

Power Market Dynamics

Presented to: Energy & the Economy Meeting

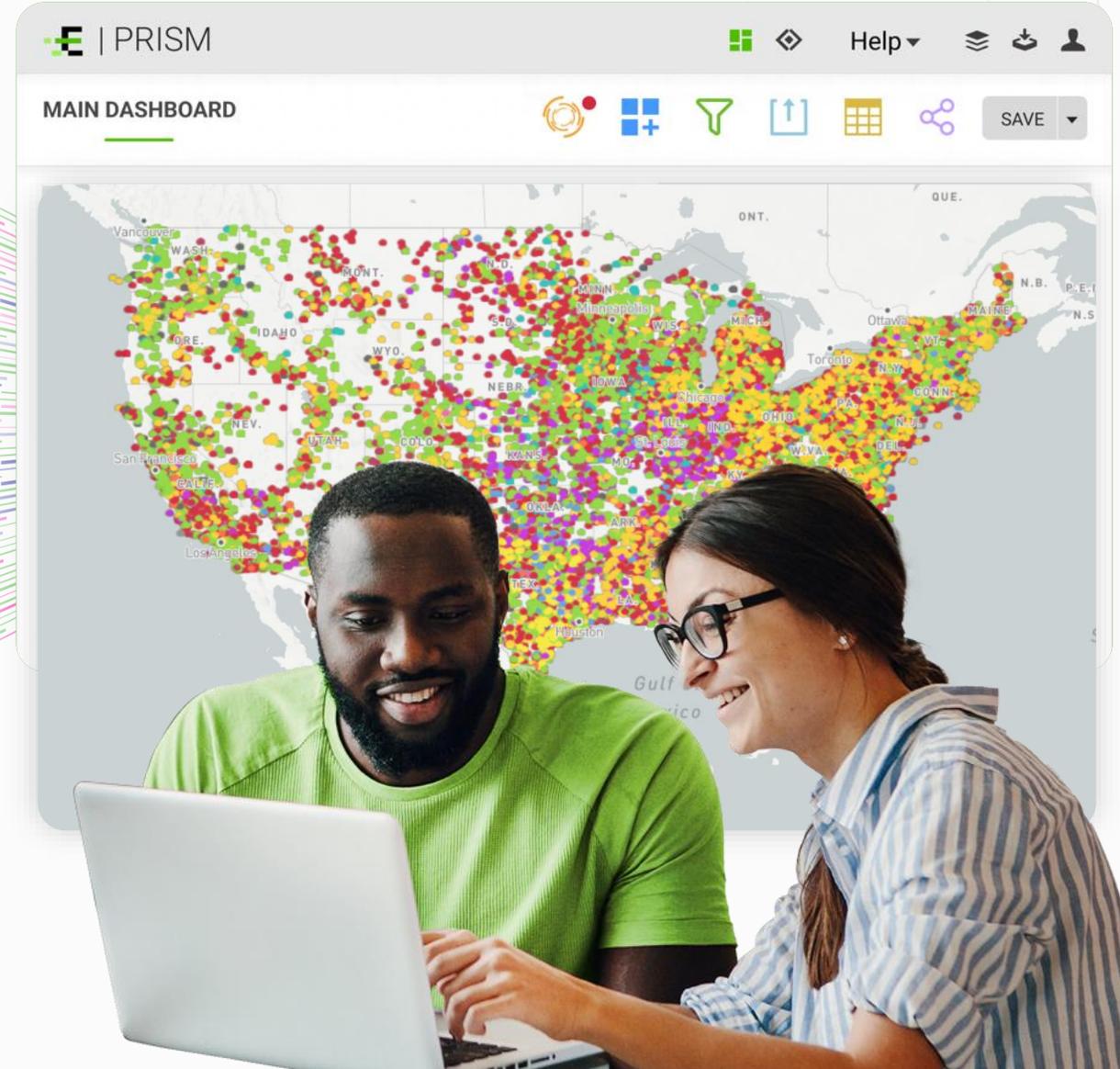


Federal Reserve Bank of Kansas City

DENVER / OKLAHOMA CITY / OMAHA

BERNADETTE JOHNSON | GM, POWER & RENEWABLES

NOVEMBER 2023



GENERAL DISCLOSURES

ENVERUS DISCLOSURE STATEMENT:

© Copyright 2023 Enverus, Inc. All rights reserved.

The material in this report is the property of Enverus, Inc. ("Enverus") unless otherwise indicated. All trademarks, service marks and logos used in this report are proprietary to Enverus. This report is provided solely to clients of Enverus. Furthermore, this report is proprietary, confidential and provided for the exclusive use of the recipient and may not be redistributed to or shared with any individual, company or entity outside of your organization without the express prior written consent of Enverus.

The material presented in this report is provided for information purposes only and is not to be used or considered as a recommendation to buy, hold or sell any securities or other financial instruments. Information contained herein has been compiled by Enverus and prepared from various public and industry sources that we believe to be reliable, but no representation or warranty, expressed or implied is made by Enverus, its affiliates or any other person as to the accuracy or completeness of the information. Such information is provided with the expectation that it will be read as part of a mosaic of analysis and should not be relied upon on a stand-alone basis. Past performance should not be taken as an indication or guarantee of future performance, and we make no representation or warranty regarding future performance. The opinions expressed in this report reflect the judgement of Enverus as of the date of this report and are subject to change at any time as new or additional data and information is received and analyzed. Enverus undertakes no duty to update this report, or to provide supplemental information to any client receiving this report. To the full extent provided by law, neither Enverus nor any of its affiliates, nor any other person accepts any liability whatsoever for any direct or consequential loss arising from any use of this report or the information contained herein. The recipient assumes all risks and liability with regard to any use or application of the data included herein.

Enverus provides custom research to its clients which are distributed on different frequency schedules. Custom research reports may provide different depths of analysis and more frequent updates based on levels of service and fees selected by clients.

No Enverus directors, officers or employees are on the Board of Directors of a subject company and no one at a subject company is on the Board of Directors of Enverus. Enverus does not invest in any securities or manage any security portfolios. Therefore, it would have no investment relationship with a subject company. Furthermore, all employees are subject to restrictions on trading in energy company securities. The views expressed in this report accurately reflect the research analyst's personal views about the subject securities. Enverus analysts are compensated from overall firm revenue only and are not compensated to express any view about an issuer or from proceeds derived from any particular transaction between Enverus or any of its affiliates and an issuer. Enverus and its affiliated companies serve over 6,000 customers globally and should be assumed to have received compensation from the subject company for non-securities related products or services in the preceding twelve months.

Equity owners of Enverus include affiliated entities of Hellman & Friedman and Genstar Capital, each of whom separately sponsor and manage private investment funds and may make investments in, or otherwise seek to do business with, a company or companies covered by this report. Enverus has adopted an implemented policies and procedures reasonably designed to maintain the independence of its research coverage in an attempt to mitigate any potential conflict of interest related to such activities.

Economics and Valuation Methodology

Enverus economics and valuations are based primarily on discounted cash flow (DCF) models and consequent calculations of net asset value (NAV). Enverus uses historical data and assumptions to inform inputs into these models. Enverus will use the aforementioned historical data and assumptions to make an assessment of possible future scenarios. Enverus typically runs a number of sensitivities around key variables to show the range of possible outcomes.

Note to UK Persons

Enverus is not an authorized person as defined in the UK's Financial Services and Markets Act 2000 ("FSMA") and the content of this report has not been approved by such an authorized person. You will accordingly not be able to rely upon most of the rules made under FSMA for the protection of clients of financial services businesses, and you will not have the benefit of the UK's Financial Services Compensation Scheme. This document is only directed at (a) persons who have professional experience in matters relating to investments (being 'investment professionals' within the meaning of Article 19(5) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (the "FPO")), and (b) High net worth companies, trusts, etc of a type described in Article 49(2) of the FPO (all such persons being "relevant persons"). Enverus' services are available only to relevant persons and will be engaged in only with relevant persons. This report must not be acted or relied upon by persons who are not relevant persons. Persons of a type described in Article 49(2) of the FPO comprise (a) any body corporate which has, or which is a member of the same group as an undertaking which has, a called up share capital or net assets of not less than (i) in the case of a body corporate which has more than 20 members or is a subsidiary of an undertaking which has more than 20 members, £500,000 and (ii) in any other case, £5 million, (b) any unincorporated association or partnership which has net assets of not less than £5 million, (c) the trustee of a high value trust within the meaning of Article 49(6) of the FPO and (d) any person ('A') whilst acting in the capacity of director, officer or employee of a person ('B') falling within any of (a), (b) or (c) above where A's responsibilities, when acting in that capacity, involve him in B's engaging in investment activity.

THE ENERGY INDUSTRY **HAS CHANGED**



THE HEADWINDS: A SUMMARY



WHAT WE SAY WE NEED FOR THE ENERGY EVOLUTION



Hydrocarbons ↓ | Need to decline at a rapid rate to meet Well Below 2°C ambitions.



Investment ↑ | Need public and private investment to fill in demand gaps with technology.



Collaboration ↑ | Global collaboration at levels never seen before.

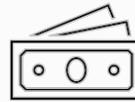


Government Intervention ↑ | Global government intervention at levels never seen before.

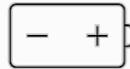
WHAT WE NEED TO CONSIDER ABOUT THE ENERGY EVOLUTION



Hydrocarbons ↓ | Lack of investment will cause price volatility and shocks to world economies.



Emissions ↓ | Efforts to reduce emissions require higher cost measures short term.



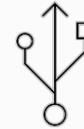
Storage ↑ | Industrial-scale storage key to reliability of grids throughout the electrification.



End-Use ↑ | Need to address the energy needs of transport, industry, & buildings.



Infrastructure ↑ | Redundant infrastructure and early abandonment of existing infrastructure is costly.



Digitalization ↑ | Digitalization of new and existing infrastructure and cybersecurity risk mitigation is costly.



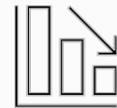
Access ↑ | Need to address immediacy of access to electricity and clean cooking.



Financing ↑ | More financing for developing and emerging economies to address emissions.



Supply Diversification ↓ | Hydrocarbon production becomes more concentrated, making supply riskier.



Hydrocarbon Revenues ↓ | Hydrocarbon revenues decline, making resource-rich economies unstable.

