

Putting Sustainable Manufacturing Into Practice



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The
Deciding
Factor

Y2K is remembered as a flop, but it was an infrastructure transition



2 key questions

How can we transition to transformative approaches in manufacturing?

How do we bring the sustainable transition to every business?

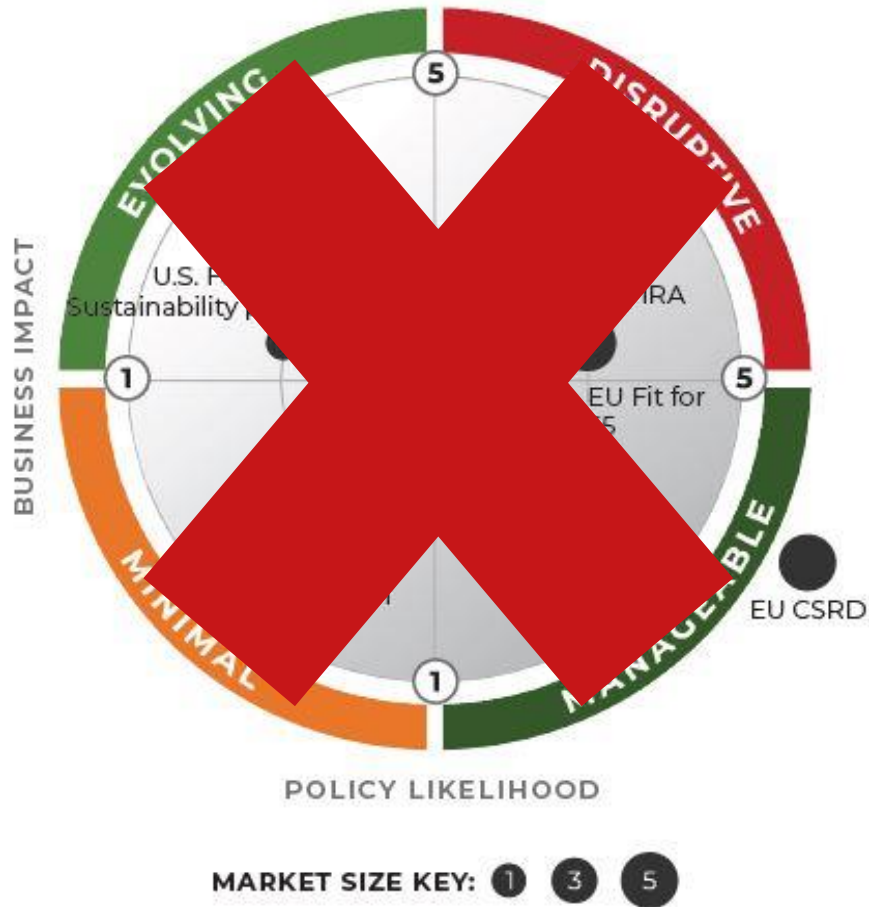
Aggressive policy is one route...

