

Today's Webinar Will Begin Shortly:

The Lux Foresight Report: Implications and Innovations in a Post-COVID World

QUESTIONS?

Use the questions box on your screen

AUDIO ISSUES?

Use the global dial-in number in your confirmation email



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The Lux Foresight Report: Implications and Innovations in a Post-COVID World



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Agenda

- 1** | Lux Approach and Methodology
- 2** | 2021 in Passing: Hindsight, Surprises, and Signposts
- 3** | Our Top Technologies to Watch for in 2022
- 4** | Example technology dives
- 5** | (Un)popular Predictions
- 6** | The \$10M Question

Lux Research by the Numbers

250+ Clients

Including multinational corporations, investors, and governments

on

5 Continents

>80%
of the largest
chemical
companies

>75%
of the largest
CPG
companies

>60%
of the largest
oil & gas
companies

>50%
of the largest
electronics
and **IT**
companies

>45%
of the largest
diversified
industrial
companies

Lux Research by the Numbers

150+ Employees in 5 Offices

Boston

New York

Amsterdam

Singapore

Tokyo

The Lux Sustainable Innovation Model – Innovation at the Interface



Climate Tech

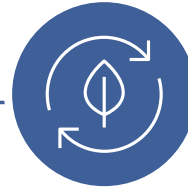
Enabling the elimination and remediation of greenhouse gas emissions

Lux Recommends

Your innovation strategy needs to leverage technologies and sectors powering the energy transition as well as figure how to directly reduce emissions and evolve your business models to reach your enterprise's sustainability goals.

Focus Areas

- Decarbonizing industrial processes
- Renewable grid integration
- Energy storage
- Carbon capture, utilization, and storage
- Hydrogen economy
- Electric vehicle charging
- Synthetic fuels



Circular Tech

Enabling the elimination and remediation of waste as well as the regeneration of natural systems

Lux Recommends

Your innovation strategy needs to have a compelling vision, clear business models, and proof that the circular economy practices deliver on their promise of product performance and resource efficiency to build circular supply chains.

Focus Areas

- Plastic waste
- Food and agriculture waste
- Building and construction waste
- Textile circularity
- Circular design tools
- Tracking and traceability
- Synthetic biology
- Chemical recycling



Future Consumer Tech

Enabling nutrition and wellness for the world's population

Lux Recommends

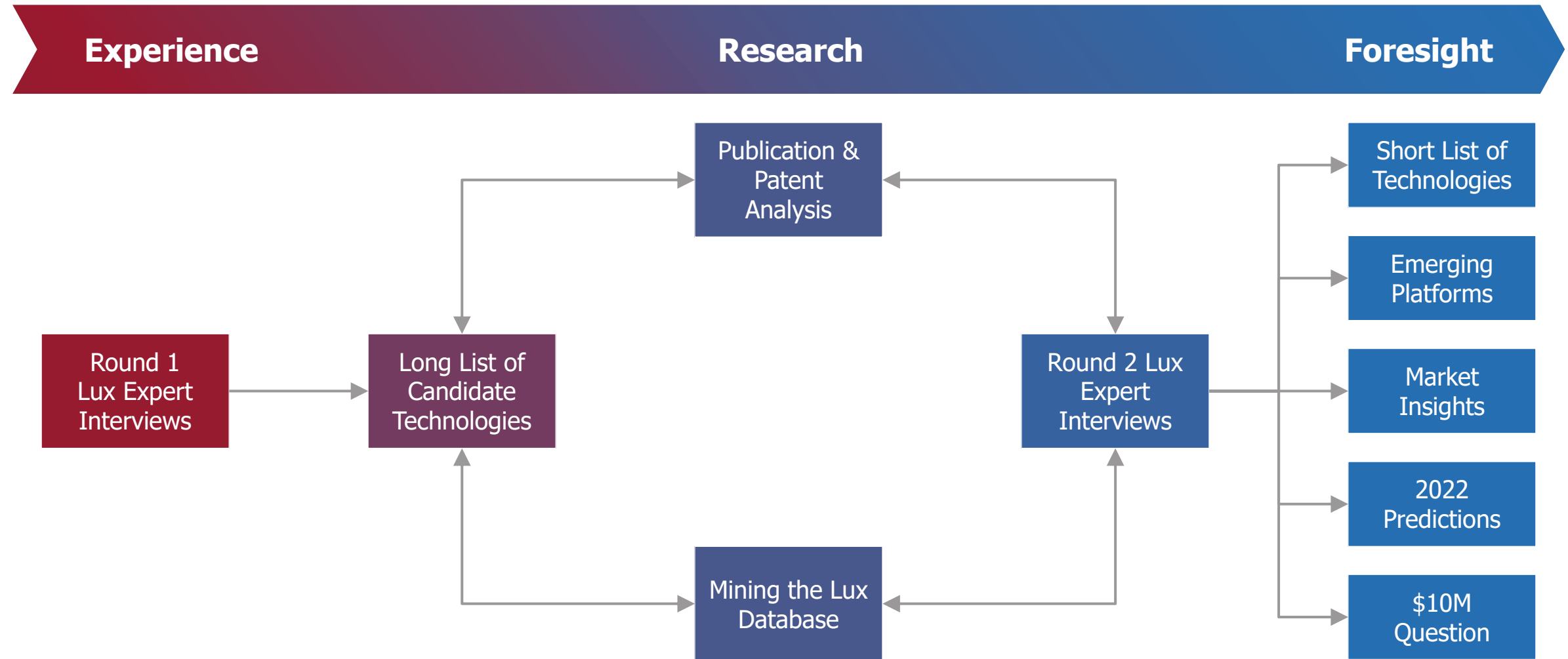
Your innovation strategy needs to strike the right balance between sustainability outcomes (health, safety, and transparency) while delivering on performance, cost, and ease of access to capitalize on the rapidly evolving needs of the future consumer.