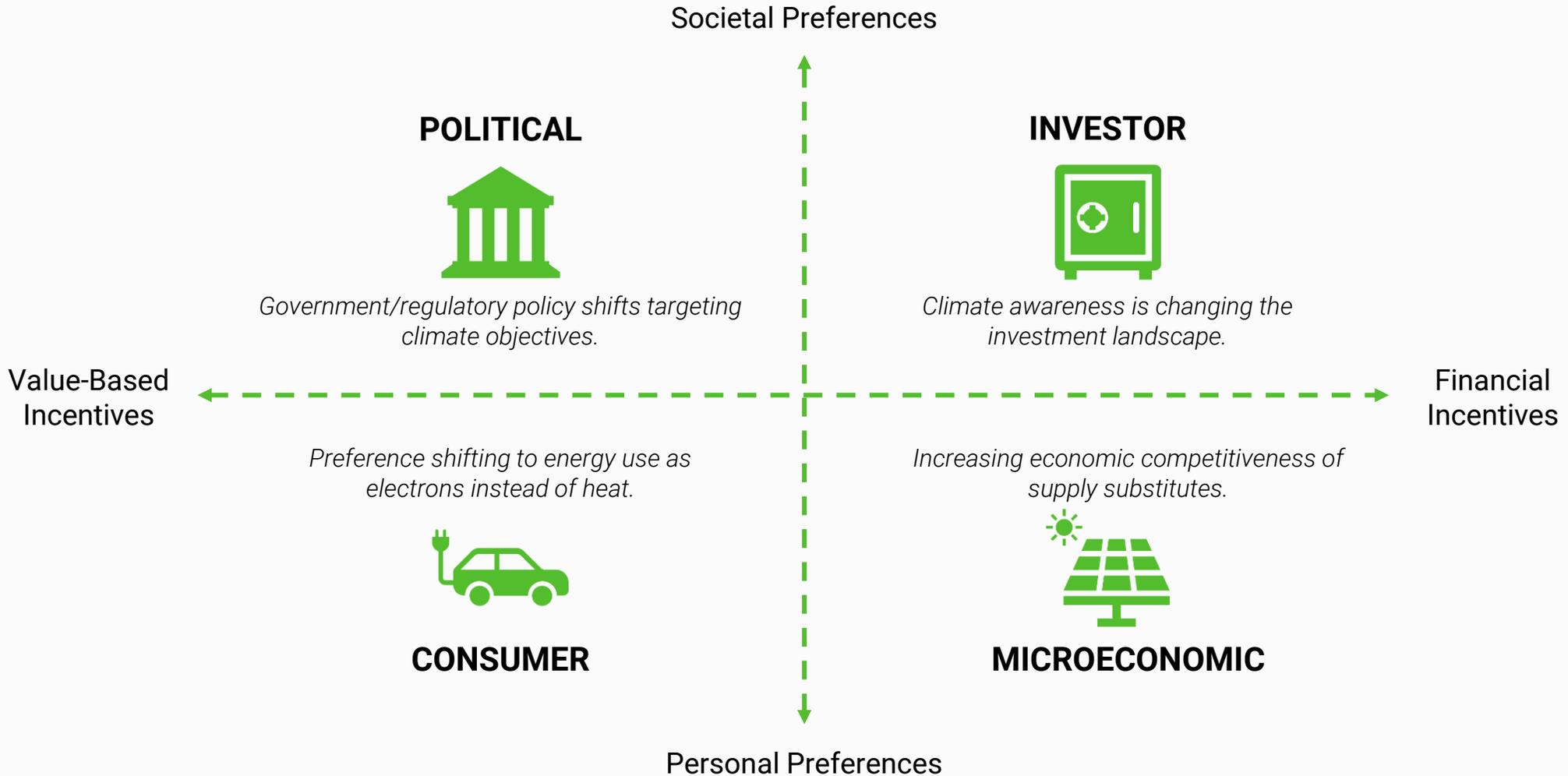


Mining ↑ | Require more minerals, which are concentrated in fewer countries with weak ESG practices.

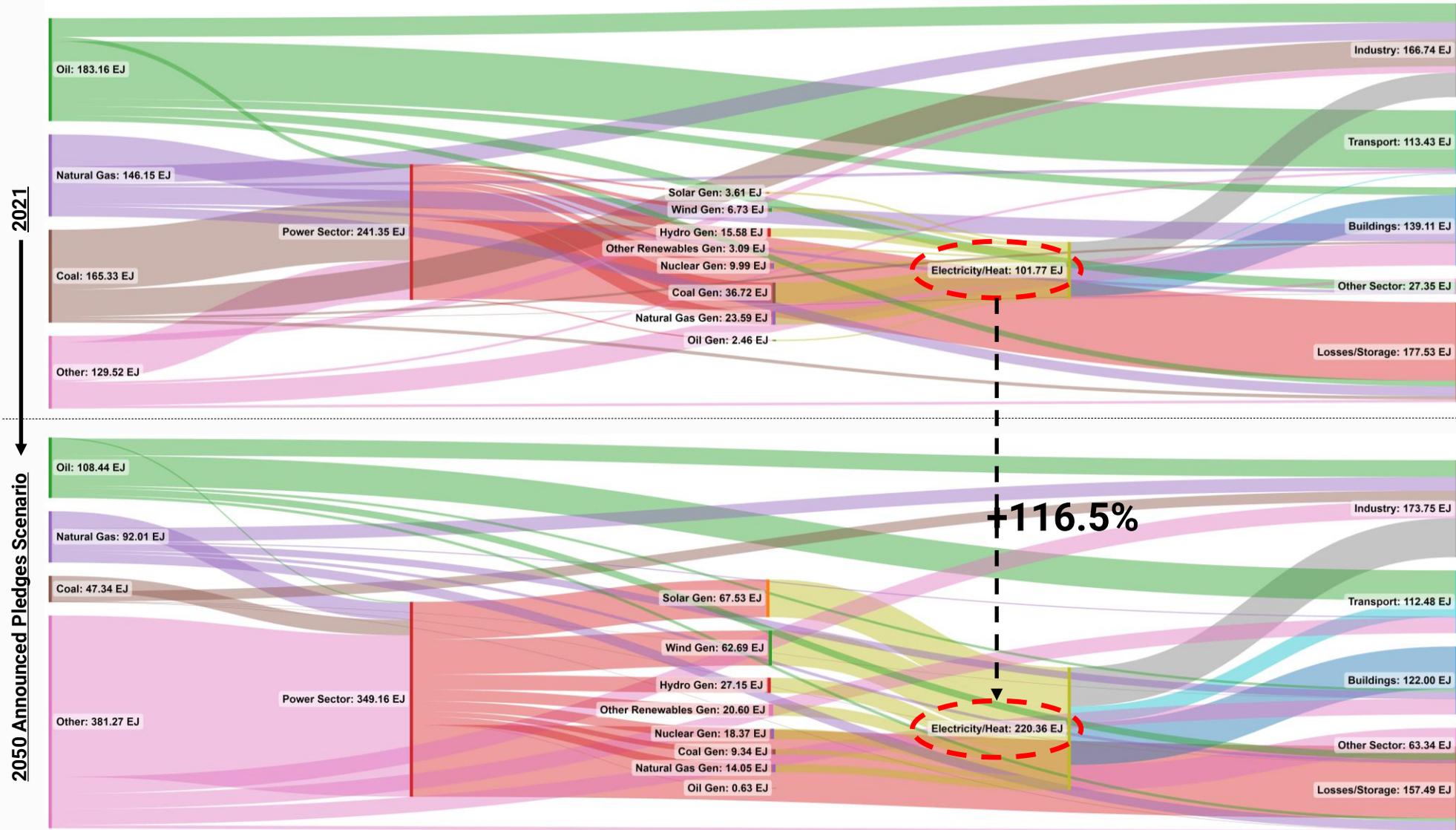


Workforce ↑↓ | Changes in energy mix will impact workers and communities differently.

THE FOUR FORCES OF THE ENERGY EVOLUTION



CONSUMER: PREFERENCE FOR ELECTRONS



Source | Enverus, IEA

POLITICAL: THE TAILWINDS

1988 | Global warming hit the mainstream as summer temperatures were the hottest on record to date.



PROBLEM IDENTIFICATION

1988 | The IPCC is created to study climate change and potential response strategies in the future.



AGENDA SETTING

1997 | Kyoto Protocol & **2015** | Paris Agreement set broad policy framework to address climate concerns.



POLICY FORMULATION

Today | Countries are developing and implementing policies to meet national & international commitments.