The Lux Policy Compass for Chemicals:
Decarbonization



...but let's put that aside for now

The Lux Policy Compass for Chemicals:
Decarbonization



Focus on business models

Agenda

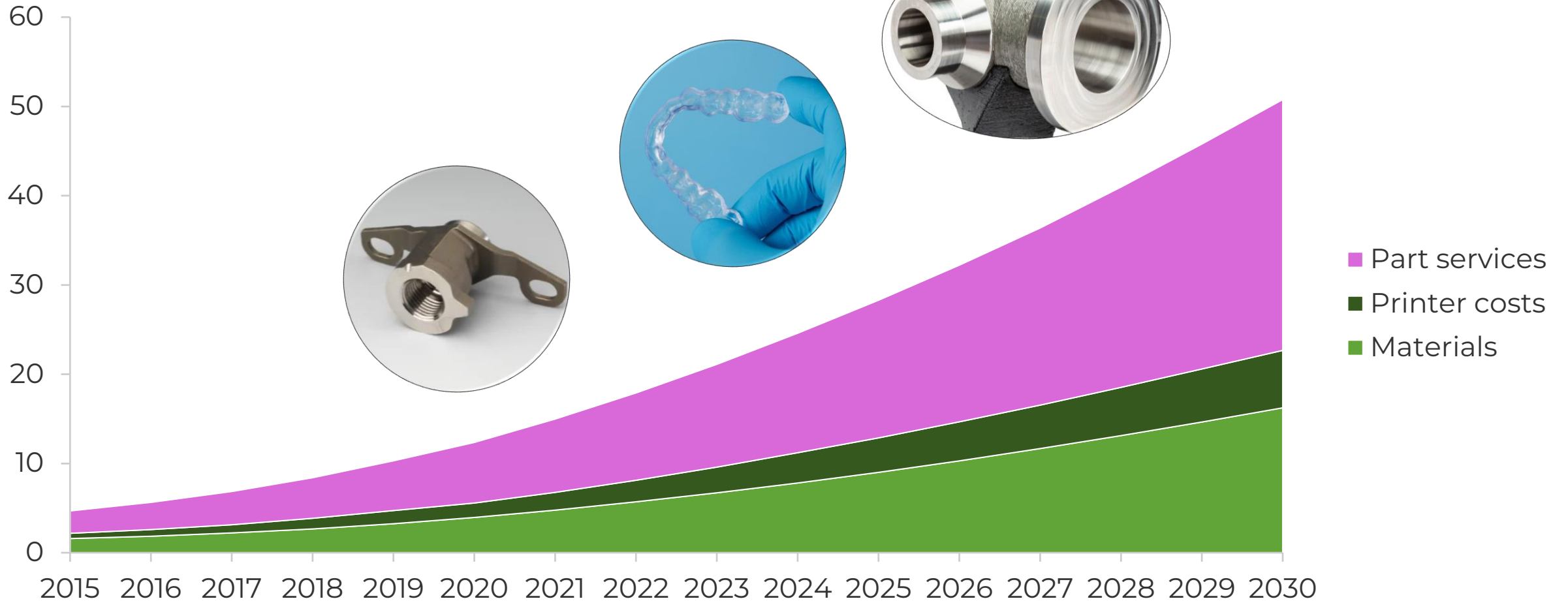
1 | **3D printing and business model innovation**

2 | Applying these lessons to sustainable manufacturing

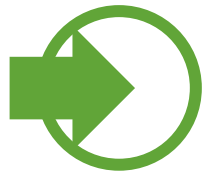
3 | Outlook

Why look at 3D printing (3DP)?