Focus Areas

- Alternative food production systems
- Alternative proteins and food ingredients
- Nutraceuticals
- Microbiome
- Digital biomarkers and therapeutics
- Digital sales platforms
- Personalization

Lux's Prioritization Approach

Capturing Observation, Insights, and Experience



2021 in Passing: Hindsight, Surprises, and Signposts



Climate Tech

Carbon capture becoming a business

Building on Tesla and others selling carbon credits for revenue, Exxon takes the next step in building a first-of-its-kind business around carbon itself, which will further stimulate capture and utilization technology development.

Signposts & Signals

- COP26 accelerates and converges government policymaking around the globe
- The U.K. announces a 2023 experiment to swap H₂ into its NG infrastructure, setting the pace
- Initial windfarms reach their end of life, prompting renewed focus on large-scale recycling technologies



Circular Tech

Chemicals embrace DSPs in a bigger way

In a sign of decreased dependency on volumetric sales models, companies like BASF embrace just-in-time sales through partnerships with data and analytics companies, signaling a fundamental shift in overall business strategies.

Signposts & Signals

- COP26 drives further carbon policy formation and stimulates technology development
- Stock prices of oil and gas and chemical and materials companies do not bounce back to pre-COVID levels without strong ESG programs
- Companies add policy, trend spotting, and NGO understanding to their tech scouting activities



Future Consumer Tech

Cellular meat receives market approval

Intense consumer interest drives rapid market development of alternative proteins. Singapore leads with first market approval of a cell-cultured product. Sustainability concerns by empowered consumers create new perceptions, rapid policy shifts, and novel product opportunities.

Signposts & Signals

- Global replication of Land O'Lakes' TruTerra consortium model of analytics-to-the-acre, solving for yield, profitability, and consumer preference
- The U.S. and EU follow Singapore, enacting bioengineering policy, including food safety and provenance
- Companies spend more on innovation scouting in response to the increasingly complex environment



Digital Tech

COVID drives D2C and further shortens last mile of supply chain and "everything on the edge" thinking

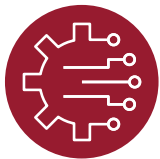
Signposts & Signals

- Incumbent CPGs accelerate acquisition of purpose-built companies
- Rapid rise of NFT saps energy and value from ecosystems
- Supply chain systematizes the meshing of sensors to create intelligent systems
- Telemedicine rolls back with COVID subsiding, but digital biomarkers go big