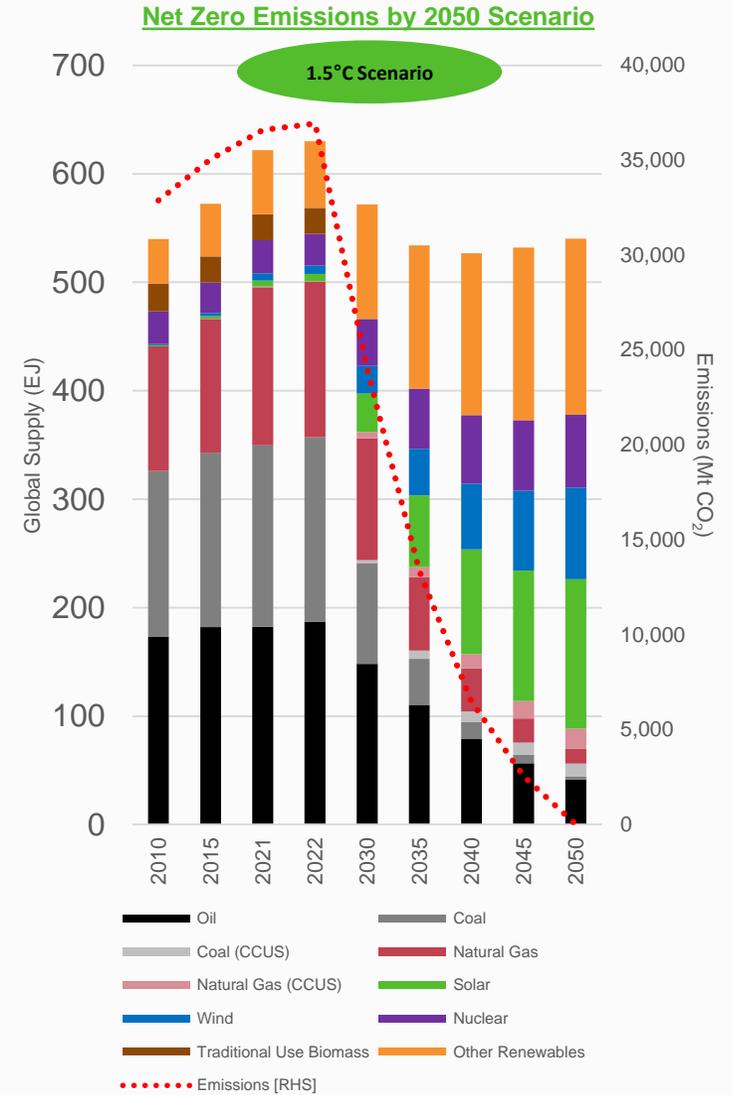
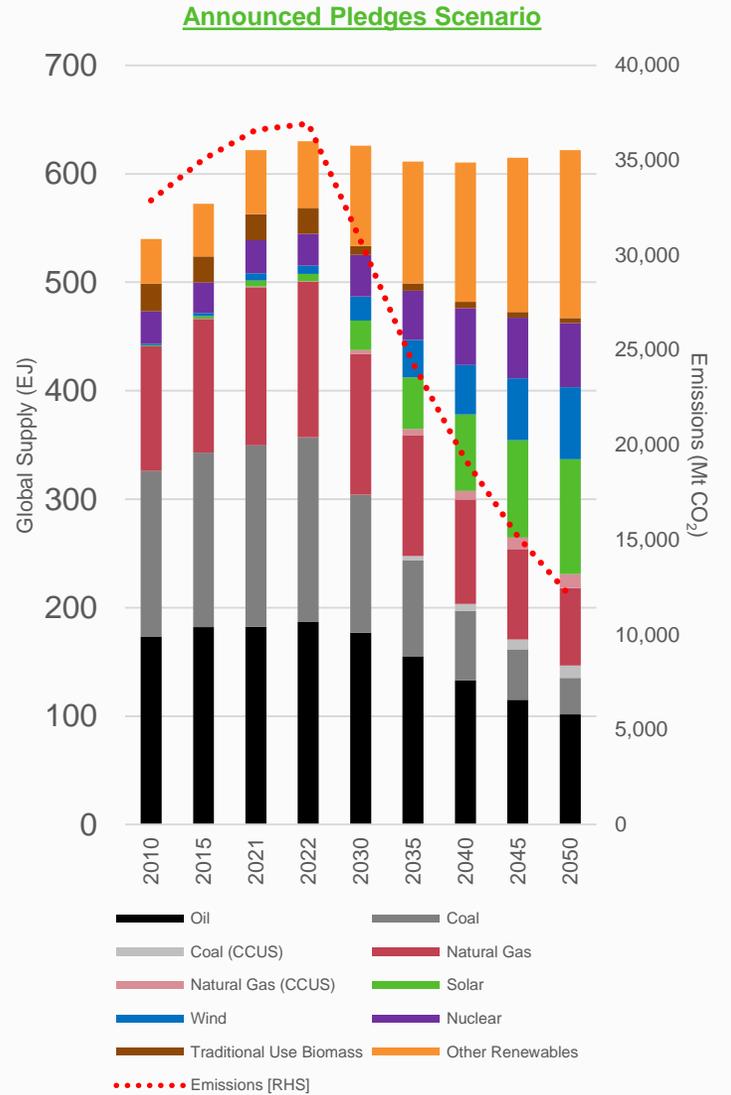
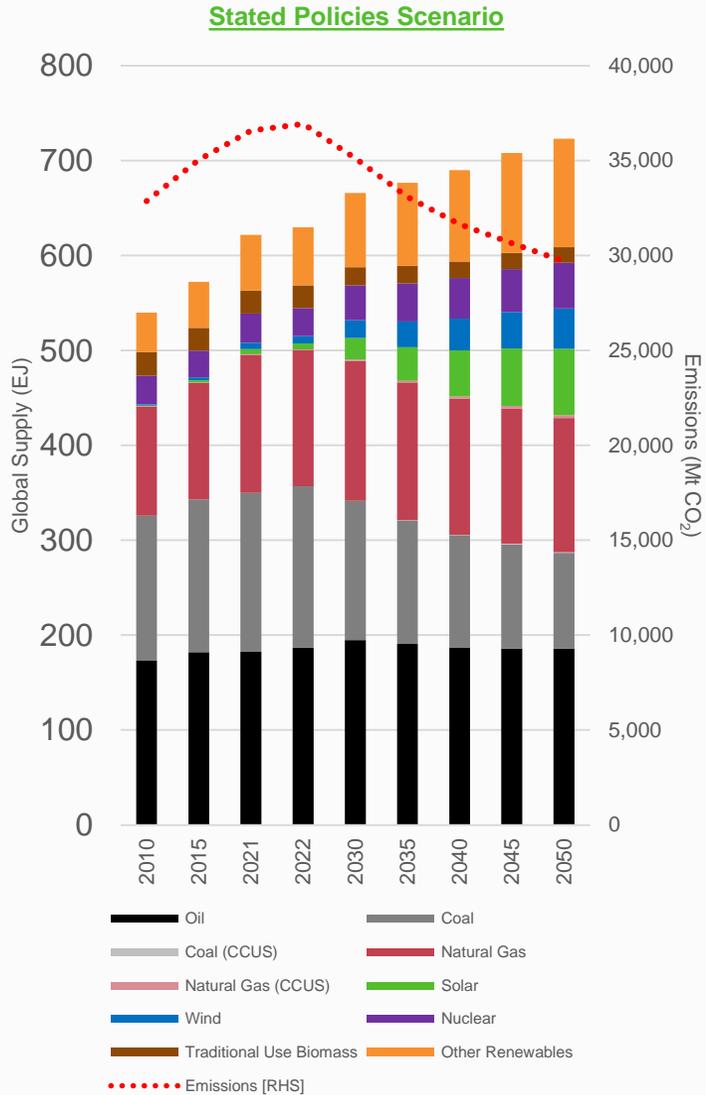
IMPLEMENTATION

Next | Tracking progress towards goals to evaluate the impact of policies will be crucial to climate outcomes.



