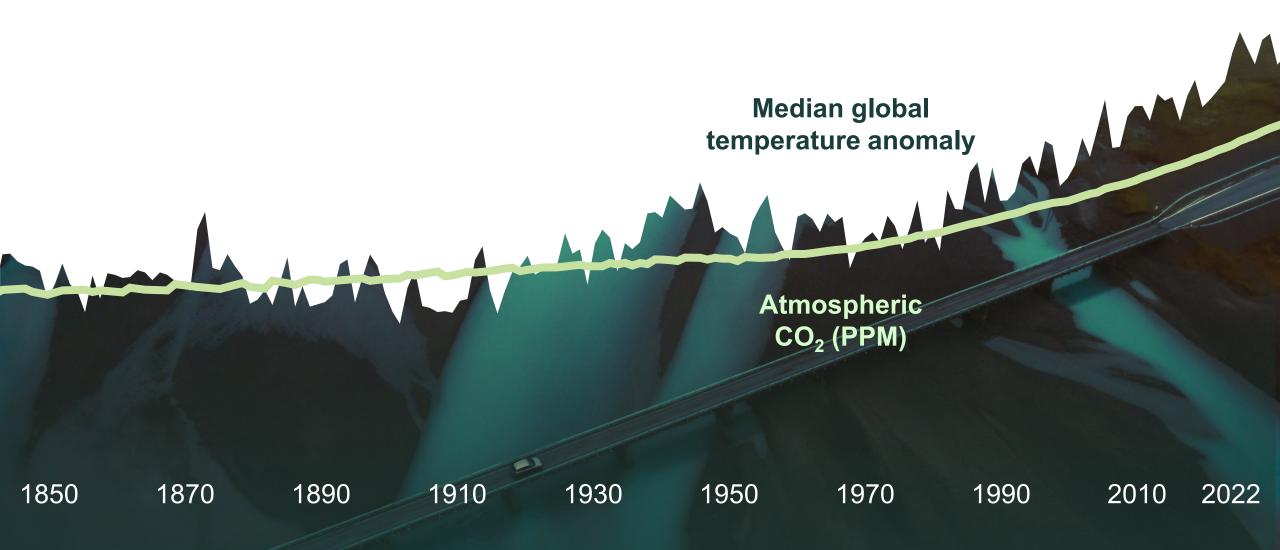




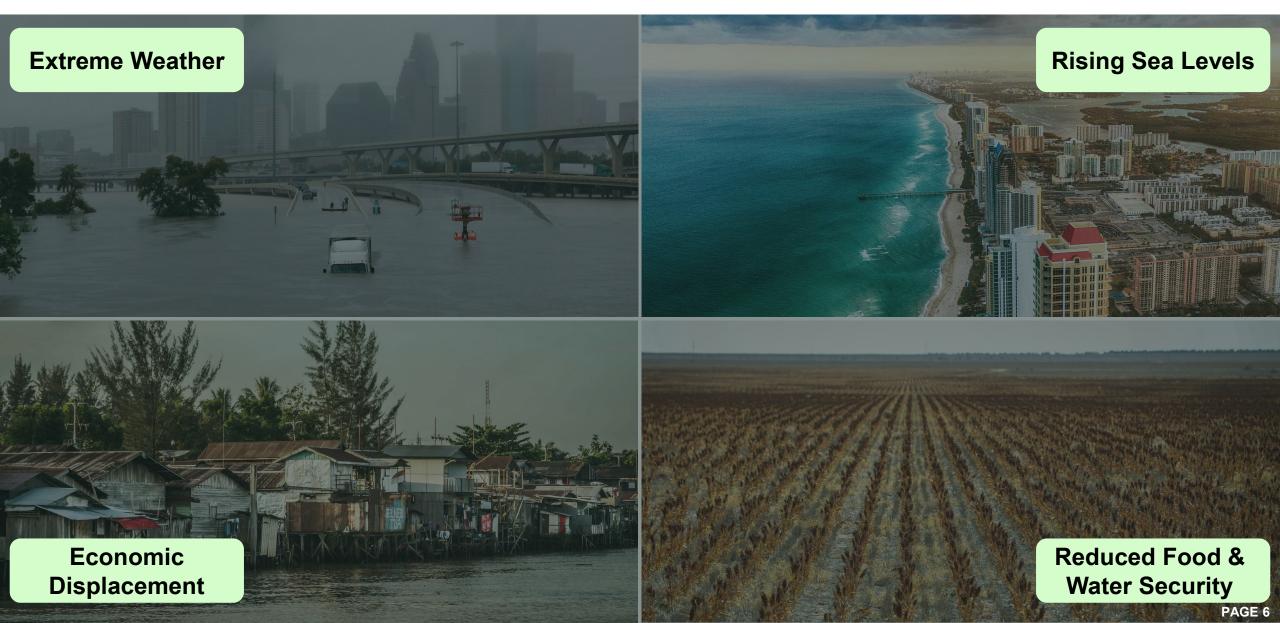


However, 1.2°C Global Increase since Pre-Industrial Times



Age of the dinosaurs Last ice age when crocodiles could be found above the Arctic Circle when ~25% of Earth's land area was covered in glaciers How much is 1.2°C? 4°C 6°C degrees **higher** than today degrees lower than today PAGE 5