Clean Energy Technologies

Green energy,
green storage



Digital Technologies

Data about everything



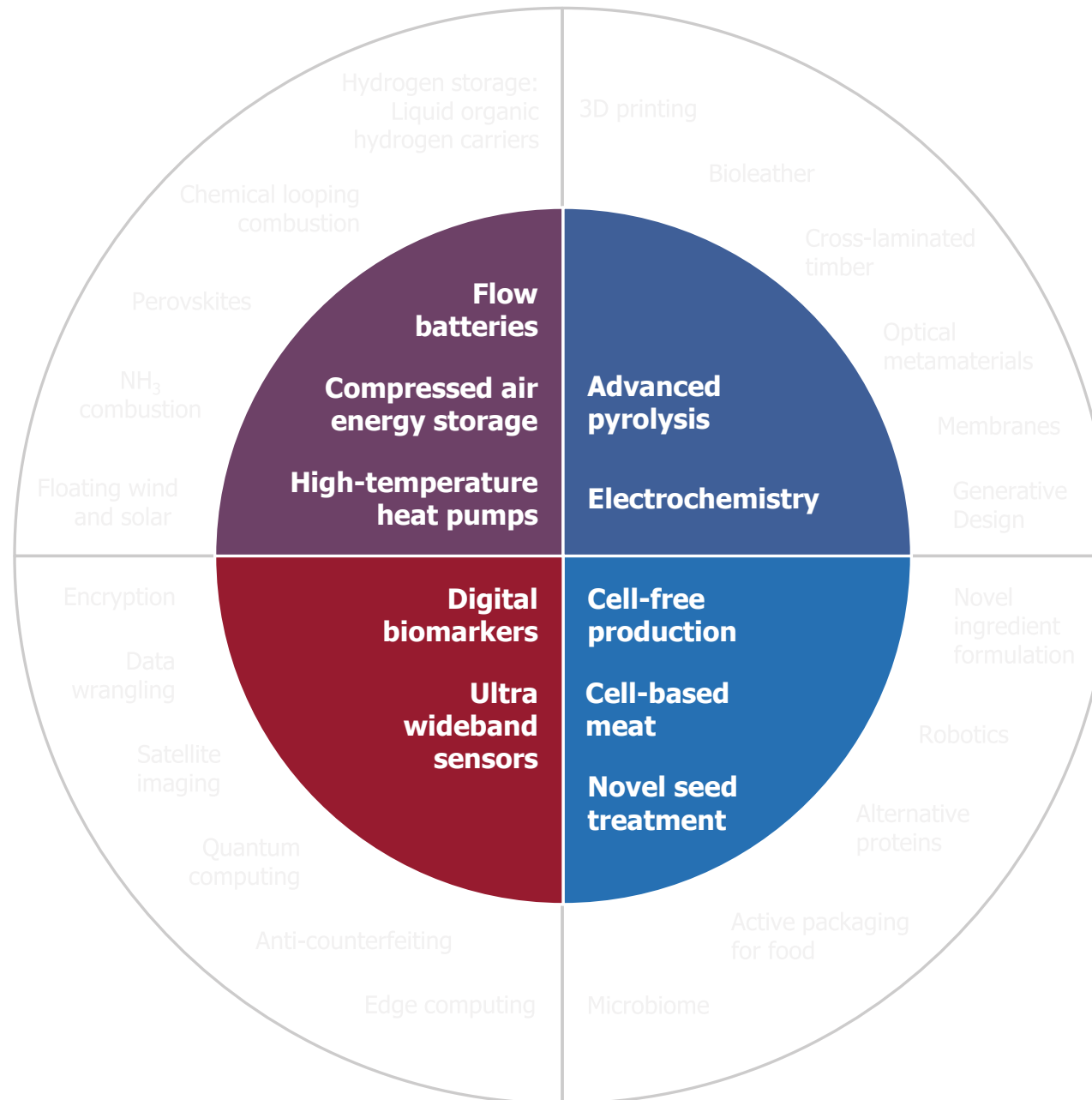
Circular Technologies

Scale new materials,
recycle old



Future Consumer Technologies

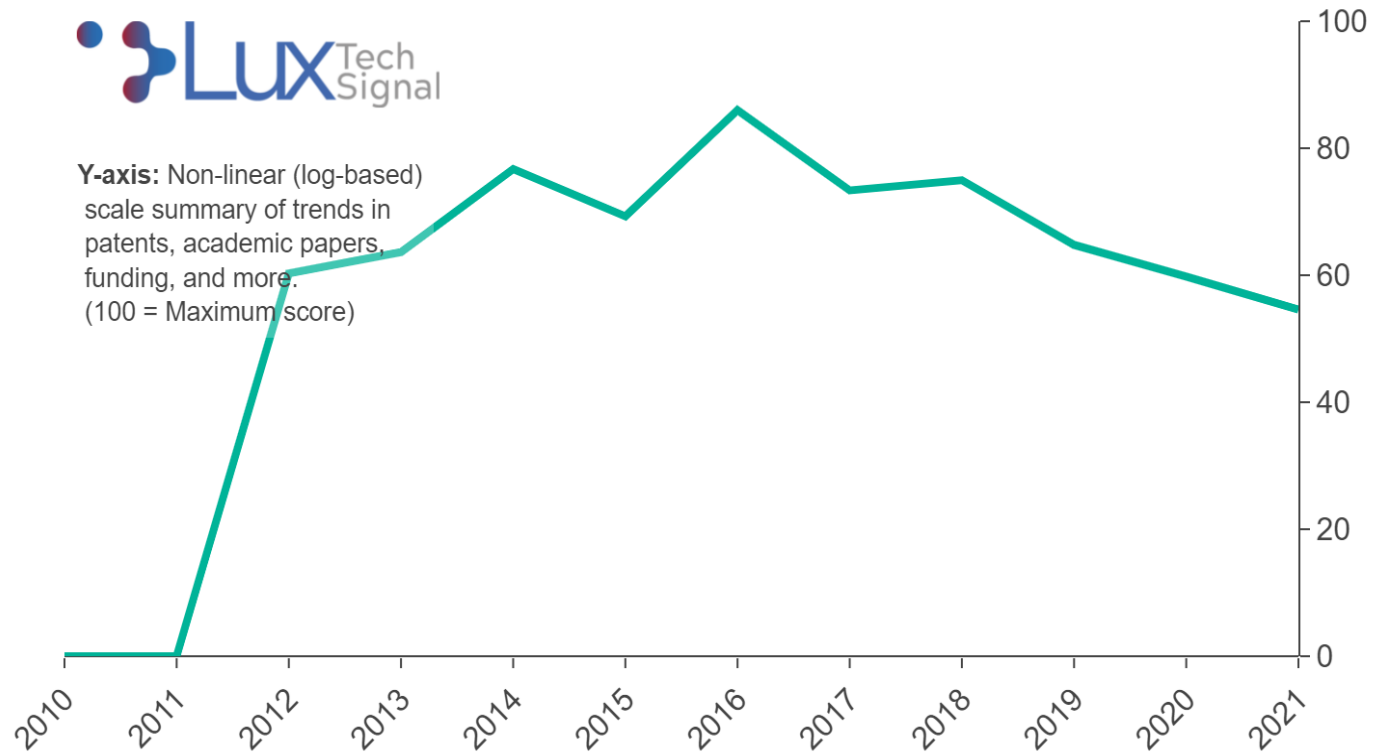
Scaling future platforms



High-Temperature Heat Pumps



Y-axis: Non-linear (log-based) scale summary of trends in patents, academic papers, funding, and more.
(100 = Maximum score)



Note: 10-year AUC depiction for relative comparison purposes



High-Temperature Heat Pumps

NOTABLE NOTES

- June 2020: Oak Ridge National Labs awards \$2.4M grant to AO Smith, Isotherm Inc., and Brayton Energy to build advanced heat exchanger technology for natural gas-based heat pumps and modular power generation
- April 2021: SINTEF, NTNU, and ToCircle announce 180 °C heat pump installed at Danish TINE dairy consortium, claiming world's first zero-emissions dairy operation
- October 2021: Honeywell announces collaboration with U.K. company Futraheat on novel heat pump technology, utilizing low GWP HFO refrigerant R1233zd
- October 2021: U.K. government announces £5,000 grants to homeowners to purchase heat pumps



Heat is a monetizable market.