3DP Market Forecast
USD billions



Introducing the flexible manufacturing framework



Input and Output flexibility



Timing flexibility



Scale and Location flexibility



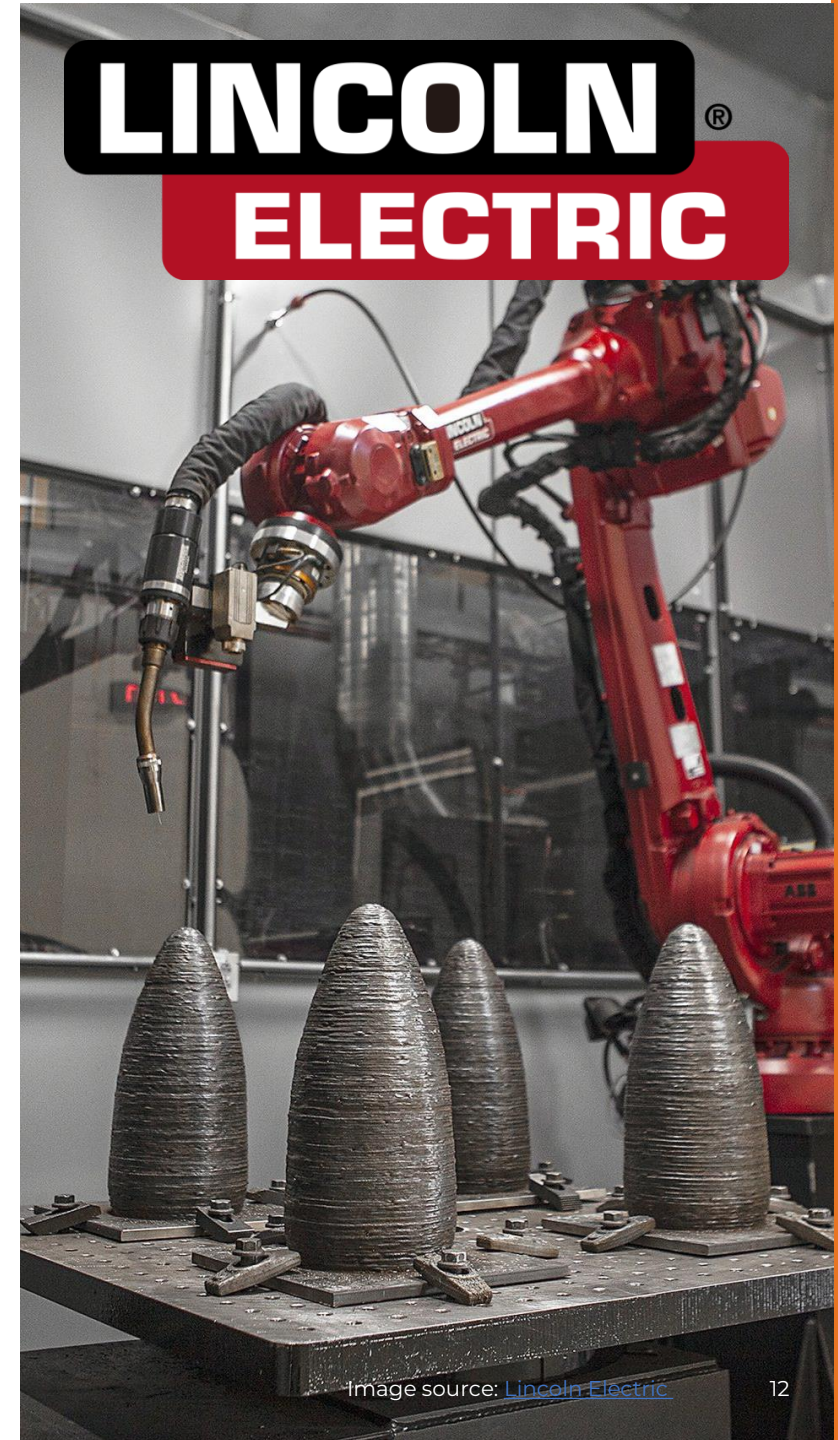
Oil and gas 3DP leverages timing flexibility

Lincoln Electric made headlines by printing eight large refinery parts in 30 days in response to unexpected delays in Chevron's supply chain.

Custom software and a dedicated support team enabled Lincoln to turn around on the designs quickly, leveraging its unique large-size 3DP capacity.



Timing flexibility is crucial — especially in cases where the ecosystem is a lot more valuable than the part itself.



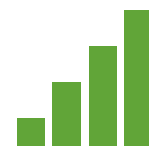
Formlabs pushes distributed dental 3DP

Formlabs has rolled out low-cost 3DP to dental labs and offices, producing a wide range of products on site.

While cost reduction made 3DP affordable, software, education, and services allowed it to be deployed by nonexperts in new use-cases.



Supporting tech enabled adoption by nonexperts — allowing Formlabs to target scales and geographies that were previously out of reach.



3DP adoption

Technology cost and competitiveness was just the first step

Supporting skills, business models, and ecosystems were crucial to enabling adoption

Agenda

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2 key questions

**How can we transition to
transformative approaches
in manufacturing?**

**Let's apply the flexible
attributes**

Geno builds a flexible supply chain with Unilever via fermentation

Unilever and Geno announced a USD 120 million deal to develop fermentation-derived surfactants for personal care applications.

The goal of the work is to provide an alternative to palm-oil-based surfactants, which have come under increasing pressure from sustainability groups.



Introducing flexibility into the supply chain — first on the inputs side and then on the outputs side — is the explicit goal of the collaboration.



Pangaia pushes print on sustainable footwear

Pangaia recently launched a 3D-printed shoe with a range of claimed sustainability benefits — from lower carbon footprint to easier recyclability.

The shoes are printed on demand and are ready in just three days thanks to 3DP, despite being customized to the size and shape of the customer's foot. This limits the need for up-front investment in a risky new product.



