

The Pathway to Global 100% Renewables

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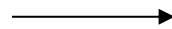
Plenary: Global, National, and International Outlook on Getting to 100% Renewable Energy; August 9, 2023

A Global Perspective on Climate and RE

- RE markets remain strong; single largest source of new power supply. However:
- COP 27 (Sharm al Sheik, Egypt), 2022:
 - Fails to adopt "phase out all fossil fuels" language
 - Focus on "loss and damages"
- G20 Summit (Goa, India), 2023:
 - No agreement on addressing climate change
- COP 28, (Dubai, UAE), 2023:
 - New "phase out all fossil fuels" language unlikely
- ...and the war in Ukraine, trade wars, supply chain issues, and economic and political disruption persist...

For the decade 2010 – 2019:

+1.07 °C



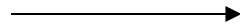
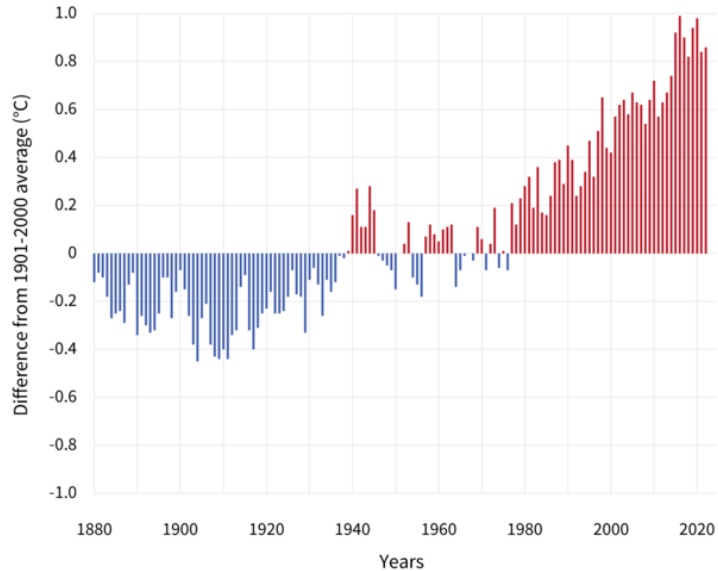
**Remaining carbon budget
to cap at 1.5 °C :
600 – 800 GT CO₂**

**Compared to 1850-1900
(preindustrial average)**

Source: IPCC, 6th Assessment Report, 2021

Global Temperatures 2022

GLOBAL AVERAGE SURFACE TEMPERATURE



+1.06 °C

Compared to 1880-1900 Avg.