EXAMPLE PLAYERS



Panasonic



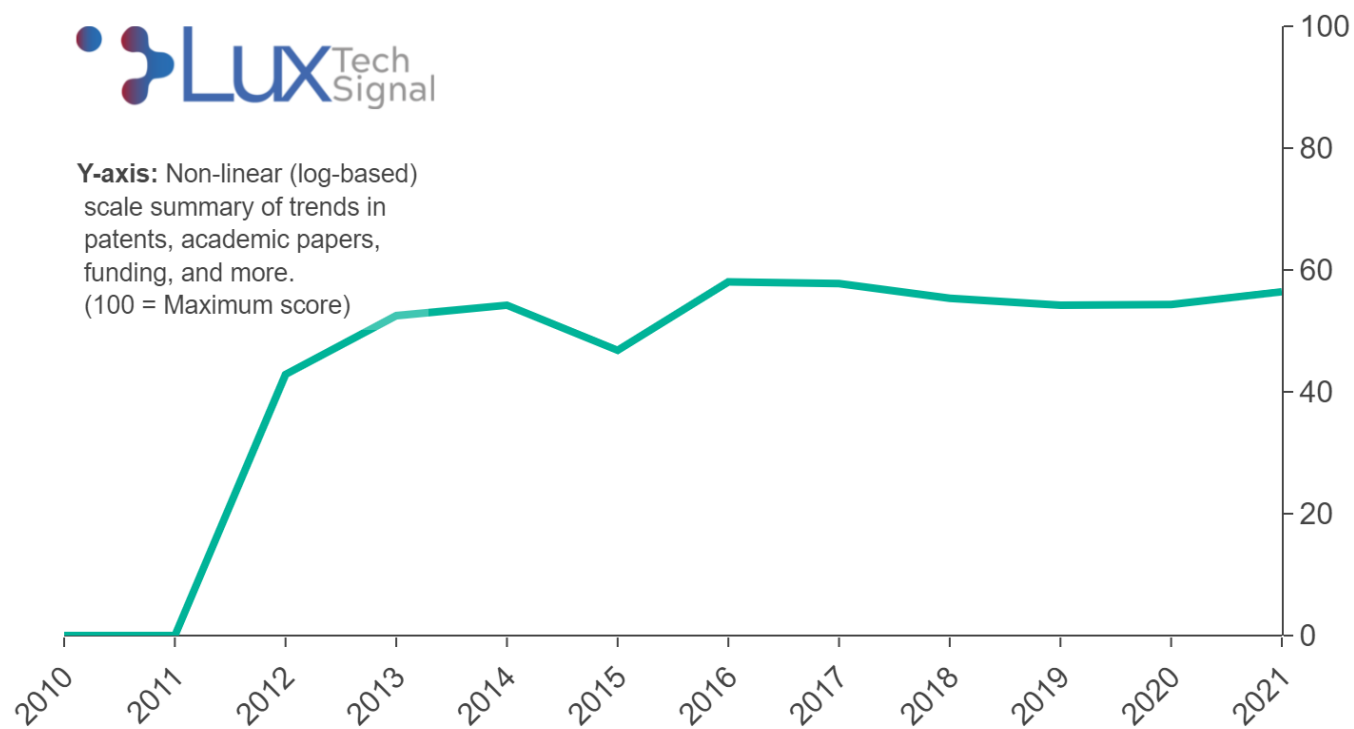
Honeywell



Advanced Pyrolysis



Y-axis: Non-linear (log-based)
scale summary of trends in
patents, academic papers,
funding, and more.
(100 = Maximum score)



Note: 10-year AUC depiction for relative comparison purposes



Advanced Pyrolysis

NOTABLE NOTES

- June 2021: Braven Environmental and Chevron sign long-term feedstock agreement
- September 2021: Shell Ventures BV takes a 21.2% stake in BlueAlp
- October 2021: Dow announces recycled polymer introduction in 2022, and Exxon Mobil announces plans to build recycling facility
- November 2021: Honeywell announces new process technology and partnership with Sacyr to deliver 30K metric tons of mixed plastic delivery by 2023



Renewed focus on pyrolysis sandwiched by sorting and purification technologies creates an increasingly economically viable platform.