Consequences of Warming are Real









enda

Overview of OpenMinds and Our Energy and Climate Forecast

2 Implications of Warming

3 Potential Impact on Houston

OpenMinds' Mission & Identity

OPENMINDS



WHAT MAKES US UNIQUE



Energy AND climate



Cross-functional expert team



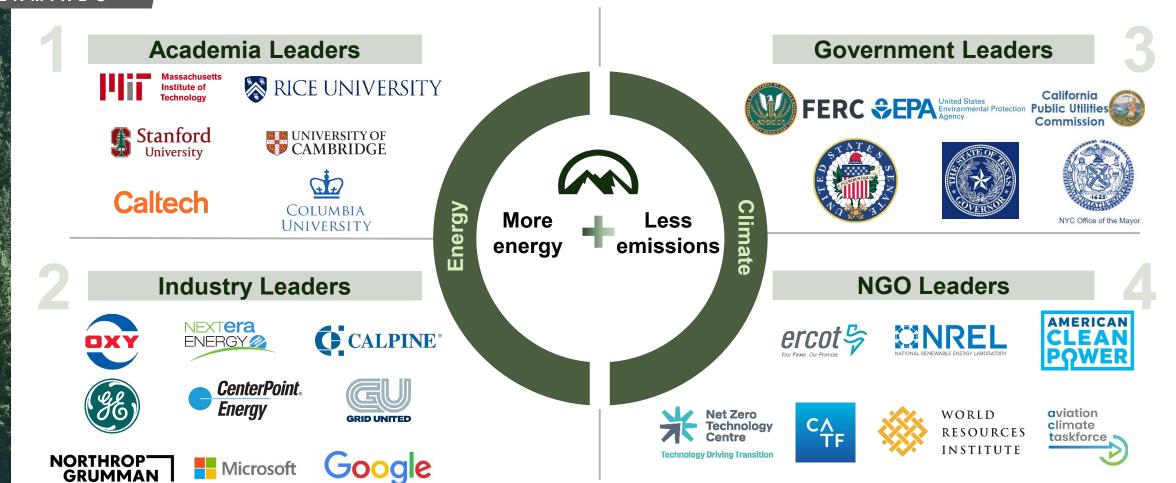
Detailed solutions framework



Impact bottlenecks before 203X

Aligning Academia, Industry, Government and NGOs for Impact

OPENMINDS



OpenMinds + Bain = Differentiated Impact

OPENMINDS



Energy and Climate



125 Experts Across Key Energy and Climate Sectors



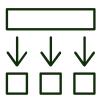
Bain Partnership



Data-Driven



Practical Solutions
Framework and 10-Year
Horizon



Impact Projects Targeting Key Bottlenecks

'P50' Outlook - Forecasting Our Current Path

GLOBAL OUTLOOK

2035 forecasts included in the 'P50' Outlook





Global

US

Energy Demand





Supply Mix





Emissions





Developed and reviewed by industry leaders

MODEL CREATION





EXPERT REVIEW













OpenMinds 'P50' Outlook Model Assumptions

GLOBAL OUTLOOK

Key assumptions		2023	2030	2035	
Energy and Electricity Demand	GDP growth (%)	Global	2.6	2.7	2.7
		USA	2.0	1.7	1.9
	Energy intensity ¹	Global	3.8	3.4	3.0
		USA	3.7	3.4	3.1
	EV sales penetration (% of new car sales)	Global	17	45	64
		USA	10	35	55
	Electricity demand from data centers and Al (TWh)	Global	400	1,060	1,230
		USA	117	351	410
