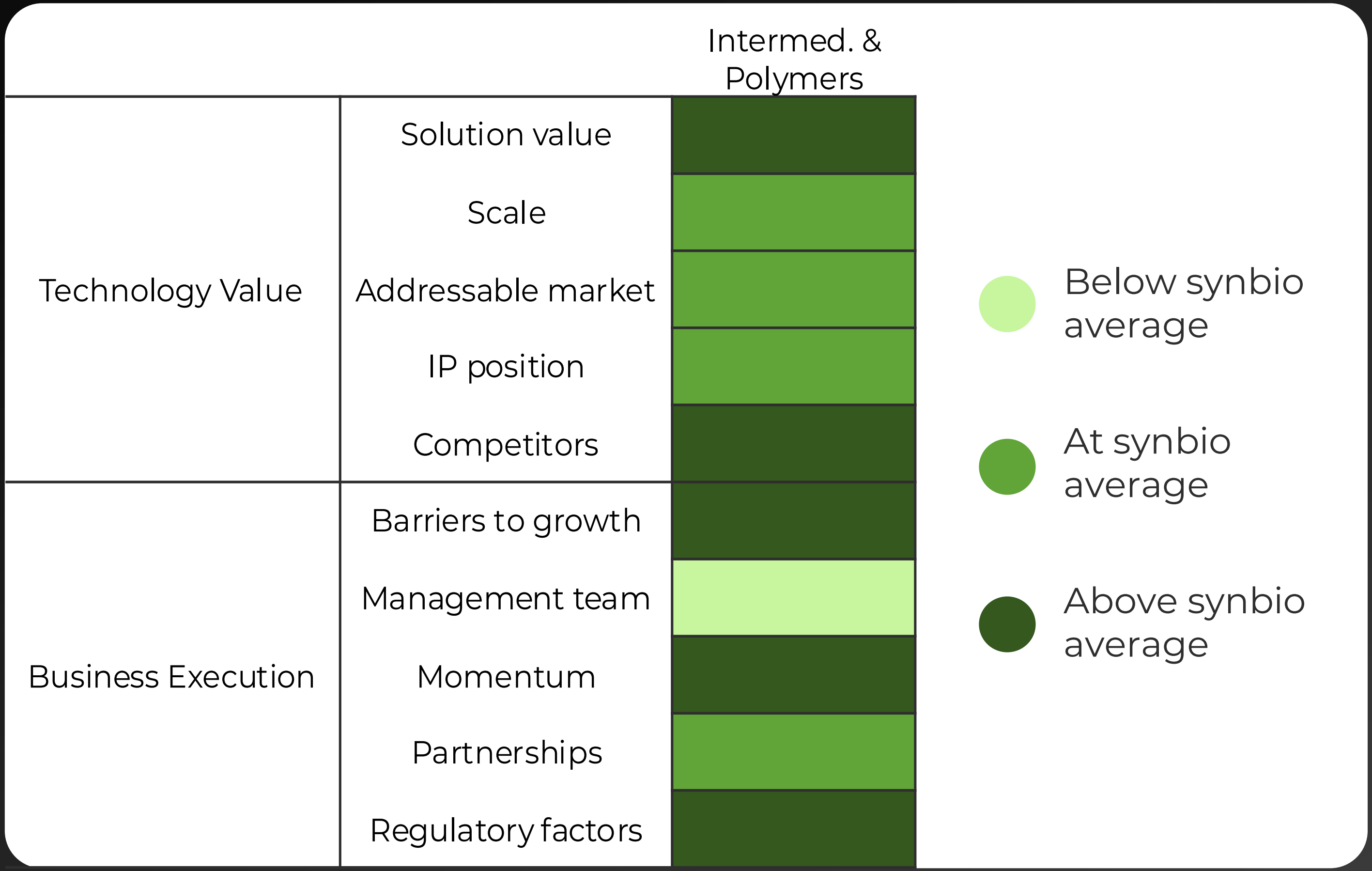
Intermediate chemicals & polymers



Intermediate chemicals & polymers

Process innovation drives value, but entrenched value chains pose limitations

- Developers prioritize **process innovation over product innovation**.
- Discovering alternate intermediate routes to products with clear commercial pathways bolsters competitive differentiation.
- **Startups struggle to prioritize targets strategically** and break into entrenched value chains, despite strong regulatory support.