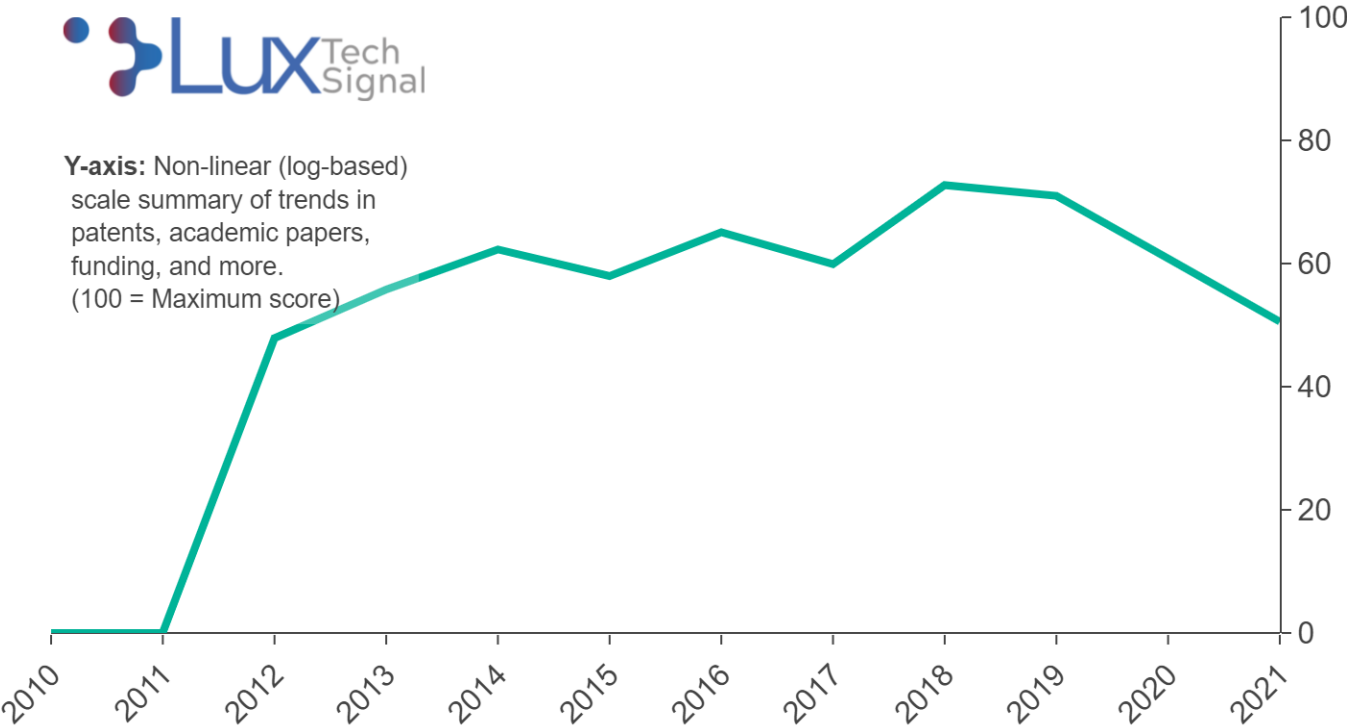
EXAMPLE PLAYERS



Novel Seed Treatments



Y-axis: Non-linear (log-based)
scale summary of trends in
patents, academic papers,
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(100 = Maximum score)



Note: 10-year AUC depiction for relative comparison purposes



Novel Seed Treatments

NOTABLE NOTES

- February 2021: AEA Investors acquires Verdesian
- March 2021: Nippon Soda announces U.S. registration of Vayantis for antifungal seed treatment licensed to Syngenta
- July 2021: Marrone Bio and Rizobacter extend seed treatment to Brazil market
- September 2021: Andes raises \$14M for its Microprime seed treatment designed to obviate need for synthetic fertilizers
- October 2021: Albaugh announces EPA registration of novel water-soluble fungicide seed treatment



Unusual market in that large players provide innovation due to superior access to seeds and farmers. New players combining genetics, analytics, and libraries should find viable entry points.