Power Sector	US Value-Adjusted Levelized Cost of Electricity (VALCOE, \$/MWh)	Solar	60	64	62
		Wind	64	71	77
		Gas	59	59	59
		Nuclear	105	105	105
	US LCOE learning rate ² (%)	Solar		<u> </u>	
		Wind		<u> </u>	
	US Capacity factor (%)	Solar	18	19	20
		Wind⁴	35	38	40
	Battery storage intensity ³ (%)	Global	2	8	11
		USA	6	19	22

Questions answered by model

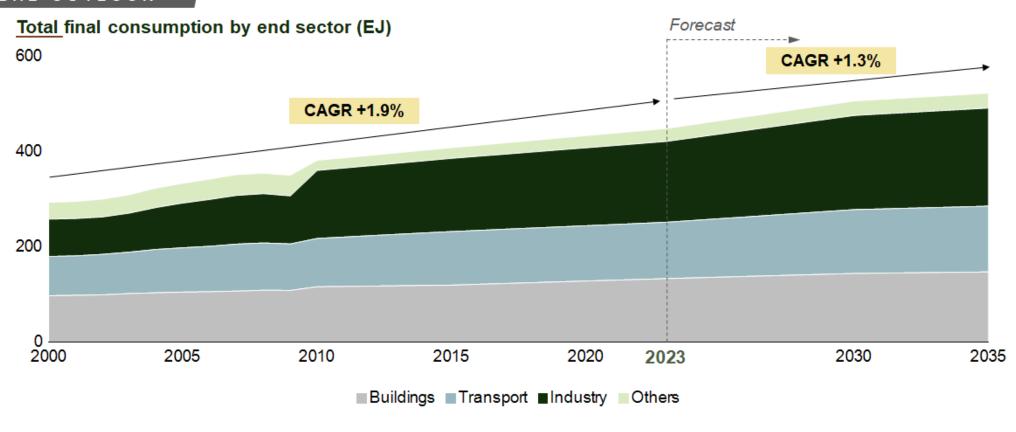
- What is the outlook for **energy demand** and which sectors will drive growth?
- 2 How will the **energy mix** shift in coming years?
- What does emissions trajectory look like through 2035?
- Based on that emission trajectory, what are the likely **implications of warming**?

Note: ¹Energy intensity shown in terms of total final consumption (EJ) per purchasing power parity (PPP) in trillion dollars (T\$). ²LCOE learning rate is the percentage decrease in LCOE for every doubling of installed capacity. ³Battery storage intensity calculated as the total installed battery capacity as a % of total installed variable renewable energy (wind and solar) capacity. ⁴Wind capacity factor provided as weighted averages across offshore and onshore Source: IEA, Goldman Sachs, IRENA



Global Energy Demand is Expected to Rise Driven by Consumption Growth in Buildings and Industry Sectors

GLOBAL OUTLOOK





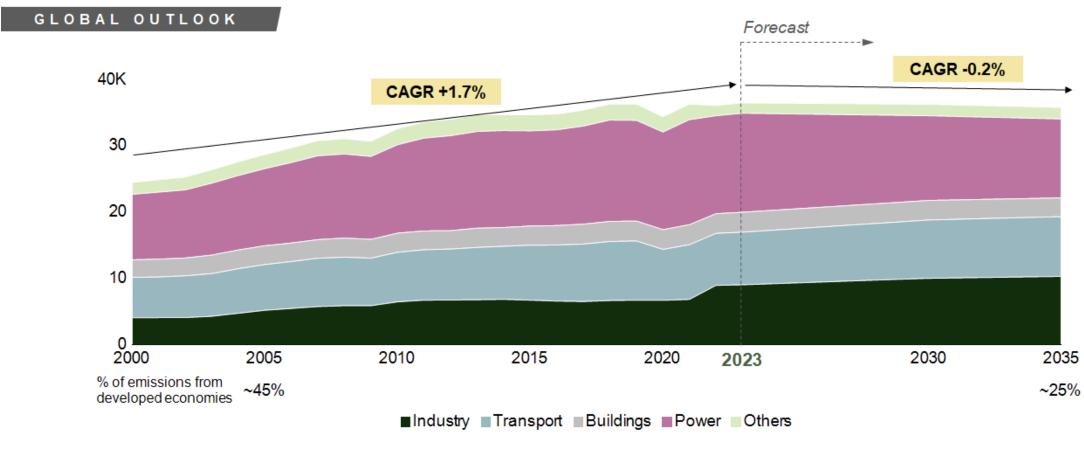
Renewables are Forecast to Continue to Phase Out Coal in Global Energy Supply Mix