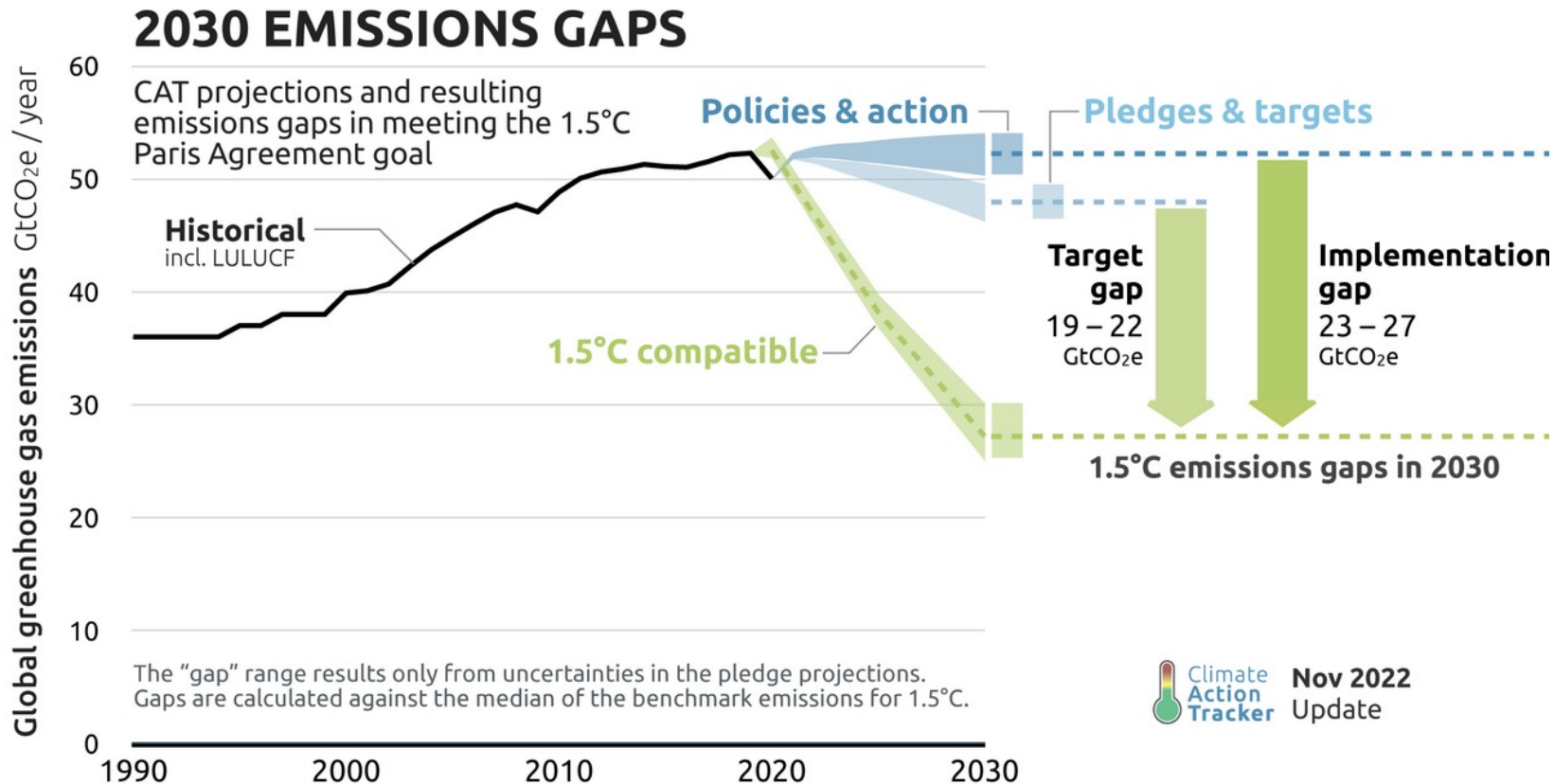
Source: NOAA Climate.Gov News, 1/28/2023

Summer 2023 Weather Report

- July 3: global average = 17.01 °C...new all-time record
- July 6: 17.23 °C...possibly the hottest in 125,000 years
- 2023 may be the hottest year ever recorded
- Paris Agreement of 1.5 °C could soon be exceeded

“...nothing ever resembling a human civilization has ever known a world this hot.” Bill McKibben, the New Yorker, July 24, 2023

Yet, Lack of Int'l Ambition Persists



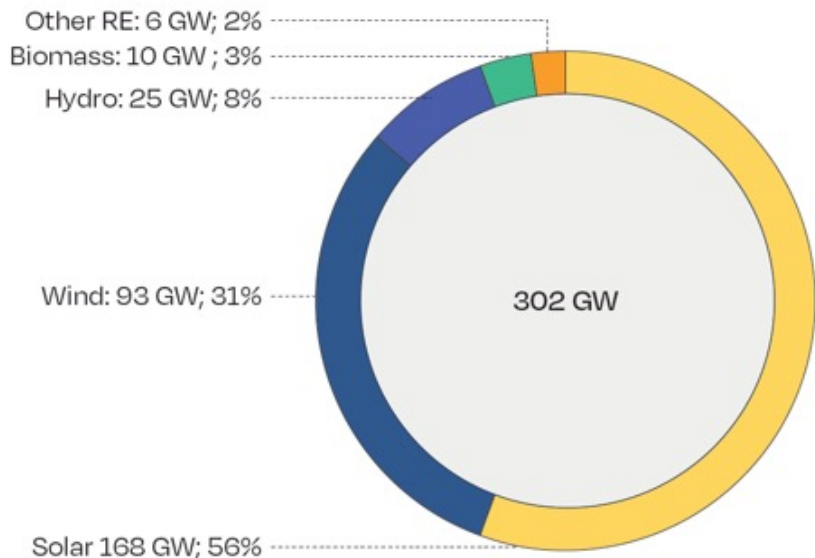
Are We Facing a Climate Change Abyss?