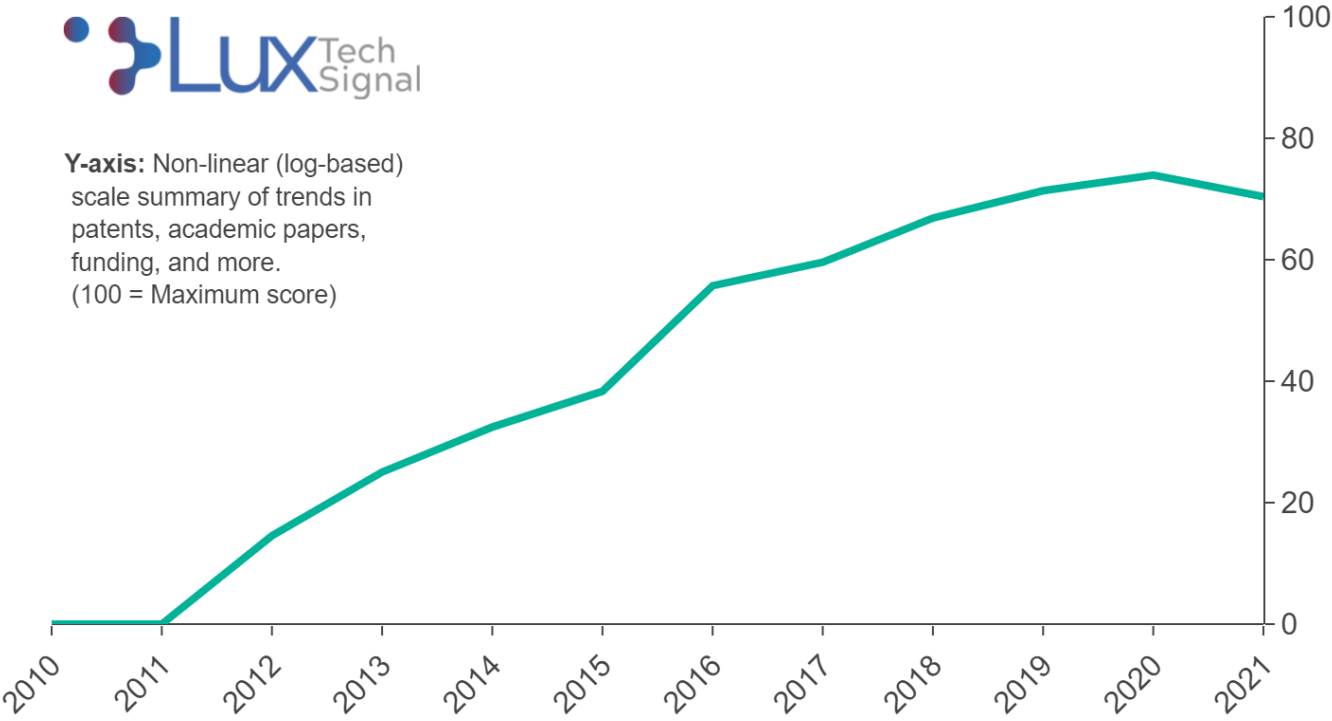
EXAMPLE PLAYERS



Ultra Wideband Sensors



Y-axis: Non-linear (log-based)
scale summary of trends in
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(100 = Maximum score)



Note: 10-year AUC depiction for relative comparison purposes



Ultra Wideband Sensors

NOTABLE NOTES

- Apple began putting UWB chips into its iPhone 11 and continues with its iPhone 13, Apple Watch 6, and HomePod Mini, creating a location monitoring ecosystem; Samsung began adding in 2021
- June 2020: Henkel deploys Kinexon solution for employee COVID monitoring
- August 2021: UWB Alliance announces the 45-member CEPT countries' release of EEC327, detailing UWB data sharing and compatibility
- August 2021: Murata announces world's smallest combined UWB + Bluetooth chip, stating the UWB market is set to grow 30%



UWB systems become ubiquitous in asset location management and noninvasive measurements in healthcare.