GLOBAL OUTLOOK Forecast 800 **CAGR +1.1% CAGR +1.8%** 600 200 2000 2005 2010 2015 2020 2023 2030 2035



■ Coal ■ Oil ■ Natural Gas ■ Nuclear ■ Renewables and bioenergy

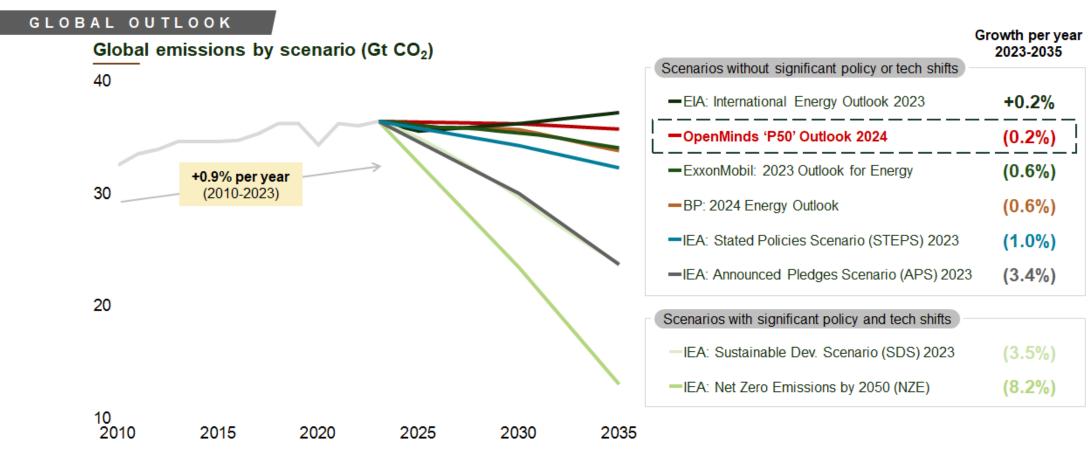
Developing Economies' Fossil Fuel-Powered Industrialization Offsets Developed Economies' Decarbonization