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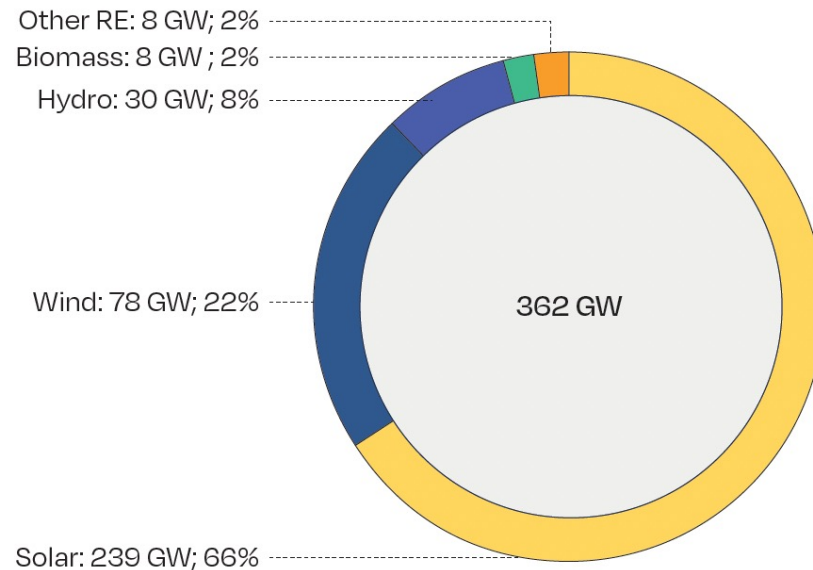
Installed RE Capacity - Especially Solar - Is Growing