EVALUATION

POLITICAL: AMBITION REQUIRES EVALUATION



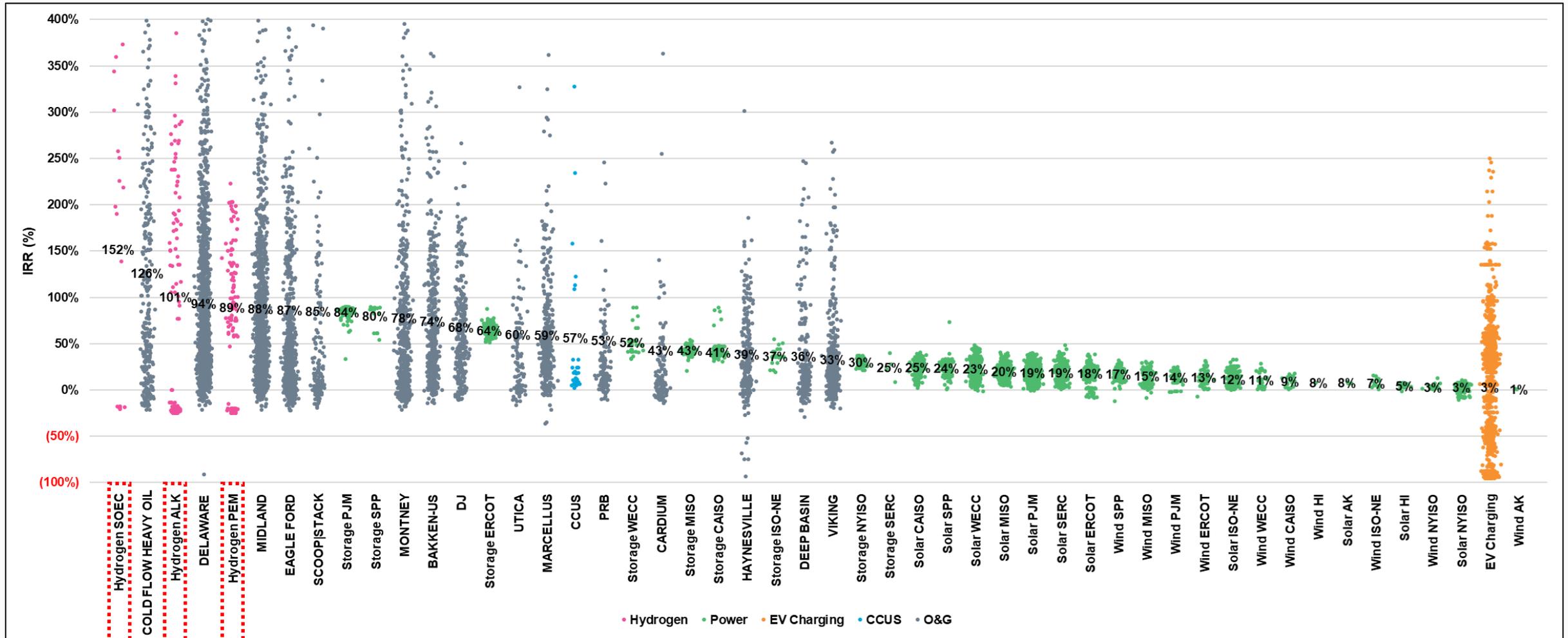
Source | Enverus, IEA

MICROECONOMIC: COMPETING INVESTMENTS



FIGURE | Energy Technology Economics Comparison

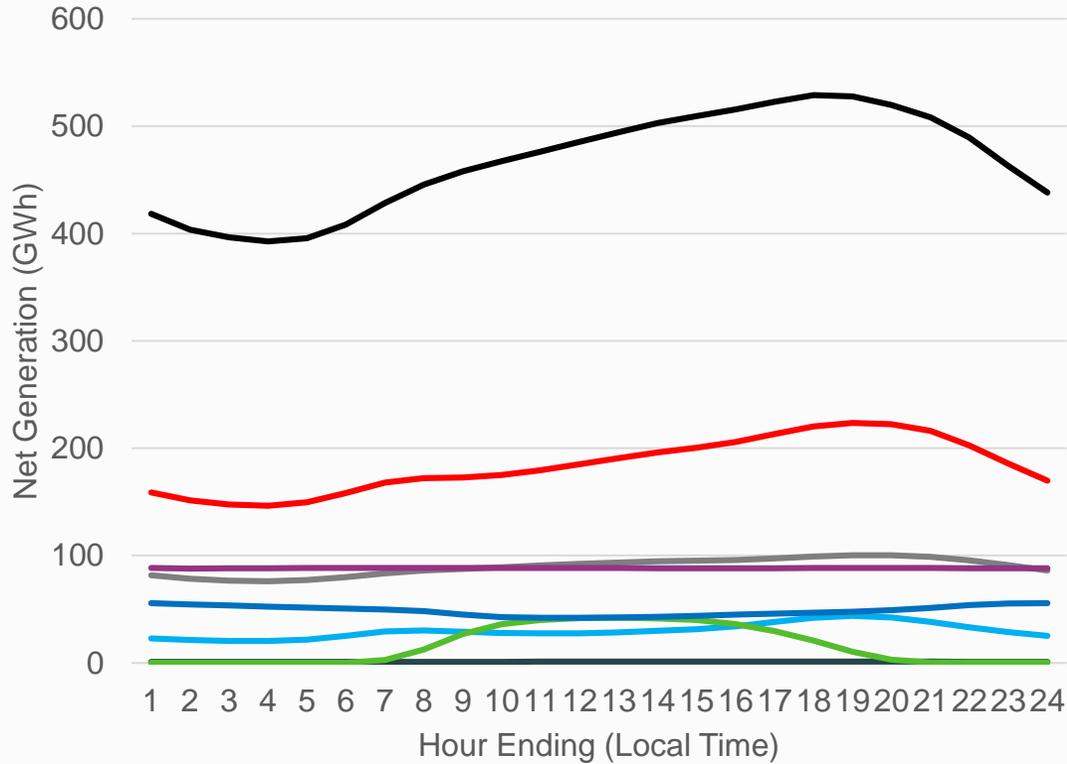
Assumptions | 2023/24 Vintage | Oil & Gas : \$60 WTI/\$3 HH | Generation: \$40/MWh | Storage: LTM Combo Strategy | Hydrogen: \$1.50/kg, No Transport | EV: 5% Utilization



Source | Enverus P&R - NAV & Economic Analysis, Enverus Intelligence - Energy Transition Research

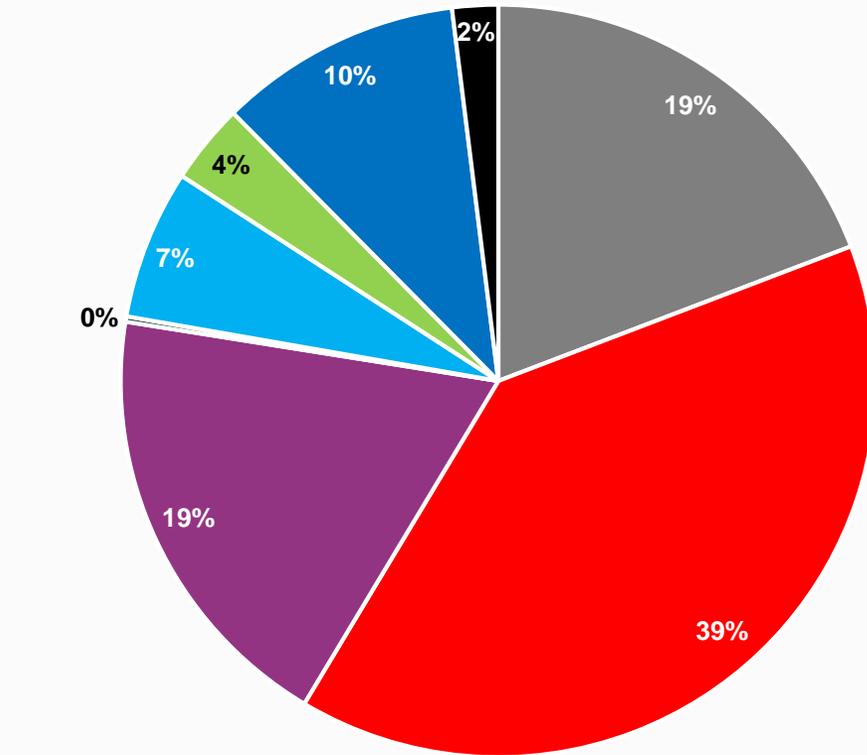
24/7 RENEWABLES | THE PROBLEM

Avg Hourly Net Gen by Technology (Jan 2022-Oct 2023)



- Total
- Natural Gas
- Petroleum Products
- Solar
- Coal
- Nuclear
- Hydro & Pumped Storage
- Wind

Avg Hourly Net Gen by Technology (Jan 2022-Oct 2023)

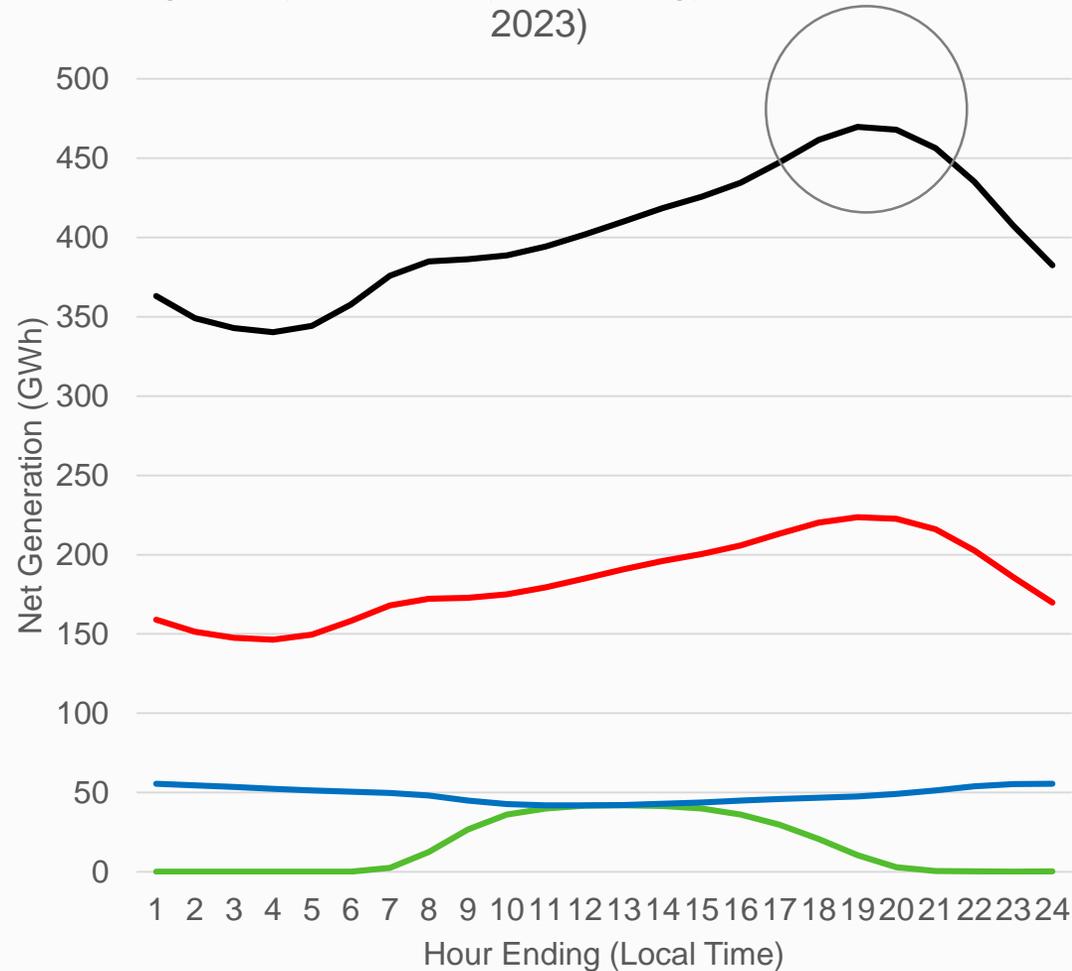


- Coal
- Natural Gas
- Nuclear
- Petroleum Products
- Hydro & Pumped Storage
- Solar
- Wind
- Other

Source: Enverus, Balancing Authorities, EIA

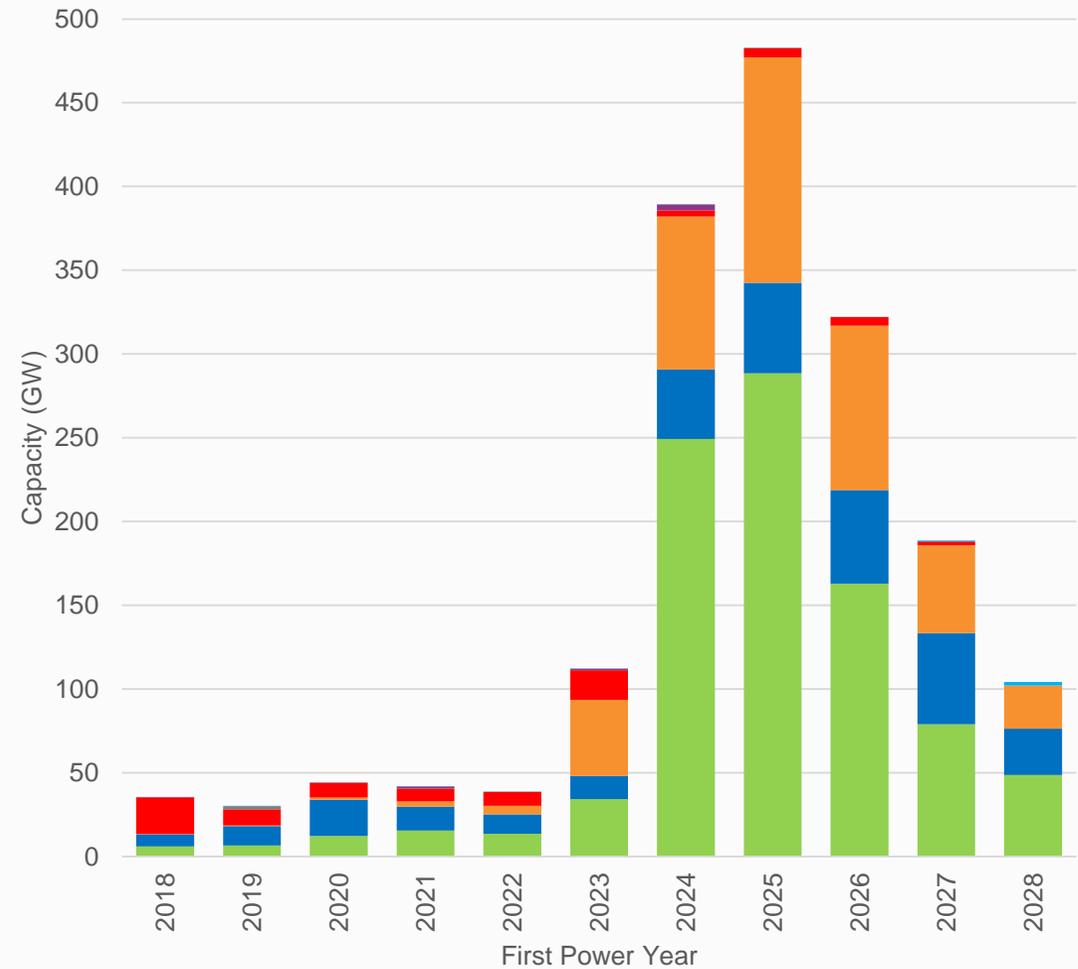
24/7 RENEWABLES | WHAT ARE WE DOING?