Source: Intersect_{SM} Carbon & Energy Transition CGE Model; IEA WEO 2023

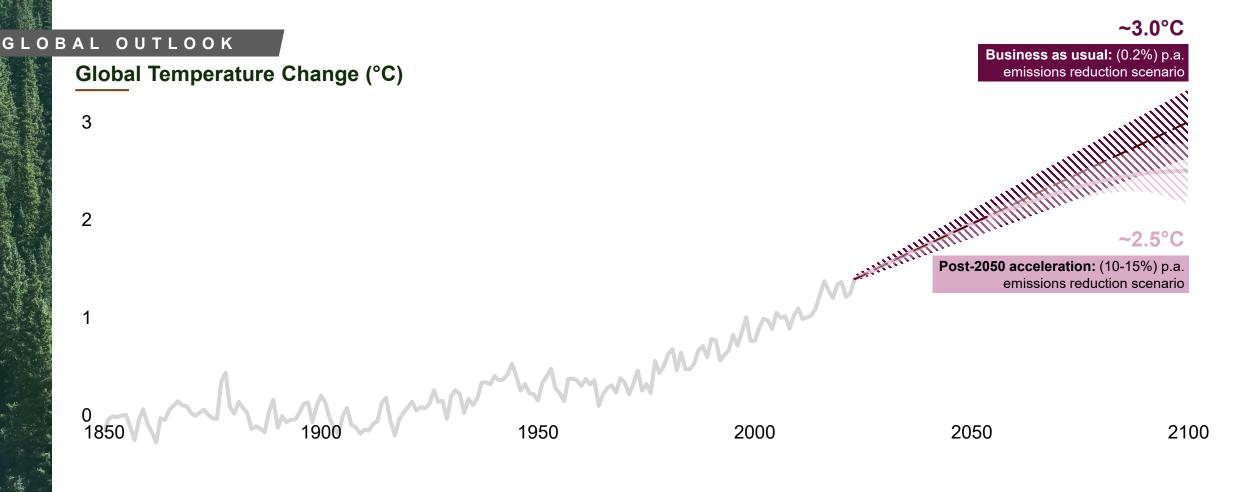


Global Carbon Emissions Likely to Decline Slightly by 2035



Source: BP Energy Outlook, 2021; ExxonMobil 2023 Outlook for Energy; International Energy Agency, World Energy Outlook 2023; EIA International Energy Outlook 2023

Temperature is Set to Increase by ~2.5-3.0°C through 2100 Depending on Pace of Emissions Reduction



-1



Implications for Global Energy & Climate Outlook



GLOBAL OUTLOOK



Energy Demand...

is <u>set to grow</u> 15% by 2035, largely driven by developing economies

Oil Demand...

peaks in 2030, as the world passes a tipping point in EV adoption

Natural Gas Demand...

will grow in-line with total energy demand, maintaining its ~23% share through 2035

Renewable Energy...

share of energy mix is forecast to increase from ~15% to ~25% in 2035, as strong growth continues

Carbon Emissions...

will largely <u>remain flat</u>, decreasing ~0.2% p.a. to reach ~35 Gt in 2035

Differing Priorities...

in <u>developing and</u>
<u>developed</u> world, with
former focused on
energy access, latter
on climate change





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Practical Implications of Warming



Implications of Energy Transition





Short term investment (2023–2050) Longer term benefits (2050+)

Energy investment		
- Fossil fuels	→ Stable	Declining
- Fossil fuel "decarbonization"	Growing	
- Clean energy	Growing	Growing
CO2 emissions	Increasing	Decreasing
Climate impact	Warming/volatile	
Energy and climate costs	Increasing	Declining
Economic growth	Slowing	Accelerating