Industrial Microbes

Hybrid ethanol-to-acrylic-acid production platform through an alternate intermediate

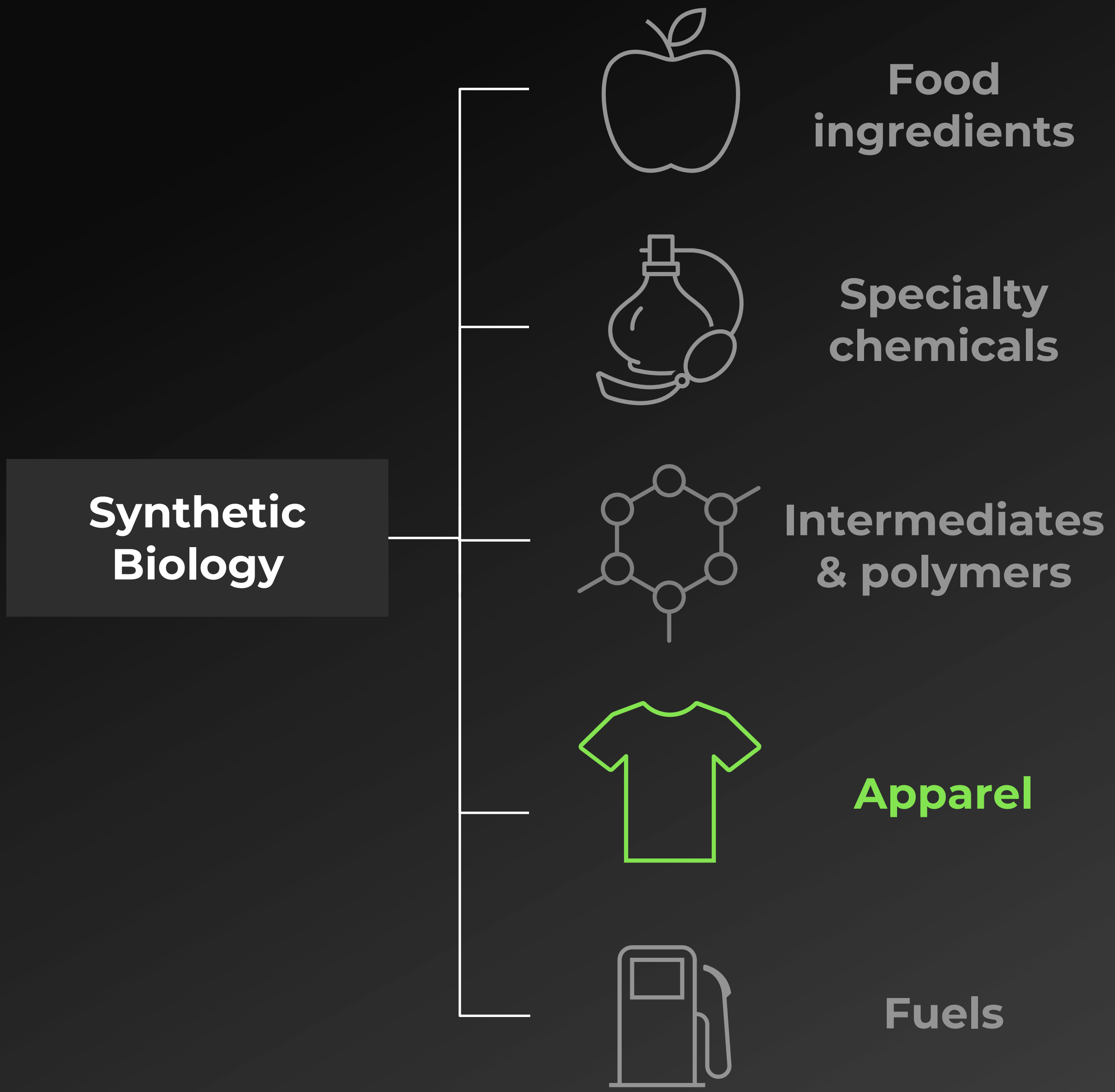
- Its use of poly-3-hydroxypropionate (P3HP), a stable and soluble alternative intermediate to 3-hydroxypropionic acid (3HPA), enables intracellular conversion.
- This bypasses costly extraction steps to achieving glacial-grade acrylic acid; early sampling indicates alignment with incumbent purity specifications.