Avg Hourly Net Gen by Technology (Jan 2022-Oct 2023)



— Demand excl. Solar + Wind — Natural Gas — Solar — Wind

Capacity Operating and in Queues by Technology

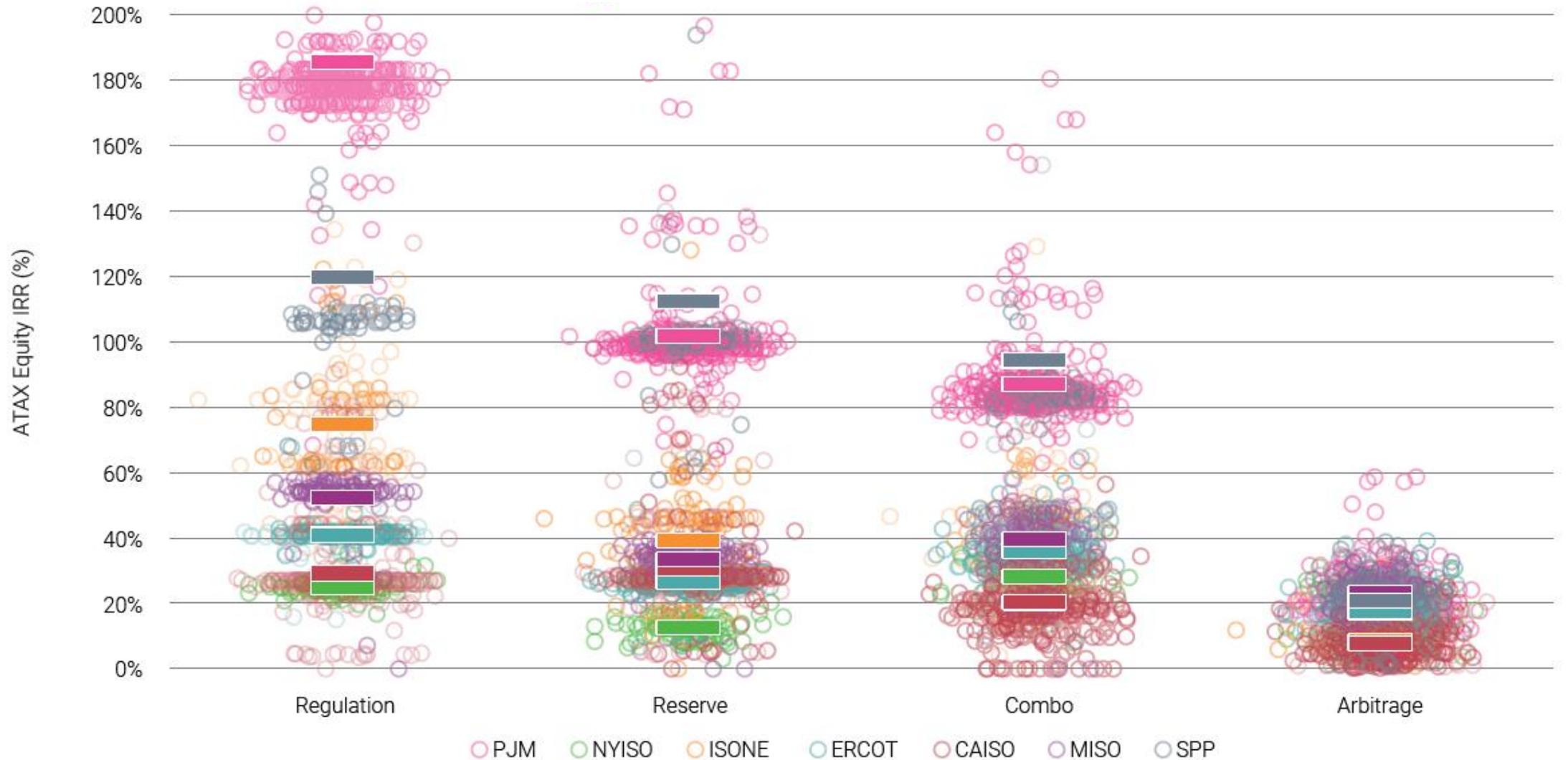


■ Solar ■ Wind ■ Storage ■ Natural Gas ■ Coal ■ Nuclear ■ Hydro

Source: ENVERUS P&R – Project Tracking, Balancing Authorities, EIA

STORAGE | RETURNS LOOK GOOD FOR NOW...

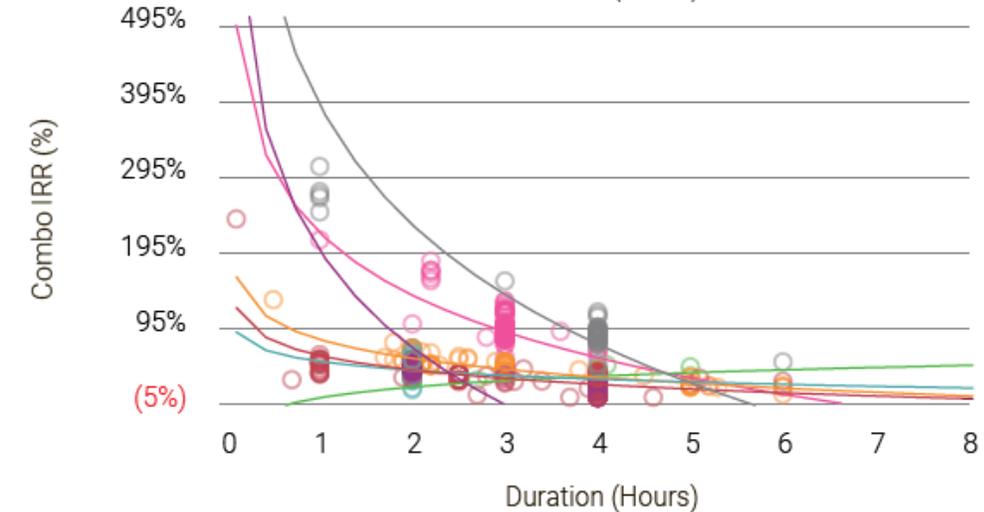
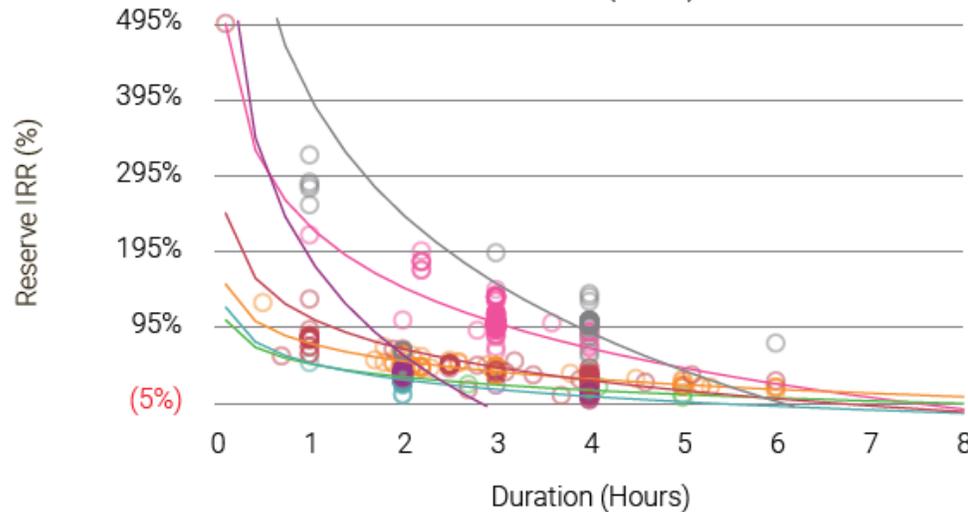
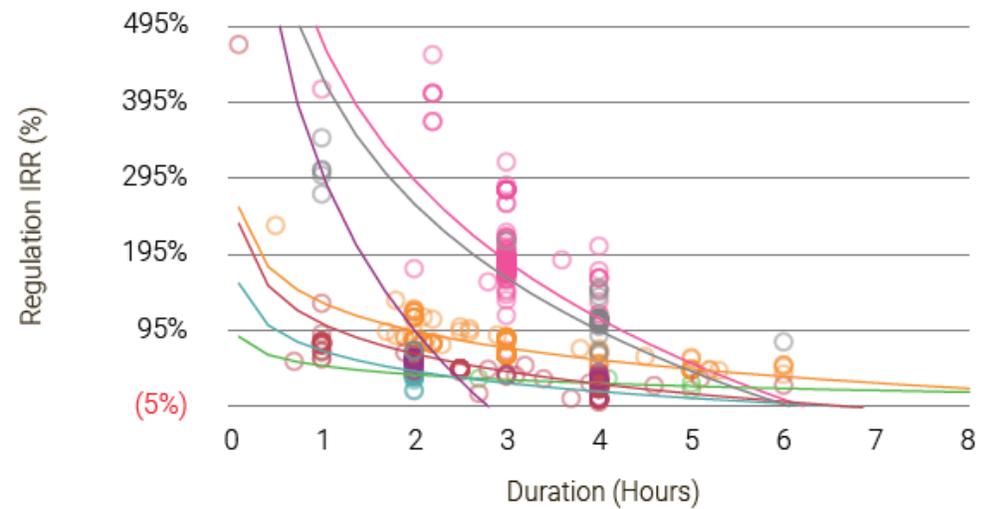
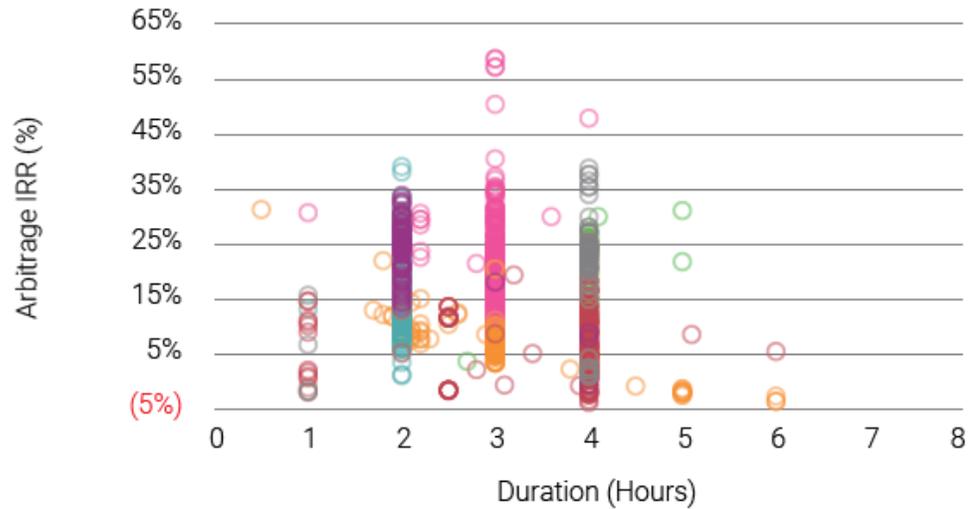
FIGURE | Storage Strategy Returns Benchmarking



Source: Enverus P&R – Economics, Enverus Intelligence

STORAGE | ...ARBITRAGE EATS ITS OWN TAIL...