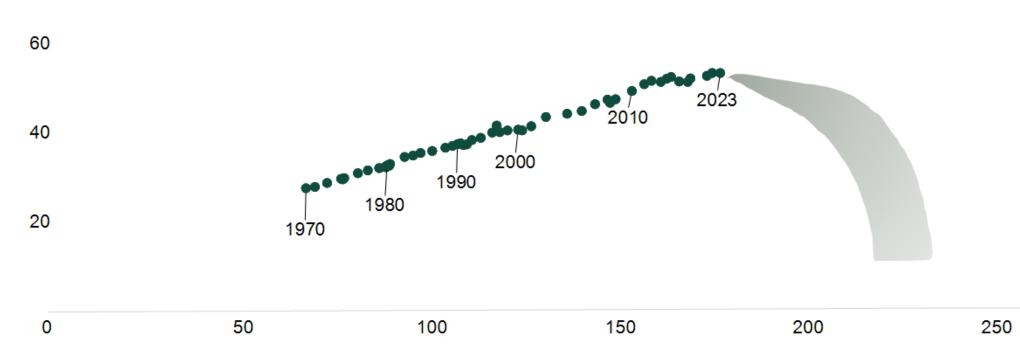
Beneficiaries

Next generation

Our Challenge: We Must Reverse the Growth in Emissions

GLOBAL OUTLOOK



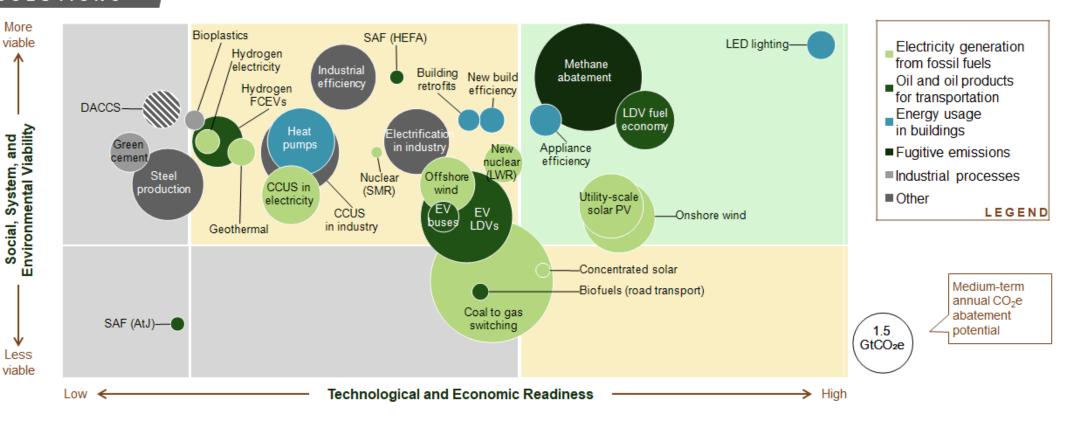


Global primary energy demand (petawatt-hours)

Source: Our World in Data

Prioritization of Potential Solutions

SOLUTIONS



Note: Abatement potential refers to medium-term annual CO₂e emissions reduction; building efficiency and retrofits refers to insulation and HVAC only; DACCS abatement potential virtually infinite; industrial efficiency includes solutions such as waste to heat recovery; renewable solutions include battery component in cost and abatement potential; geothermal represents enhanced geothermal systems; assumes methane has global warming potential 30 times that of CO₂ Source: IEA; IRENA; Goldman Sachs; Project Drawdown; OpenMinds research and lift. scan





OpenMinds' Top 10 Solutions

SOLUTIONS

'Top 10' solutions

Prioritized set of solutions with high viability and sufficient technological and economic readiness to "bend the curve" by 203X

Big 4 opportunities

Abating methane emissions from energy	Renewables (i.e., solar and wind)	Coal-to-X switching	CCUS in electricity and industry
Transportation energy efficiency	Industrial efficiency and electrification	Electric LDVs	Heat pumps
		New and existing nuclear	Buildings efficiency

Other important solutions

Solutions that **may be critically important** but are assessed as having less overall impact potential by 203X relative to our list of 'top 10' solutions

Behavioral change	Adaptation	We are considering wl incorporate these mor	
Distributed generation	Green steel and cement	Nature-based solutions	Hydrogen
LED lighting	Direct air capture	Geothermal	Circular economy

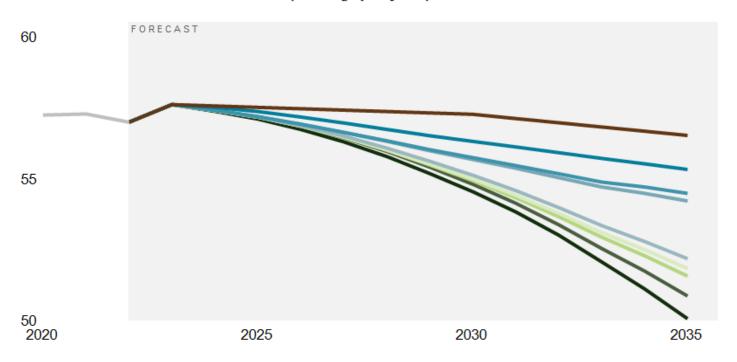


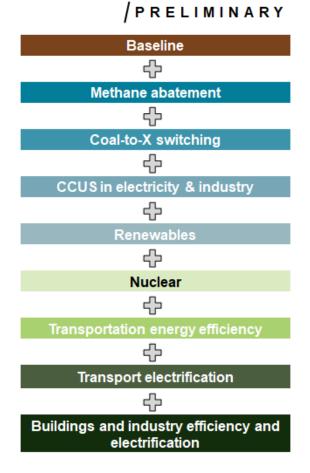
Impact of Implementing Key Solutions

SOLUTIONS

Projected emissions impact

Global annual net GHG emissions (Gt CO2e per year)









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Success Will Require a Step Change in Global Energy Investment