LUX TAKE

Industrial Microbes shows how alternate intermediate strategies can simplify operations, reducing costs for established value chains.

INDUSTRIAL MICROBES

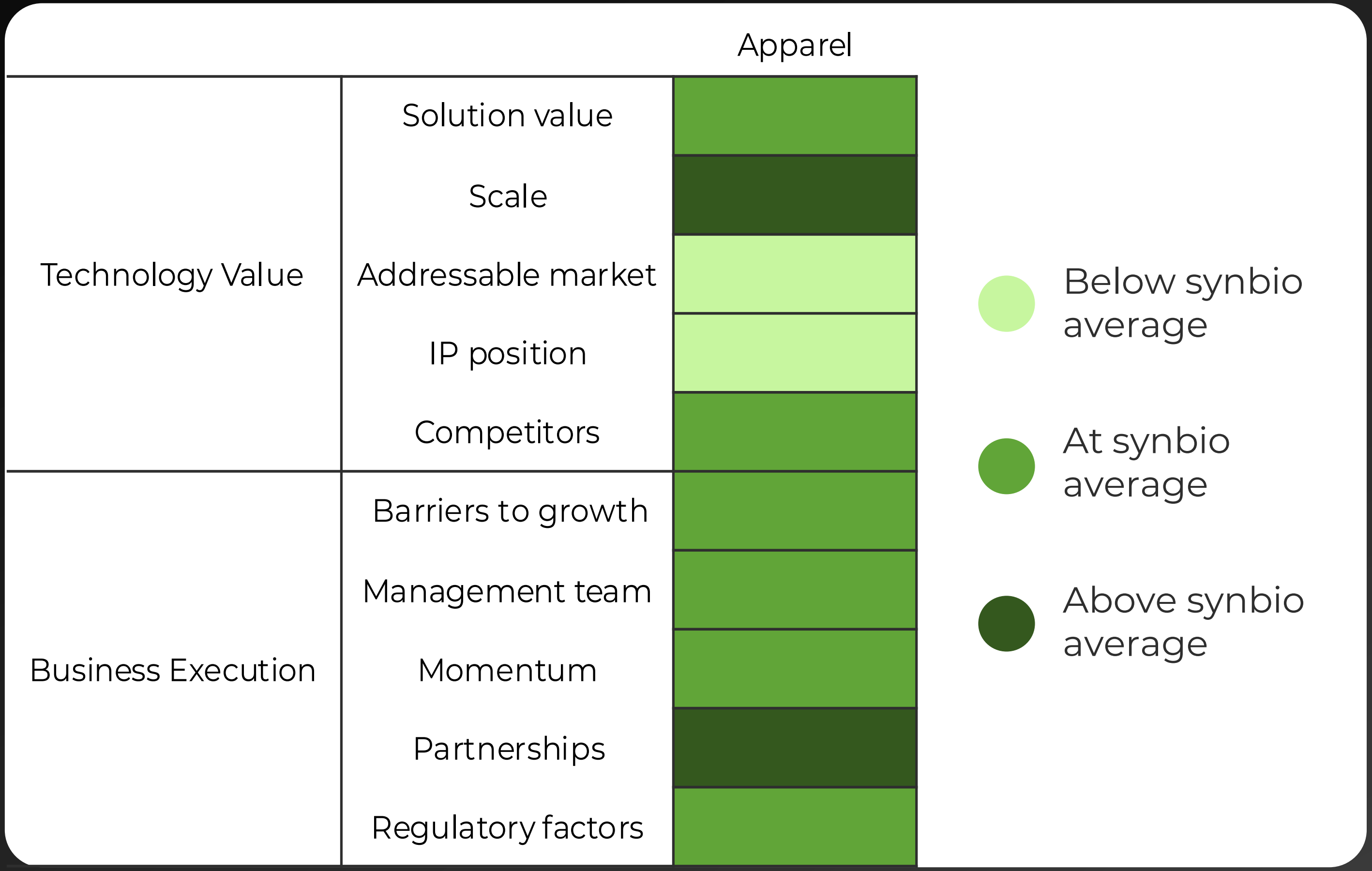
Apparel


Synthetic Biology
Food ingredients
Specialty chemicals
Intermediates & polymers
Apparel
Fuels