FIGURE | Duration Impact on Returns

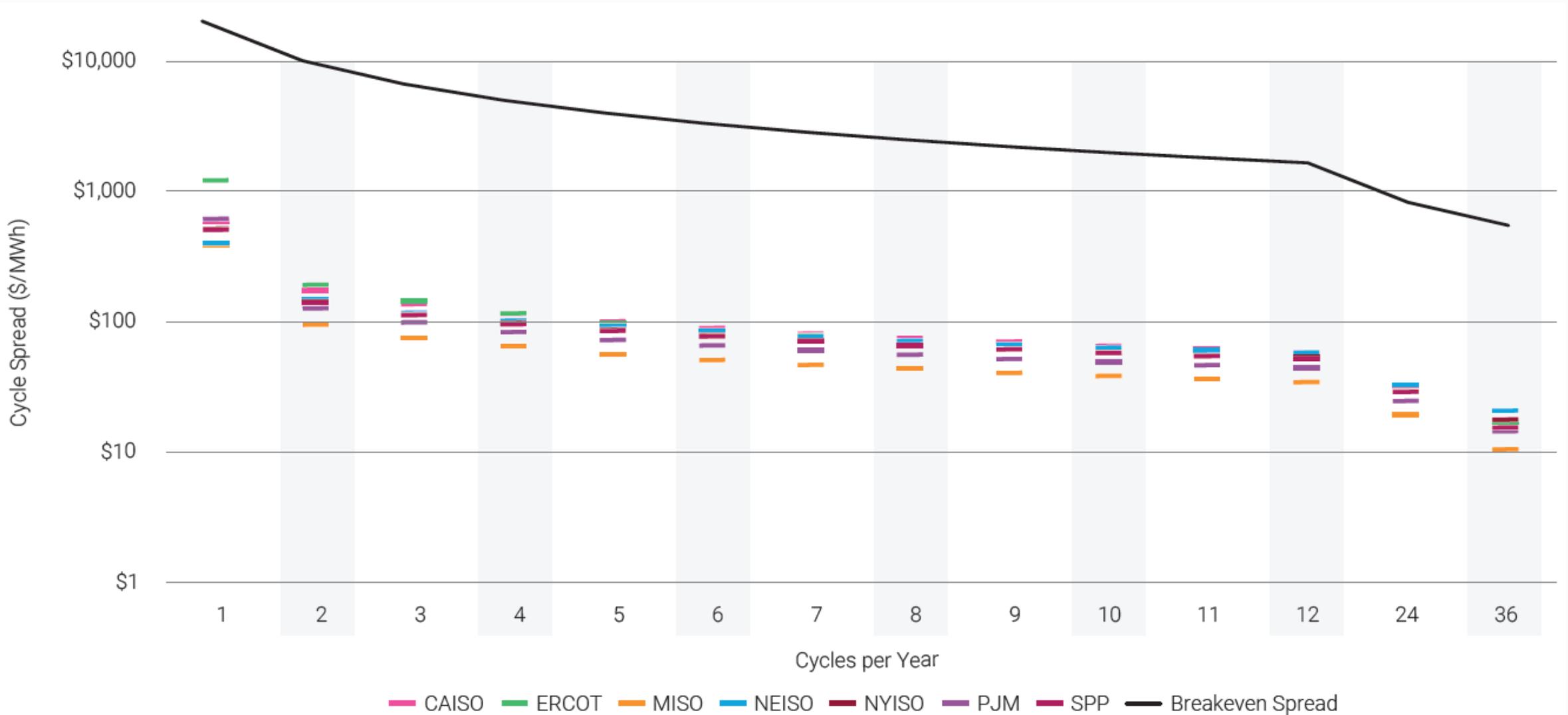


● PJM ● NYISO ● ISONE ● ERCOT ● CAISO ● MISO ● SPP

Source: Enverus P&R - LMP, Enverus Intelligence

STORAGE | ...AND LONG-DURATION IS FAR FROM ECONOMIC.

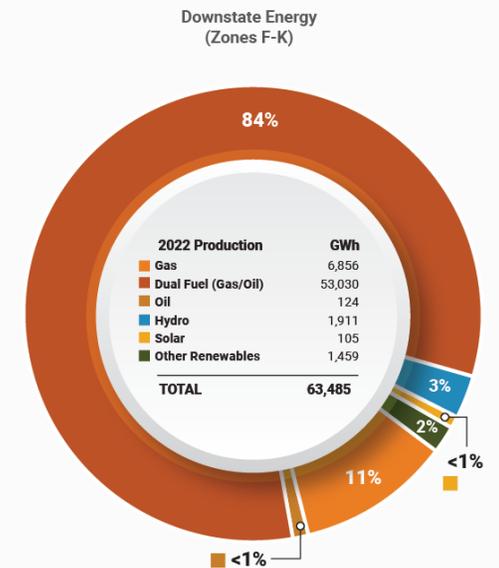
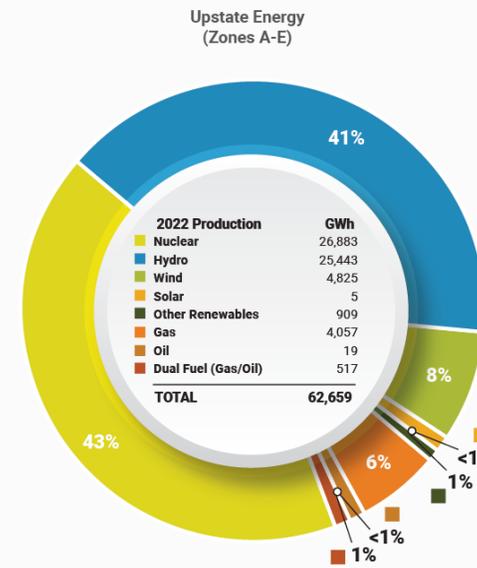
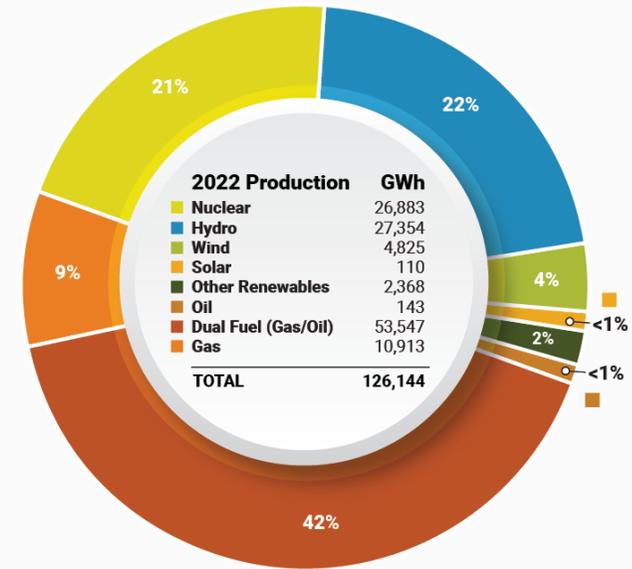
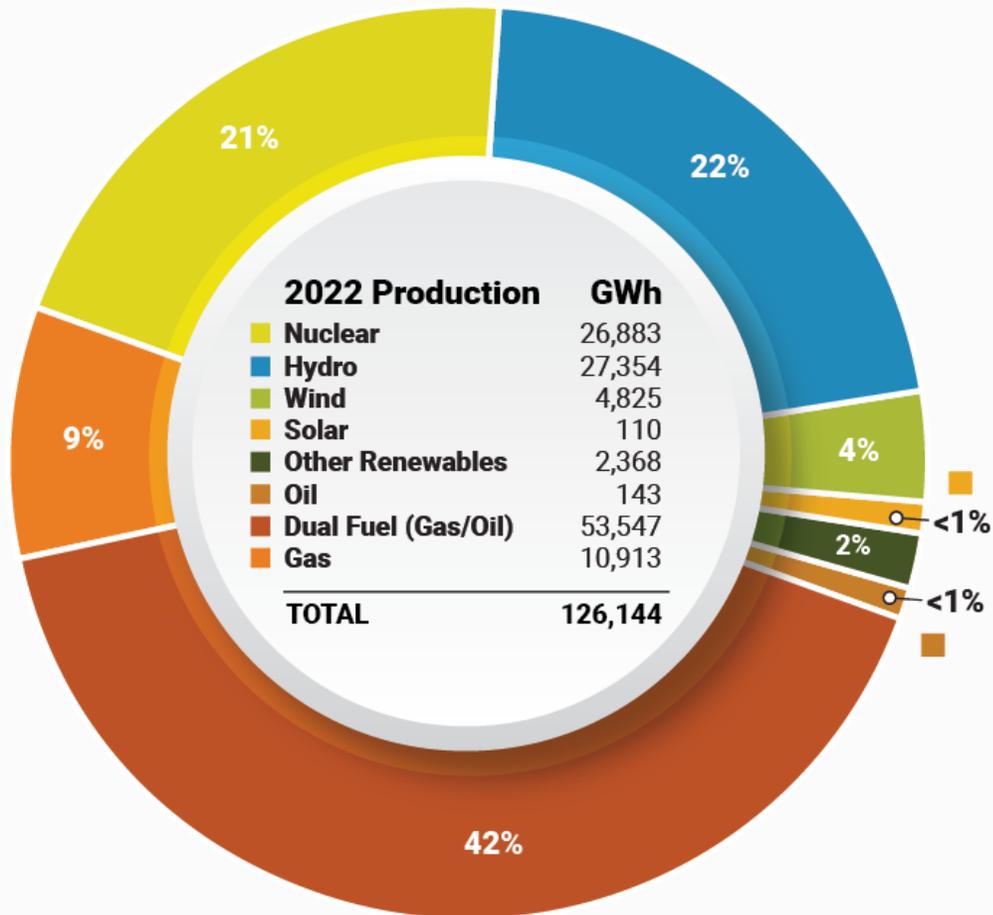
FIGURE | Achievable and Breakeven Spreads by ISO