EXAMPLE PLAYERS



KeenlyHealth



KINEXON



Our (Un)popular Predictions for 2022 (1 of 2)

Prediction	Rationale	Ramifications
No recovery of pre-COVID share prices for O&G and C&M companies	Investors focusing on the future of sustainability eschew "old world" tech	To recapture investor loyalty, companies need to robustly invest in ESG; many will seek to become Certified B Corporations
CCS and H₂ investments cross the tipping point	Synchronous global policies support otherwise uneconomic nascent businesses	CCS and eventually CCU and H ₂ become inevitable outcomes over the 10+ year horizon
COP26 drives boosting of aid to poorer countries	Decarbonization efforts accelerate, and companies and nations held to a global, not regional, standard	Decarbonization leapfrogging occurs in developing nations and continents like Africa
Plane tickets will be 2–3× more expensive; Germany to close its coal fired plants in 2045 and not 2038 as planned	Energy and fuel will be much more expensive than hoped for	Sustainability hope outpaces infrastructure capabilities challenged by intermittency issues
Digital hits a wall, slowing ML and AI market penetration and digital transformation	Data hygiene is an issue; insufficient pools of size and quality of data to train with concomitant lack of envisioned solutions for applications to companies	Companies need to first focus on data selection, wrangling, and governance to get and keep data under control
Proprietary data are dead and increasingly difficult and worthwhile to protect	Much greater value is unlocked by the ability to mix and match disparate data sets to see new patterns and relationships	Winning companies more quickly realize that profitable innovation is truly open and ecosystems-based
Insurance and actuarial companies emerge as winning sectors	Data wrangling and management are more core to these industries, accelerating use of AI	New insured services and forays into diverse activities to be based on quantified risk
EU overtakes China in green hydrogen and electrolyzer development and deployment	Economic and energy hiccups in China inhibit momentum	EU becomes global leader in deployments of green hydrogen systems

Our (Un)popular Predictions for 2022 (2 of 2)

Prediction	Rationale	Ramifications
DSPs continue to grow in importance for chemicals and materials and extend into other industries such as trading of green metals	Digital transformation continues to drive the more-with-less and just-in-time delivery ethos across markets	Many industries will face reduced sales volumes and will need to move into service partnerships to sell and drive sustainability thinking
Edge computing, computing at the edge, accelerates	Edge computing driven by cost gains, security concerns, and latency fears on overall system performance	Growing smart "sensorization" of the environment; hybrid cloud and CPG companies step up to utilize
Synbio slows down	Scaling new systems to commercial levels proves more challenging than thought	Experimentation in hybrid manufacturing systems continues, but fewer later-stage deals announced while market waits for proof of capability
Digital data on the farm accelerate consortia building	The Microsoft/Land O'Lakes partnership creates a DSP for farmers and chemical suppliers to "personalize" land management	The model replicates across the globe, enhancing farm yields, reducing waste, but also cutting into chemical company profits
Telemedicine slows down, segmented by demographic adoption	As COVID becomes endemic, older patients revert to in-person meetings, and healthier, younger adults adopt the convenience	Evolution of interface with streamlining for better user experience, followed by hooking more complex backend services for increased monitoring and interactions for better chronic disease management
A massive, unprecedented security breach occurs	Connectivity has preceded security, which is still merely reactive with ML/AI applications nascent	Bigger shift to edge computing and hybrid cloud strategies to flexibly protect incumbent systems
Soil and regenerative practices start fast, then slow down	Interest in sustainability drives, but lack of end game vision stalls, efforts	U.S. and other nations must set policies and definitions of standards to drive market development

Where would you invest \$10M in 2022?



Climate Tech

Short-Term Opportunity

Steel reduction with H₂

Long-Term Opportunity

Synfuels from CO₂



Circular Tech

Short-Term Opportunity

Digital sales platforms

Long-Term Opportunity

Electrolysis



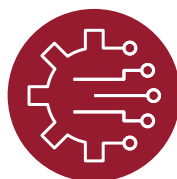
Future Consumer Tech

Short-Term Opportunity

Digital healthcare

Long-Term Opportunity

Enzyme-produced alternatives



Digital Tech

Short-Term Opportunity

Carbon trading systems

Long-Term Opportunity

Data strategy

Key Takeaways

1

Sustainability is about systems-based thinking; creating platforms where even economically suboptimal technologies can become valuable enablers

2

Regulations and policies driven by empowered consumers are key to innovation and technology strategy; geographic policy knowledge is key to successful innovation

3

You need to build a robust technology roadmap to successfully invest in sustainability R&D and partnerships

Thank you

A link to the webinar recording will be emailed within 24–48 hours

UPCOMING WEBINARS

- **January 25th**

[The Top Trends in Sustainable Innovation;
Reviewing Key Developments of 2021 and
Predictions for the Future](#)

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