Apparel

Startups remain unable to enter high-volume markets

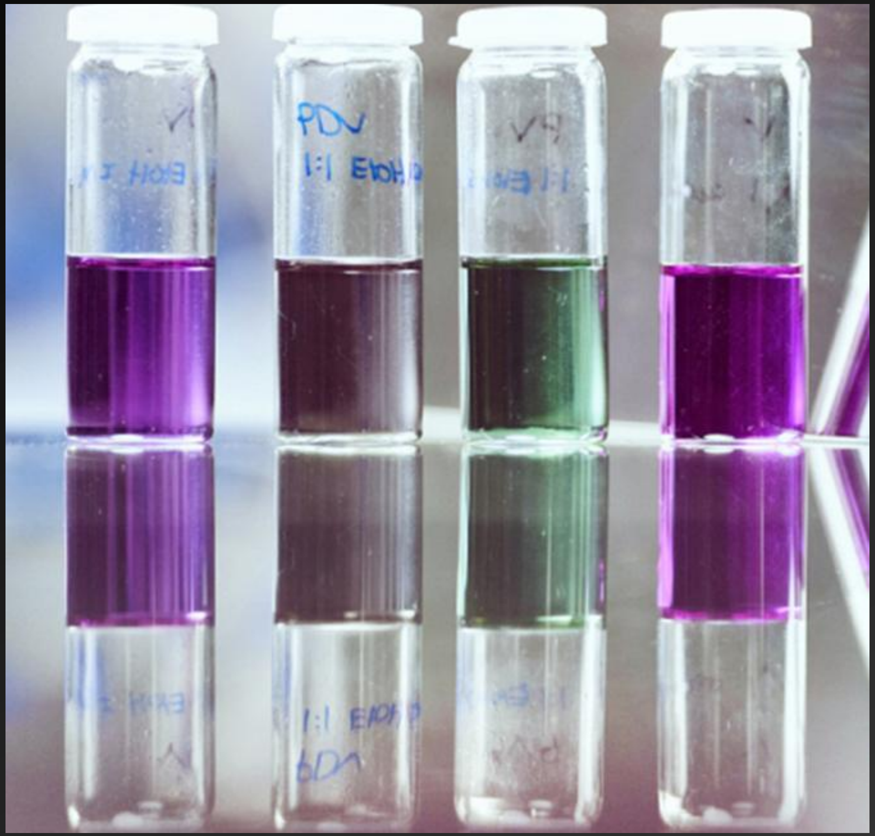
- Materials developers can unlock durability advantages but **rarely, if ever, reach cost parity with incumbents**, restricting them to luxury markets.
- Despite partnership activity, **offtake remains limited**: Premium brands use small ratios of biobased inputs.
- Dye innovators are addressing multipass dyeing and water-usage pain points for high-volume sectors.



Octarine Bio

Hybrid-fermentation-derived and enzymatically modified chromophores

- Its universal, concentrated dyes (20–40× stronger than incumbents) enable blended dyeing with fewer cycles.
- This process reduces cost in use and water usage even with unit premiums over synthetics.
- Direct sales to dyehouses have enabled integration into entrenched value chains via Portuguese textile partners.