2021



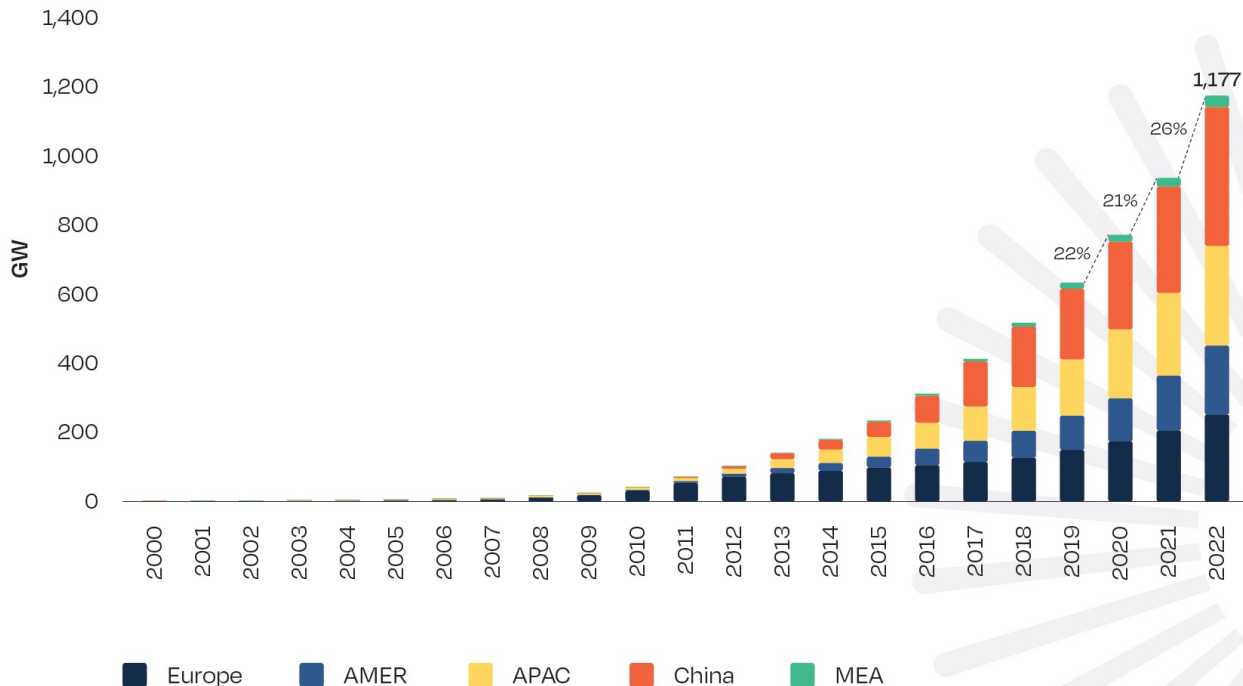
Source: SPE GMO 2022

2022



Source: SPE GMO 2023

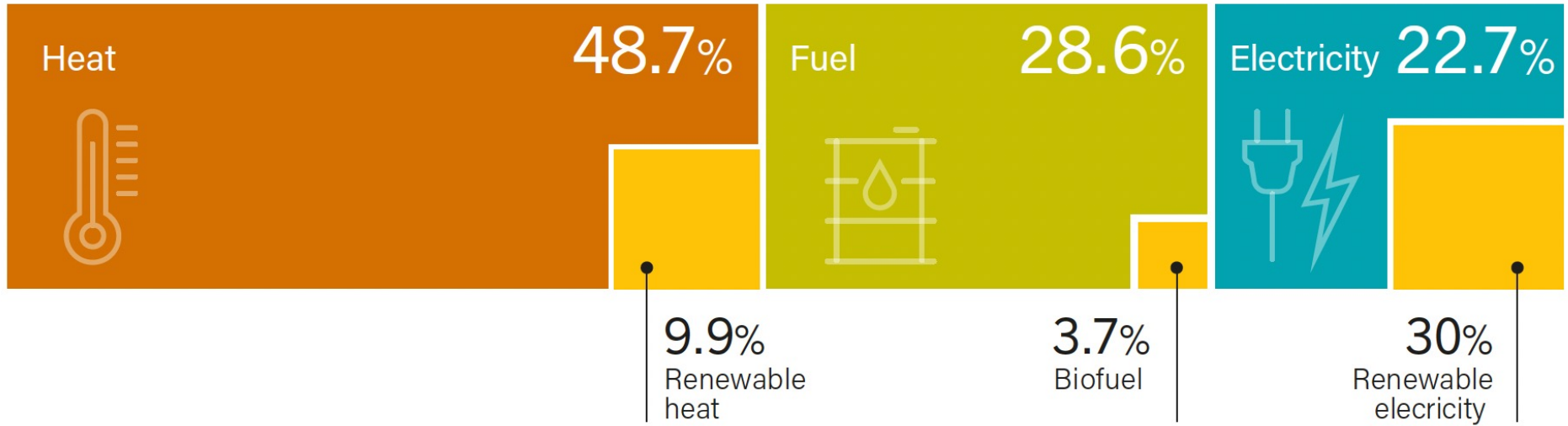
Globally, Installed PV Capacity Exceeded 1 TW in 1H 2022