Fossil fuel

per year

\$1T



Clean energy

per year

\$1T





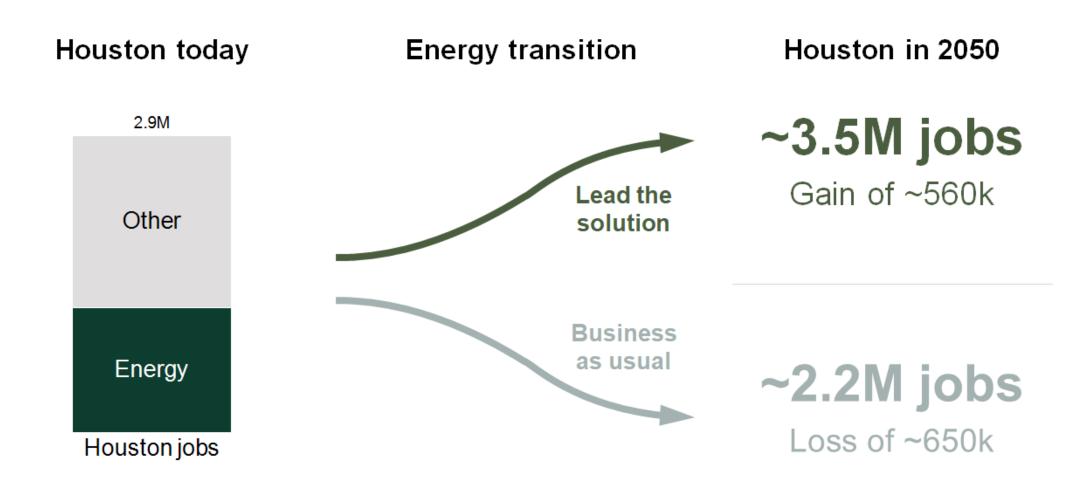
\$100T by 2050

What to Expect as an Industry Matures

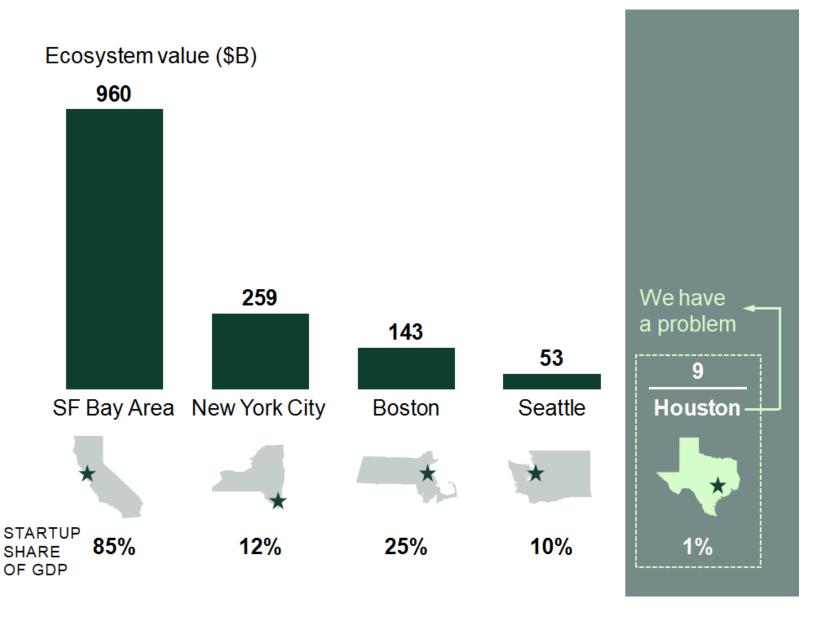


Source: Public company filings and press releases

Houston is at an Inflection Point



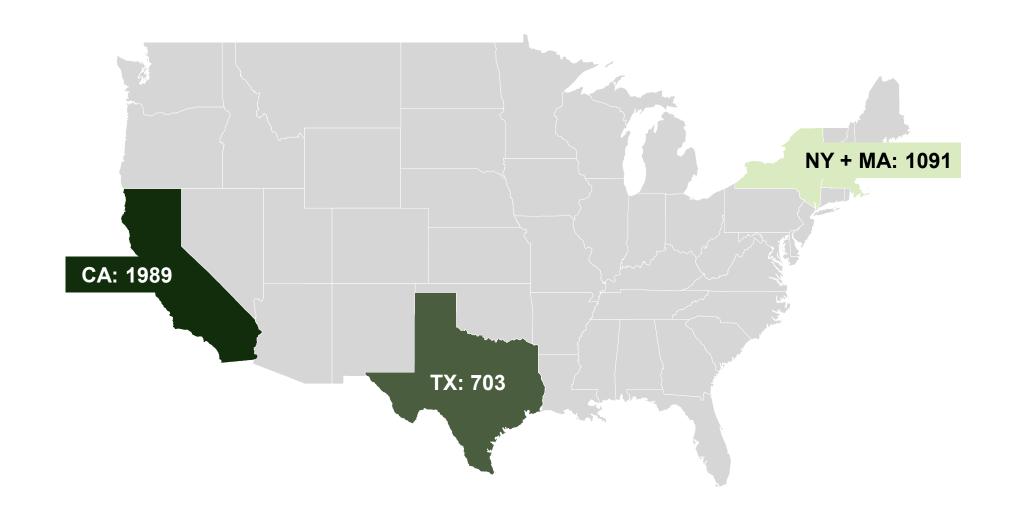
We Lack the Startup Ecosystem to Support Innovation



Energy and Climate Startups Play a Crucial Role in Tackling the Dual Challenge, yet Texas Trails Other Incubators

Climatetech startups by state

2013-2023



Source: Tex-E Pitchbook, March 2023

In Auto, New Challengers are Overtaking Incumbents

Market cap of major automakers (\$B)

CHALLENGERS

INCUMBENTS

753

122

56