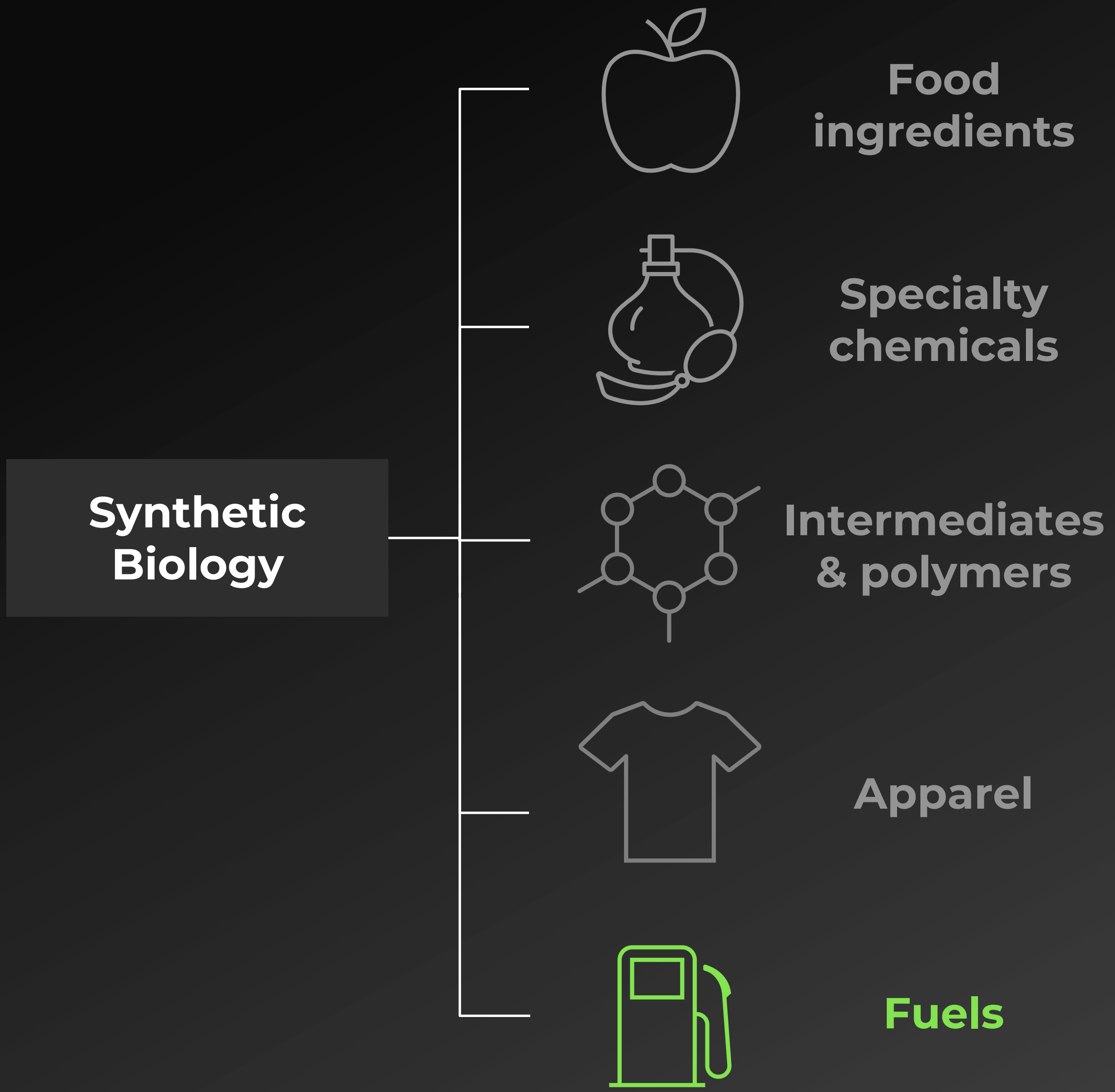


LUX TAKE

Octarine shows how reducing cost in use for integral partners within the value chain, even without unit-cost parity, can unlock end-to-end adoption in apparel.