While 3DP provides consumer and sustainability benefits, it's the timing flexibility that makes this attractive from a business standpoint.



On-site ammonia production could deliver sustainability and resilience

FuelPositive has developed a fast-ramping system for small-scale, modular ammonia production. Initial pilots will target 1 MW of energy consumption and 100 tonne/y of scale.

The company is targeting on-site production at farms, which use the ammonia for fertilizer.



FuelPositive will need to develop supporting tools for farmers to make good on its distributed production approach.



FuelPositive
Fuel For A Mindful World



Sustainability and flexibility

New business models can help transformative approaches scale

Every emerging sustainable technology provides flexibility

Agenda

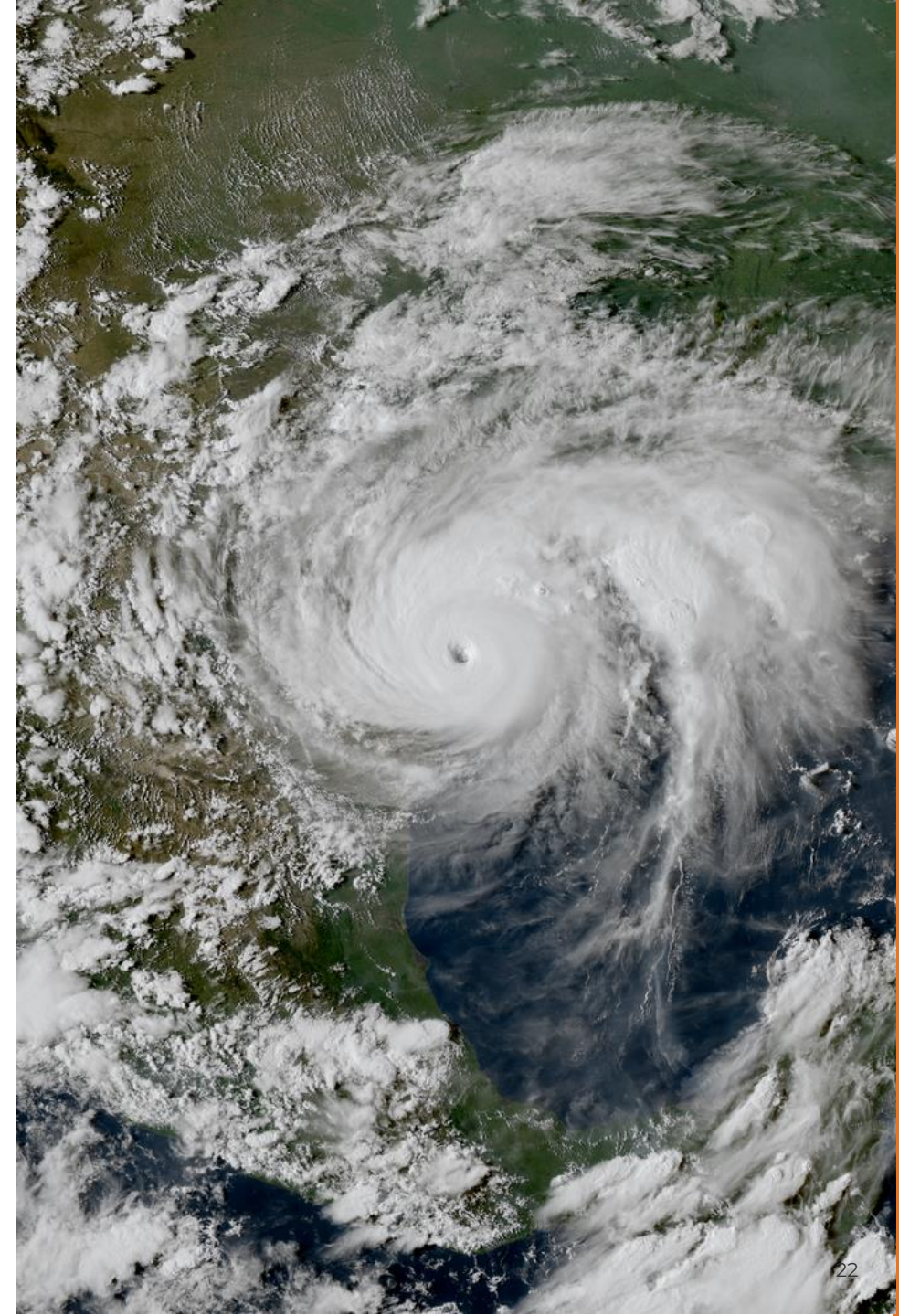
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Resilience and risk management are key value propositions

Sustainability is a notoriously tricky thing to build a business model on — even today, it can be tough to find a buyer willing to pay a “green premium.”