56

50

41





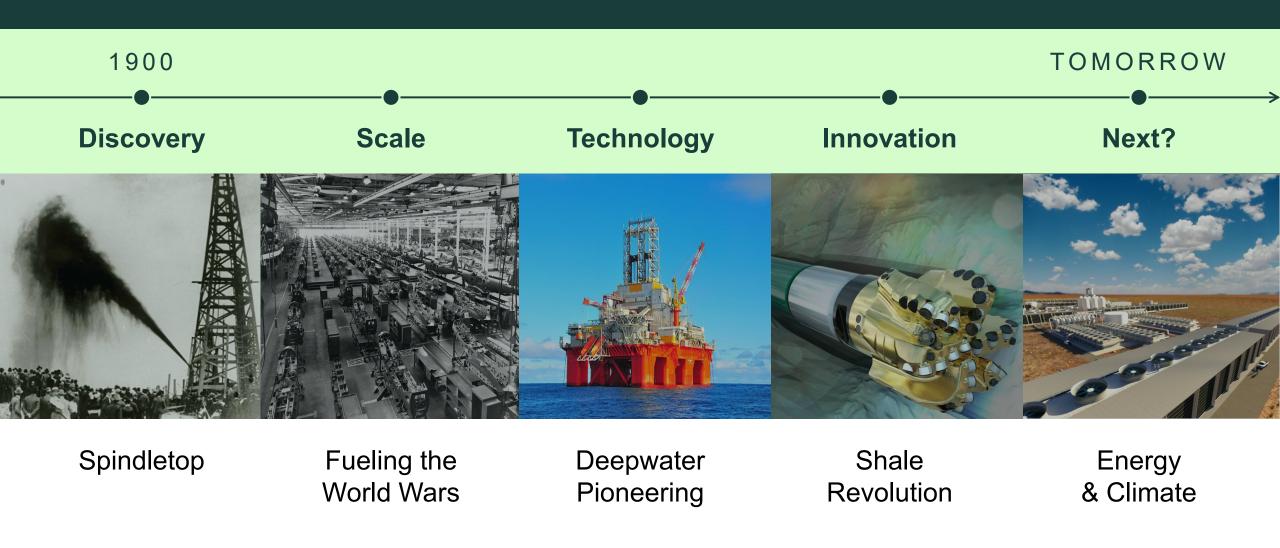








Houston's Latest Energy Challenge – Climate?



We've Done it before in Medical Innovation



1947

1969

Today

Houston's Scale Ecosystem

























Greentown Labs TEXE















The Future of Energy and Houston – Key Takeaways

- 1 Energy demand will continue to grow
- 2 Climate impacts and urgency to act will increase
- 3 New, cost-effective technologies addressing energy and climate will thrive
- 4 We are facing new competition, both nationally and globally
- 5 Houston is the incumbent, but must quickly develop clean energy capabilities
- 6 Job growth in electrification and innovation must replace traditional energy jobs