OCTARINE

Fuels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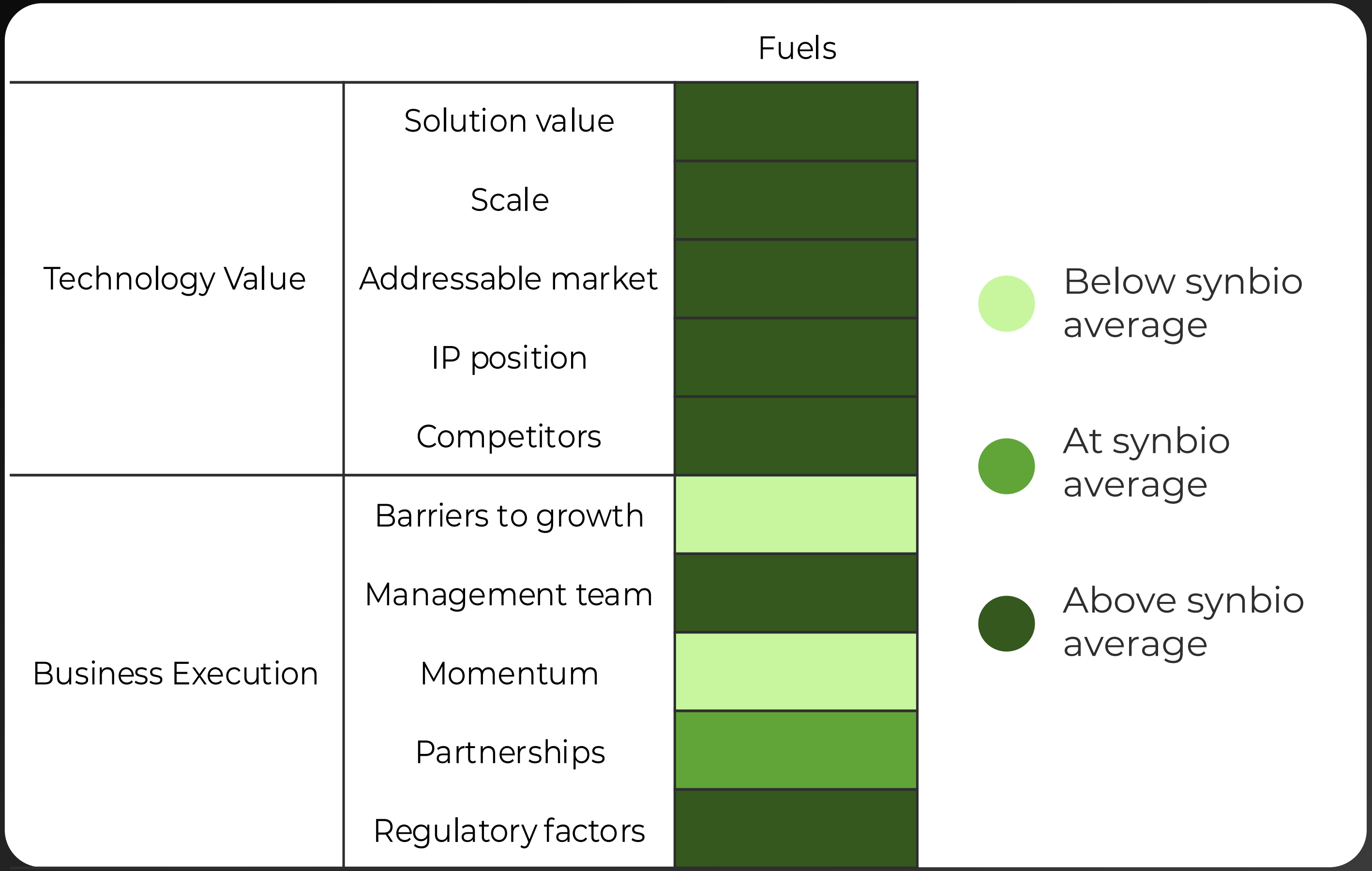
Fuels

Startups struggle due to slow approval processes and lengthy time to market

- Startups can meet stringent performance standards, but cost remains a barrier.
- Fuels producers face **steep barriers to growth: Capital intensity and lengthy certification** reflect a high-risk, high-reward path.
- Upstream developers (e.g., fuel intermediates) can capitalize on demand sooner but struggle to remain focused.



Global Bioenergies

Hybrid fermentation and chemical catalysis platform to produce fuels and derivatives

- Long certification timelines delayed traction in fuels, resulting in the cancellation of a 10,000-tonne/y facility.
- Its late pivot, launching a long-lasting-cosmetics brand, diluted focus without securing durable offtake.
- It shut down operations in 2025 after failing to find a buyer.

LUX TAKE

Startups risk overextending into coproducts as fuels are capital intensive, have lengthy approval timelines, and require high-volume production to generate revenue.