Source: Solar Power Europe
GMO 2023

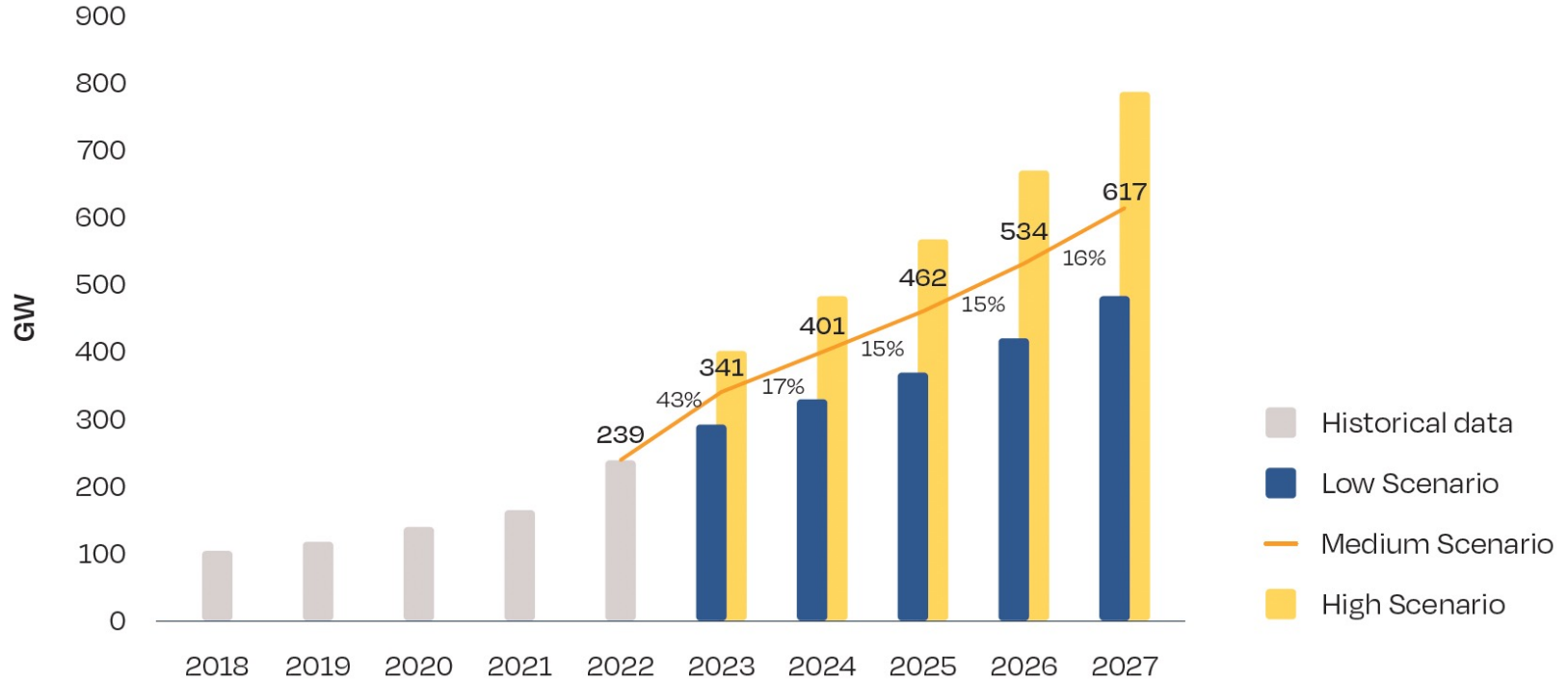
45% More PV Installed in 2022 than in 2021