Source: Enverus P&R - LMP, Enverus Intelligence

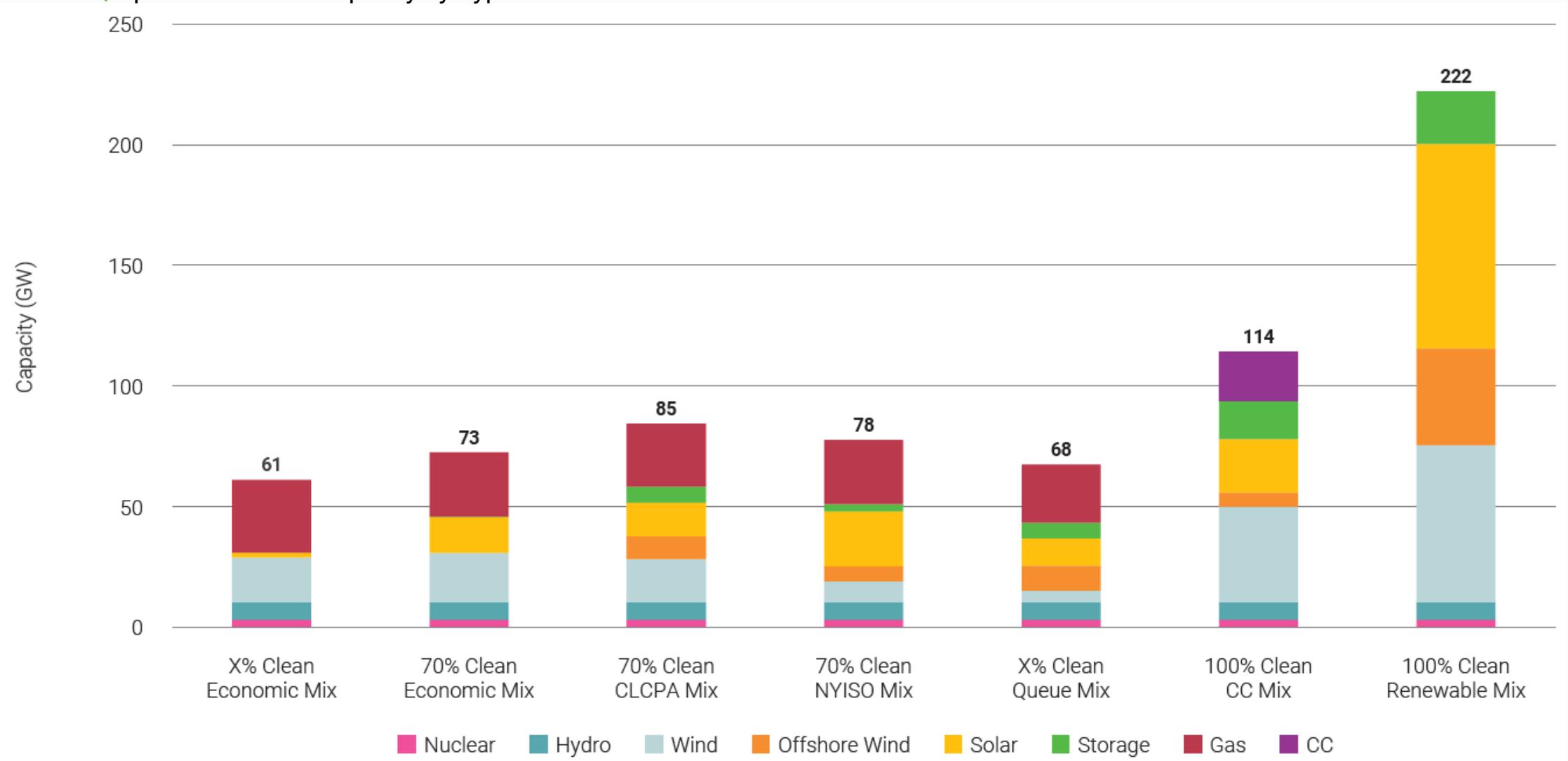
CURRENT STATE OF NYISO

NYCA Energy Production by Source



NYISO | 70X30 MANDATE – WITH WHAT TECHNOLOGIES?

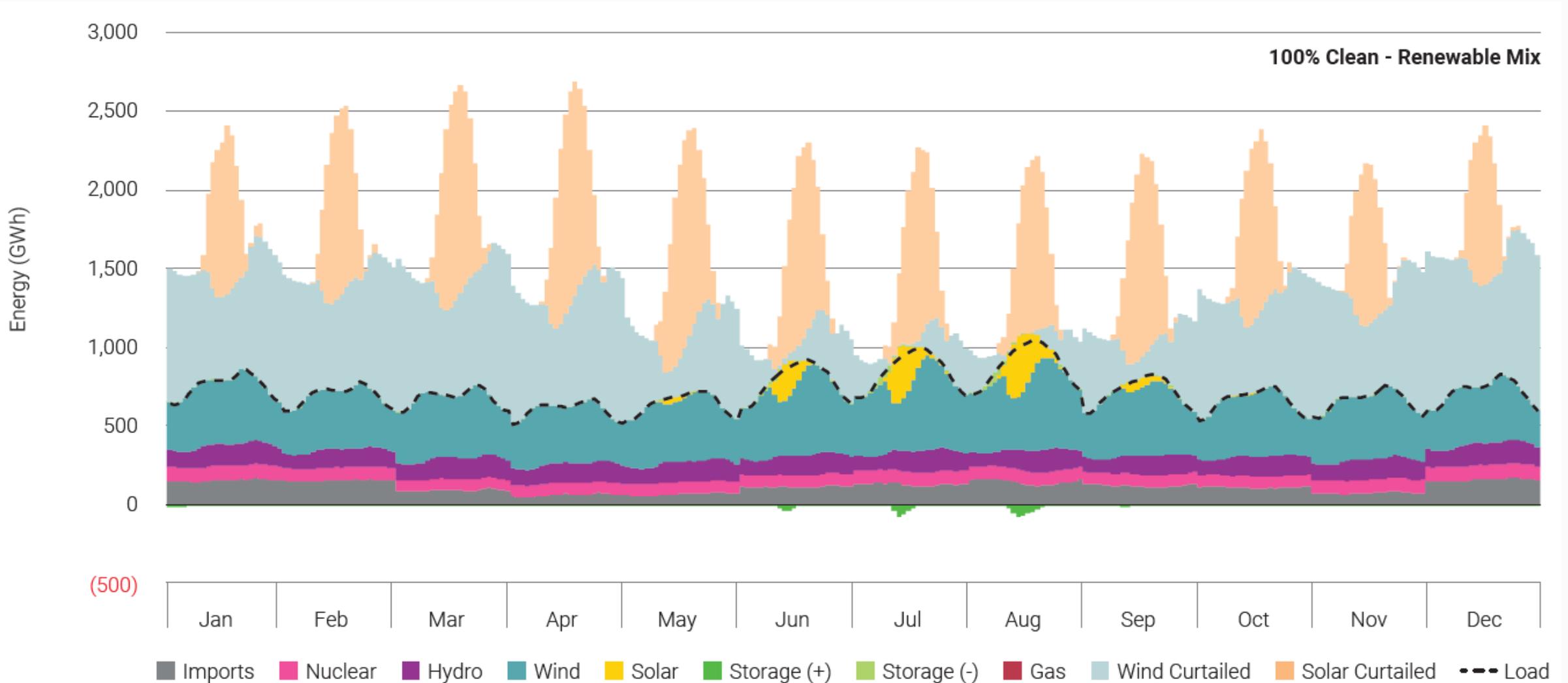
FIGURE | Optimal Installed Capacity by Type



Source: Enverus Intelligence

NYISO | 70X30 MANDATE – WHAT A WASTE

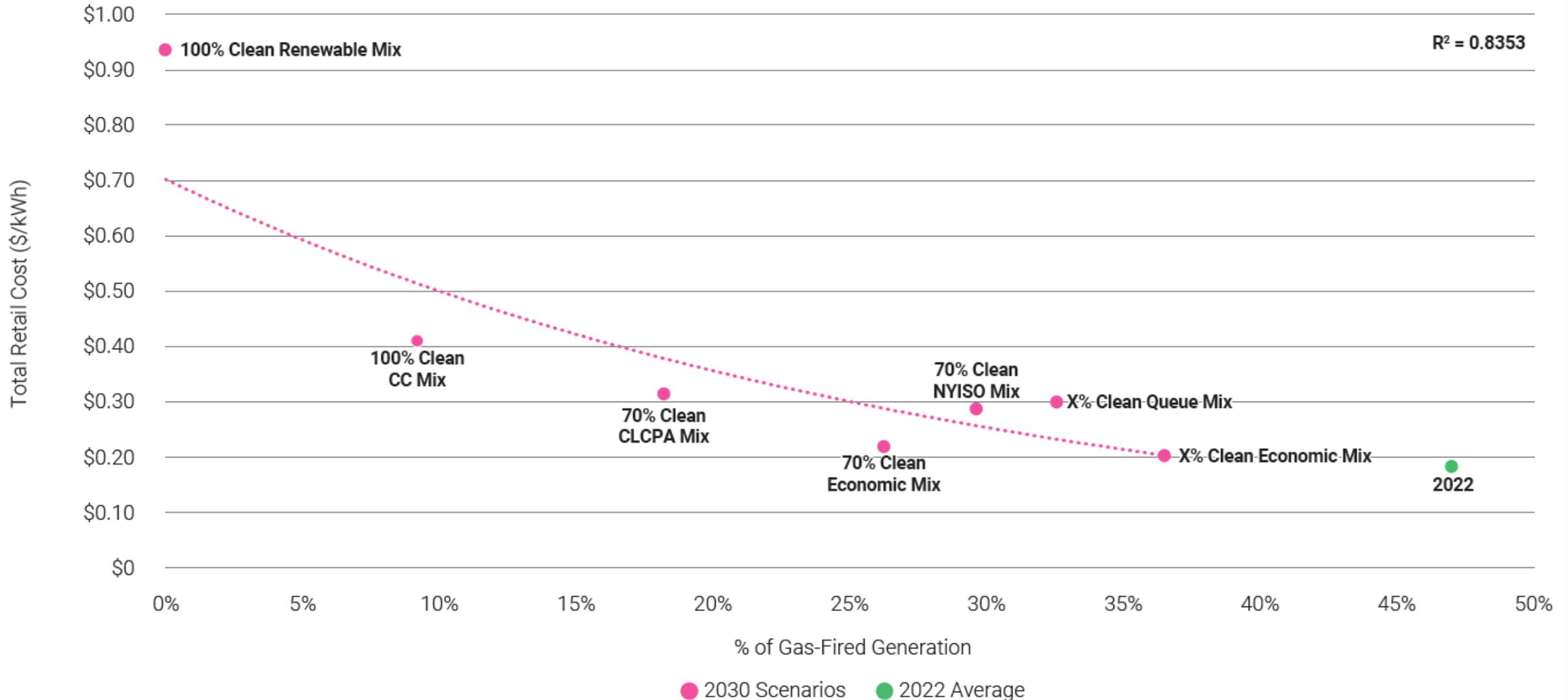
FIGURE | Average Generation Profile for 100% Carbon Free Renewable Energy