Because sustainable technologies offer flexibility, they can be used to insulate companies against risks — both market risks and other types of risk (climate, geopolitical, or regulatory).

This risk management factor will be crucial in helping companies find a complete value proposition for sustainable technologies.

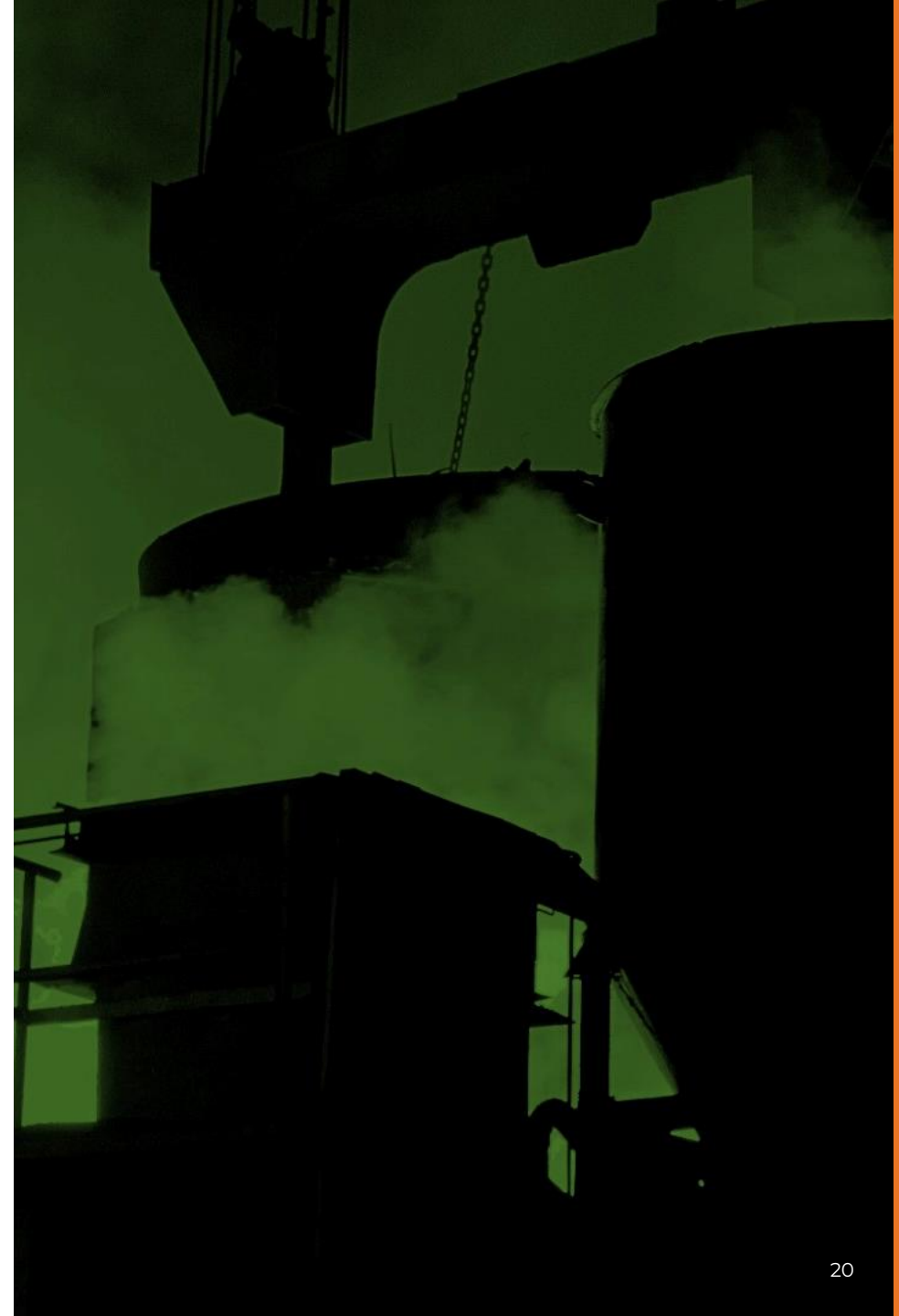


New business models need to improve the existing business

Most sustainable technologies aren't *better*, in pure economic terms, than their nonsustainable counterparts — even at scale!

Adopting new business models is crucial to making these technologies work — and to make the business work, these new business models need to complement the old business model.

There's a ton of ways to do this — adding resilience, giving the old business more leverage in sourcing or pricing, or targeting a new customer segment — but what's important is the combination of the old and new business models.



Key Takeaways

- 1** | **Government and big industry are increasingly in a position to address large-scale sustainability challenges — but that's only one piece of the puzzle.**
- 2** | **Policy and R&D to make sustainable tech cost competitive is just the first step to adoption in many cases.**
- 3** | **Business model innovation — leveraging the flexibility of sustainable approaches — will be crucial to bring sustainability to companies and industries that don't have the resources to be proactive.**

Big business handled Y2K well, but small and midsize businesses didn't have the resources to be proactive

Y2K Repair Bill: \$100 Billion

Commerce Estimate Lower Than Others

By RAJIV CHANDRASEKARAN
Washington Post Staff Writer

U.S. businesses and government agencies are being forced to spend about \$100 billion to keep the year 2000 glitch from crashing their computers, making a simple two-digit programming "bug" the most expensive peacetime catastrophe in modern history.

But the vast electronic repair effort, which has commanded an unparalleled mobilization of people, money and executive attention in the past two years, is not likely to slow down the surging American economy, the Commerce Department predicted yesterday.