Global Bioenergies

Just because you can make something with synbio doesn't mean you should

Key takeaways

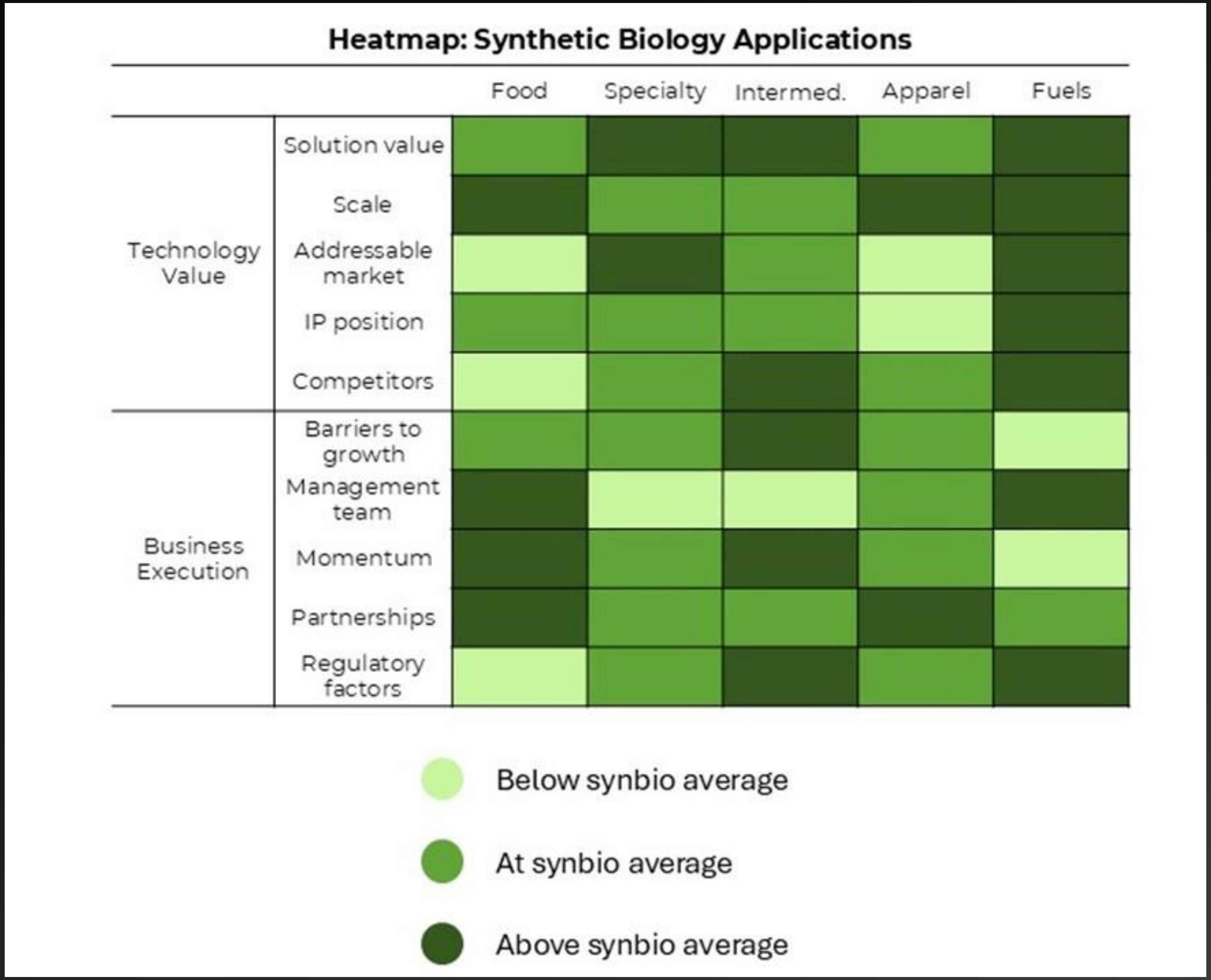
Application viability

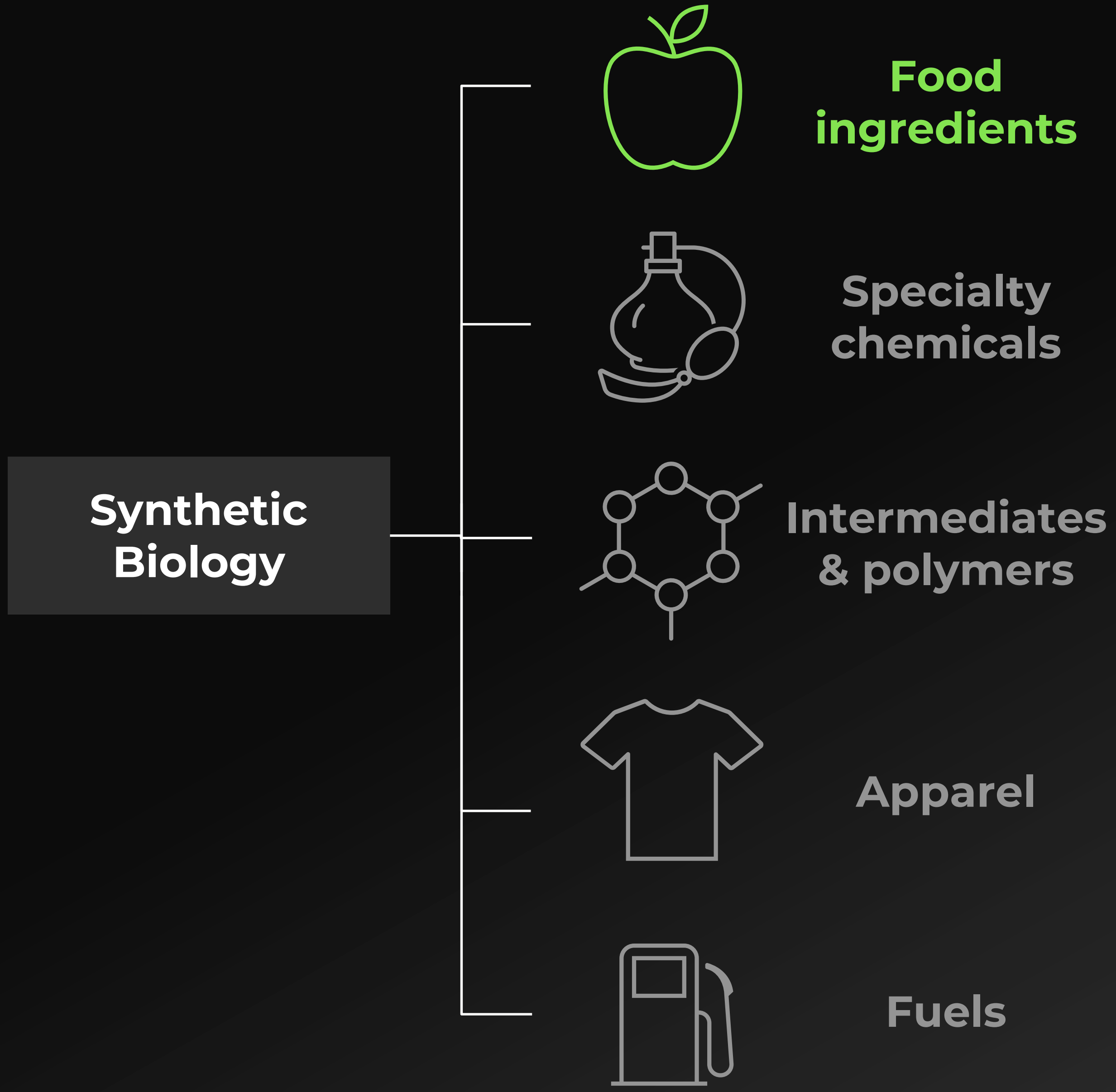
Technology Value

- Solution value and addressable market signal long-term opportunity.
- Competitors dictate new startups' market-entry ability.

Business Execution

- Barriers to growth and regulatory factors dictate near-term commercial potential.





Avoid markets where slow approval and overcrowding are unlikely to resolve (e.g., alternative meat proteins) but note that some sectors (e.g., health ingredients, food colorants) show promise. Prioritize clear regulatory paths and proven demand.

Synthetic Biology

Food ingredients

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Specialty chemicals

Monitor for midterm targets, engaging only where incumbent chemistries face challenges. Identify where policy- or supply-driven reformulation is in progress, noting that novelty- and consumer-driven plays will remain risky.

Intermediates & polymers

Apparel

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Intermediates & polymers

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Fuels

Monitor fuels leaders as a long-term play (10–15 years to value), as SAF mandates and credits have passed the point of no return in key markets like the EU. Focus on building resilience through coproducts and early certification, not temporary subsidies.

Key takeaways

1

Industry conservatism dominates the market.

Even clear performance advantages rarely justify disrupting established value chains today; similarly, cost-in-use savings may be insufficient if reformulation is required. Adoption now depends on incremental, low-risk improvements bringing guaranteed value to opportunistic markets.

2

Regional flexibility is the only North Star.

Biobased incentives will continue to shift with geopolitics; uniform, stable policy is an illusion for now. Resilient players will survive policy swings by lowering production costs via process innovation, leveraging distributed infrastructure and diverse regional markets to embed flexibility.

3

Promising startups focus on B2B drivers.

Past failures reveal that volatile consumer trends don't sustain synbio ventures. The next wave of partnerships will favor startups that solve cost, quality, and supply-reliability challenges for industrial partners, while clients lead consumer storytelling.

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