Total Final Energy Supply and RE Share



Source: REN 21 2023 GSR, Supply Module

Projected Annual Capacity Additions



Source: Solar Power Europe GMO 2023

Expanded Activity by Global Associations

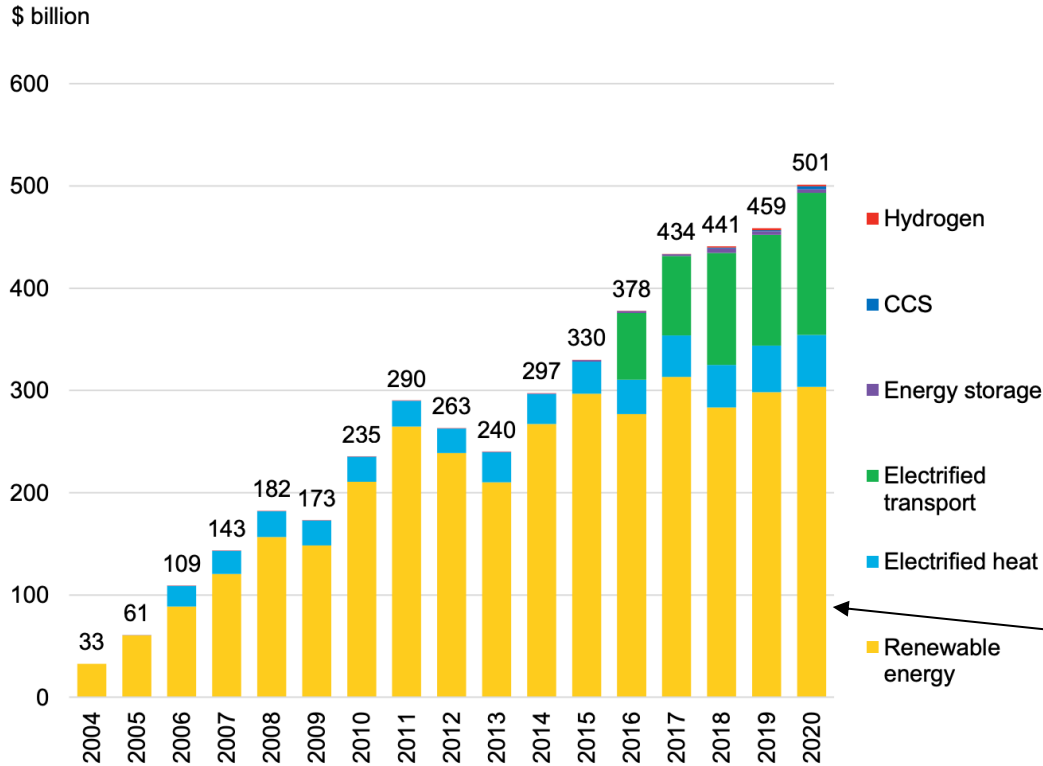
The Fossil Industry is Strengthening its Role in the Climate Negotiations

- Global Renewables Alliance (new) working with partners to establish Renewables Pavilion at COP 28
- GSC, GWEC promoting establishment of Global RE targets by 2030
- IEA, IRENA, BNEF others continue to refine net-zero pathway studies
- Several organizations (e.g. Stanford, LUT, UTS) continue work on 100% RE Scenarios
- REN21 Released a series of 2023 Status Reports

Net-Zero or Absolute Zero?

- Net-Zero pathways
 - Allow for continued (in some cases, substantial) fossil energy use in 2050
 - Place significant reliance on CCUS
 - Generally require less electrification than 100% RE
- 100% RE pathways
 - Eliminate all fossil fuel use by 2050, or earlier
 - Provide for significant electrification in all TFECS
 - Make significant use of storage, green H₂ technologies
- Both pathways support
 - Major growth in use of hydrogen
 - Energy intensity reductions and efficiency improvements
 - Substantial investments in flexible, resilient and smart grids

Estimated Global Investments for Net-Zero by 2050



Global Net Zero Will Require \$21T Investment in Power Grids by 2050...(from BloombergNEF, 2 March 2023)

In 2020:
 Solar = \$148.6B
 Wind = \$142.7B

Source: BloombergNEF

Scenarios Show Major Market Potential for Solar PV

Source	Scenario	Electricity in TFEC	Electricity Supplied by PV	2050 PV Capacity, GW	
IRENA (2021)	1.5°C Scenario	51%	~37%	>14,000	} Net-Zero
IEA (2021)	NZE by 2050	49%	43%	14,458	
BNEF NEO (2021)	Green (NZE by 2050)	49%	32%	24,010	
UTS (2019)	One Earth Climate Model	57%	49%	12,684	} 100% RE
Stanford	Wind-Water-Solar	>98%	64%	23,671	
LUT (2019)	100% RE by 2050	90%	76%	57,600	

We are at the Precipice...but Solutions are at Hand



Softwareplusplus.com

- Implement low-cost clean tech now!
 - ...in a circular economy
- Cease all investments in fossil fuels!
- Continue R&D to improve reliability and to lower costs!
- Make our energy supply flexible and accessible to all!
 - Decentralize
 - Democratize
 - Decarbonize
- Participate!

Thank You for Attending Solar 2023!

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