Comparing Y2K to "a tangled shoelace for a world-class marathon runner," the department also forecast that any problems created by malfunctioning computers—either domestically or overseas—will have an insignificant impact on the U.S. economy.

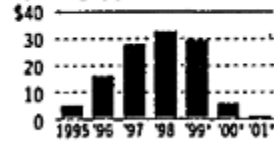
"Any glitches that pop up next year should not hurt our economic

See YaK, E18, Col. 1

The Price of Disaster

U.S. spending in 1998 alone on trying to prevent any Y2K disasters was about twice that of the most costly catastrophe (in terms of insured losses).

Total Y2K spending: \$100+ billion
Spending by year, in billions



Disaster	Date	Insured loss (in billions)
Hurricane Andrew (South Florida, Louisiana)	August '92	\$15.5
Northridge earthquake (Southern California)	January '92	12.5
Hurricane Hugo (Caribbean, southeastern U.S.)	September '89	4.2
Hurricane Georges (Caribbean, Florida Keys, U.S. Gulf Coast)	September '98	2.9
Hurricane Opal (Mexico, Florida, Alabama)	October '95	2.1
20-state winter storm	March '93	1.8
Oakland, Calif., fires	October '91	1.7
Hurricane Fran (Caribbean, North Carolina, Virginia, West Virginia)	September '96	1.6
Hurricane Iniki (Hawaii)	September '92	1.6
Tornadoes, wind, hail (Oklahoma, Kansas and other states)	May '99	1.5

SOURCES: International Data Corp., Insurance Information Institute

Across corporate America, the cost of making Y2K repairs has produced staggering bills. General Motors Corp., for instance, has said it could spend as much as \$626 million. Exxon Corp. has earmarked \$250 million for the problem, and Procter & Gamble Co. expects to shell out \$90 million. The federal government has estimated its repair costs at \$8.4 billion.

Thank you

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

UPCOMING WEBINARS

JANUARY 18

[Tech Innovation in 2024: Themes and Technologies to Monitor](#)

FEBRUARY 8

[The Future of Aviation: Opportunities in SAFs, Hydrogen, and Electric Aviation](#)



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