Source: Enverus Intelligence

NYISO | 70X30 MANDATE – AT WHAT COST?

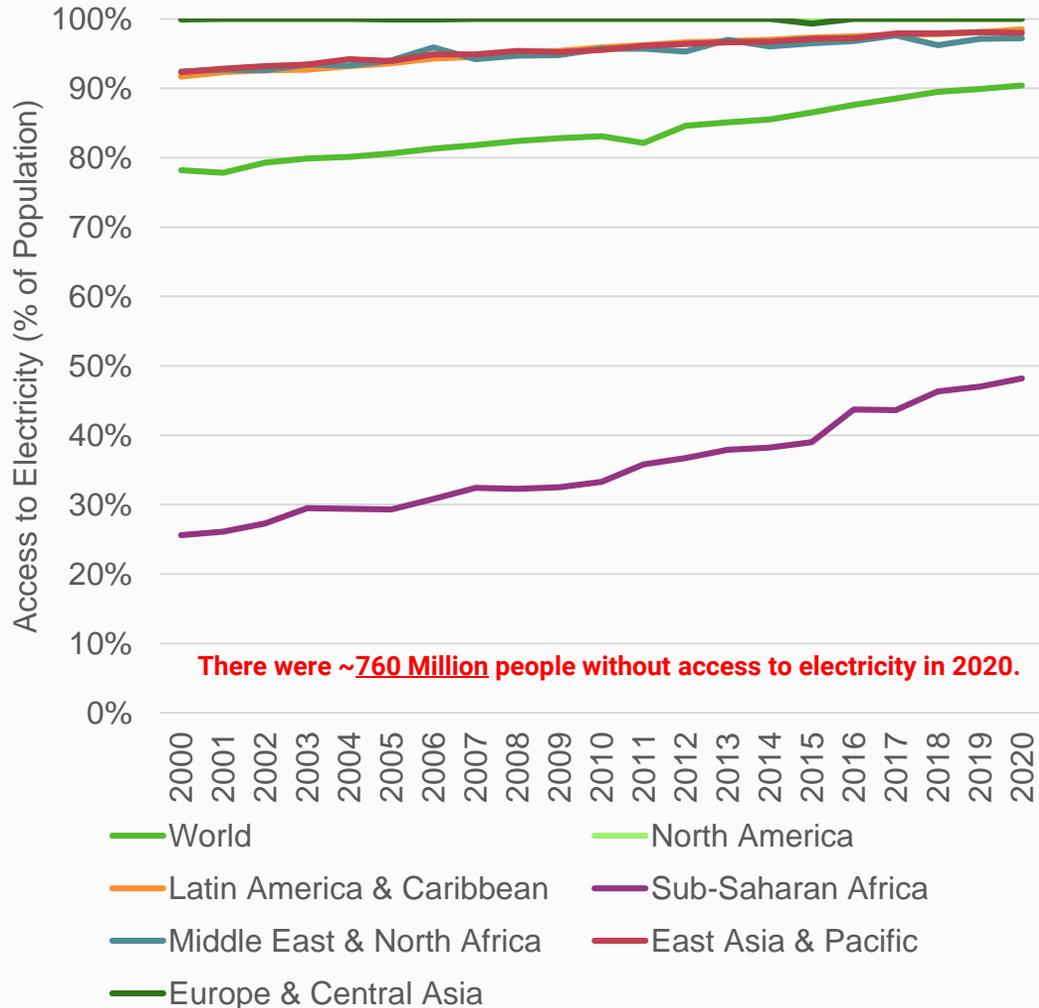
FIGURE | Cost of Flexibility in NY Power System



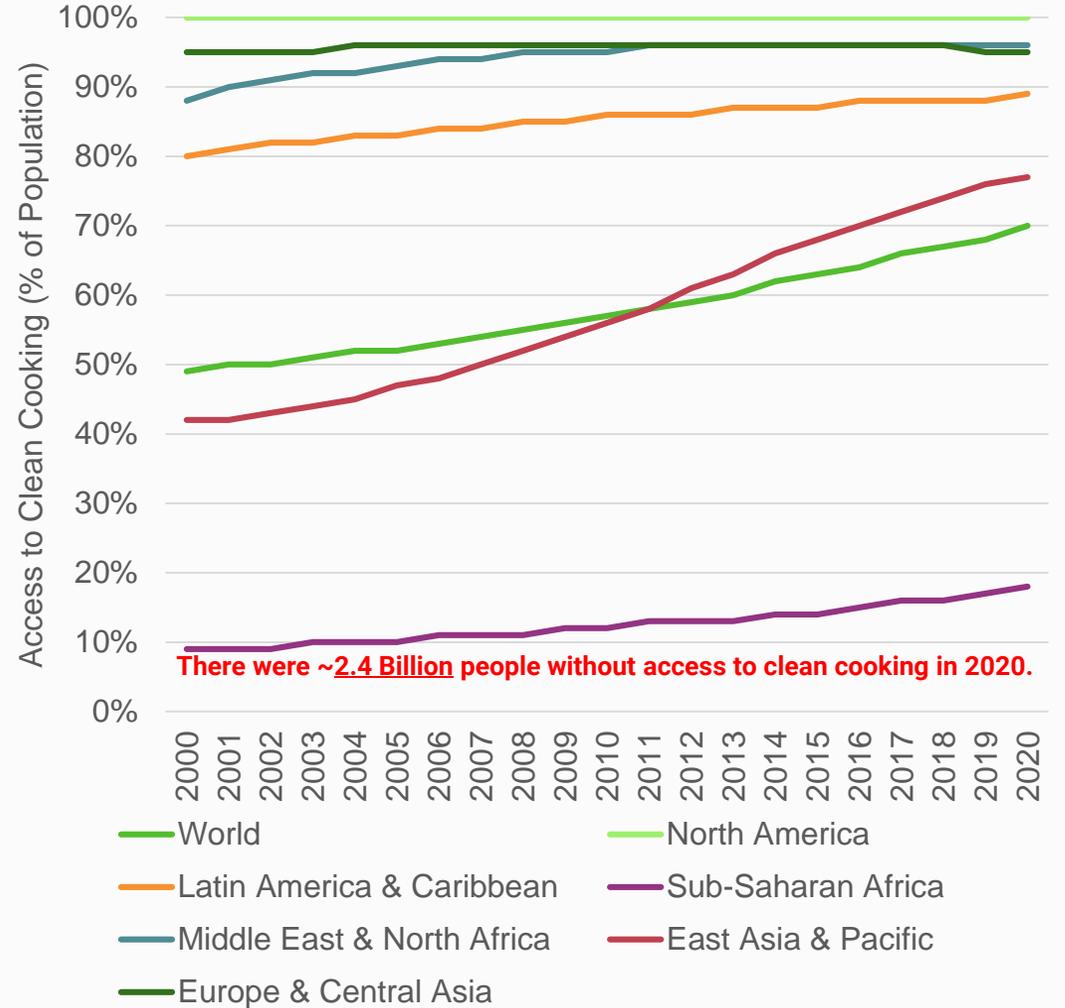
THE HEADWINDS: EQUAL ACCESS



Access to Electricity



Access to Clean Cooking



Source | World Bank

THE HEADWINDS: A SUMMARY



WHAT WE SAY WE NEED FOR THE ENERGY EVOLUTION



Hydrocarbons ↓ | Need to decline at a rapid rate to meet Well Below 2°C ambitions.



Investment ↑ | Need public and private investment to fill in demand gaps with technology.



Collaboration ↑ | Global collaboration at levels never seen before.

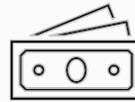


Government Intervention ↑ | Global government intervention at levels never seen before.

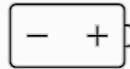
WHAT WE NEED TO CONSIDER ABOUT THE ENERGY EVOLUTION



Hydrocarbons ↓ | Lack of investment will cause price volatility and shocks to world economies.



Emissions ↓ | Efforts to reduce emissions require higher cost measures short term.



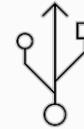
Storage ↑ | Industrial-scale storage key to reliability of grids throughout the electrification.



End-Use ↑ | Need to address the energy needs of transport, industry, & buildings.



Infrastructure ↑ | Redundant infrastructure and early abandonment of existing infrastructure is costly.



Digitalization ↑ | Digitalization of new and existing infrastructure and cybersecurity risk mitigation is costly.



Access ↑ | Need to address immediacy of access to electricity and clean cooking.



Financing ↑ | More financing for developing and emerging economies to address emissions.



Supply Diversification ↓ | Hydrocarbon production becomes more concentrated, making supply riskier.



Hydrocarbon Revenues ↓ | Hydrocarbon revenues decline, making resource-rich economies unstable.



Mining ↑ | Require more minerals, which are concentrated in fewer countries with weak ESG practices.



Workforce ↑↓ | Changes in energy mix will impact workers and communities differently.



THANK YOU!



Bernadette Johnson

GM, Power & Renewables

bjohnson@enverus.com

