METALS DERIVATIVES MARKETS AND THE ENERGY TRANSITION

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“More than anything, the energy transition is a Metals story.”

Introduction

On February 24, 2022, Russia—one of the world’s largest producers of nickel—invaded the Ukraine. Shortly thereafter, the price of nickel on the London Metals Exchange (LME) skyrocketed more than 270% over merely three trading days. At one point, the price of nickel exceeded $100,000 per ton. Then, on March 8, the LME—the global hub of industrial metals pricing, trading, and hedging—halted trading in nickel and did not resume nickel trading until March 16th. Stunningly, the exchange also cancelled $12...
billion of nickel trades. Jane Street Global Trading and Elliot Associates, firms on the losing end of the LME’s trade cancellation decision, quickly filed lawsuits. Financial regulators such as the Bank of England, the Financial Conduct Authority, and the Prudential Regulation Authority promptly launched reviews of the exchange’s actions. Not long after this nickel price surge, electric vehicle battery metals prices increased by fifty percent.

Many are likely aware of the potential impact of geopolitical risks facing oil and gas markets. However, fewer probably realize the considerably greater impact such risks could have on metals markets, especially because of the current geographic concentrations of many of these materials—as illustrated by the LME nickel fiasco—and, consequently, the implications of risks in metals markets for the United States as it shifts to an electrical energy future. As one economist commented: “[t]he impact of a stoppage of a major export metal, such as nickel or palladium, would cause an industrial recession in the Western world. Even when a certain share of a Russian metal import

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10 Id. See also Alistair Gray, LME Wins High Ct. ruling over cancelled nickel trades, FIN. TIMES (Nov. 29, 2023), https://perma.cc/M8NN-8QVM (noting that the LME recently prevailed in a “landmark legal victory”).
12 Paul Hockenos, How Russia’s War Is Putting Green Tech Progress in Jeopardy, YALE ENV’T 360 (June 16, 2022), https://perma.cc/L7FH-8JVE.
looks rather small, like copper for example, a complete cutoff would send
prices shooting up and world markets into turmoil.”  

Undoubtedly, the supply and availability of metals has assumed
utmost importance for countries around the world as they “race . . . to
electrify everything” from vehicles to lawnmowers. This push to electrify
life-critical parts of the global economy—such as transport, heating, and
industry—will require a significant increase in the production of metals,
including cobalt, lithium, copper, and graphite. For example, a typical electric
vehicle battery pack needs around 8 kilograms of lithium, 35 kilograms of
nickel, 20 kilograms of manganese, and 14 kilograms of cobalt. Solar panels
use large quantities of metals, including aluminum, copper, silicon, silver, and
zinc; and wind turbines require iron ore, copper, and aluminum.

Hence, the demand for metals essential to this transition is escalating
as is their status as a source of geopolitical power. Indeed, the U.S. has begun

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13 *Id.* (quoting Klaus-Jürgen Gern at the Kiel Institute for the World Economy in Germany).
15 See Minerals used in electric cars compared to conventional cars, INT’L ENERGY AGENCY (May 5, 2021), https://perma.cc/K8YH-9AGM (presenting a chart that breaks down the kilograms per vehicle of several minerals used by electric cars versus conventional cars).
efforts to stockpile these critical metals and is likely to be a “price taker” in this market for the foreseeable future. Some market participants caution against underestimating future demand growth for electricity given the transition to a clean energy future. A recent McKinsey report predicts severe shortages of metals essential to the energy transition for at least the next decade. In practice, the demand for these materials will likely ultimately be determined by a host of factors, including technological innovations, government policies, and supply/demand shocks. For example, the technology for both electric vehicle batteries and metals recycling has already evolved and is likely to continue doing so. Yet, global demand for metals encompasses more than just that related to clean energy production.


18 Livestream: Sept. 20, supra note 2 (explaining that countries which don’t have an abundance of minerals naturally within their borders and which import certain minerals are considered “price takers”).


20 Roland Rechtsteiner et al., The Future of Commodity Trading, MCKINSEY & CO. (Jan. 29, 2023), https://perma.cc/R3SY-P22D.

21 Livestream: Sept. 20, supra note 2.


While much attention has been placed on new energy sources themselves, much less has centered on the inputs, such as critical metals, necessary for this change. For example, some economists predict that today’s annual lithium consumption of 2,000 to 3,000 metric tons will need to increase to about 500,000 metric tons in the future to meet projected annual electric vehicle production of 100 million. Such considerations, coupled with concerns about supply chain risk, have resulted in major automakers entering direct supply contracts with miners. Major commodities companies such as Glencore, who now wants to be “the go-to metals transition company in the world,” are shifting out of fossil fuels and intensifying their focus on metals.

Fundamentally, the United States and the world are moving from their long-term dependence on the fossil fuels that built the modern world, to dependence on new commodities such as copper and lithium. Coal and then natural gas made the modern economy possible by providing heat,

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24 See Livestream: Sept. 20, supra note 2 (remarks of D. Shammann, CME Group).
27 Julie Steinberg, This Coal Giant Now Wants to Get Out of Coal, WALL ST. J. (Nov. 19, 2023), https://www.wsj.com/business/energy-oil/glencore-ceo-coal-exit-6d9f6b75.
power, and electricity to growing industries and populations in the world’s growing urban centers. Then oil made globalization possible by powering international sea and air travel, as well as overland vehicles. As electric vehicles increasingly displace fossil fuel vehicles and renewable energy sources increasingly replace fuels in heating and industry, the economic and geopolitical stakes of metals markets will grow higher and higher.

The criticality of metals derivatives markets, such as the dysfunctional market for nickel, will also escalate as governments, businesses, and others seek to hedge risks related to the increasing global dependency on metals. Hence, it is not surprising that the Commodity Futures Trading Commission (CFTC) Energy and Environmental Markets Advisory Committee (Committee) has recently dedicated a significant portion of its meetings to metals derivatives markets and their role in the transition to a clean energy future. It has also created a subcommittee, the Role of Metals Markets in Transitional Energy Subcommittee, to focus on this issue. In the U.S., the CFTC is the primary regulator of derivatives markets.29

However, despite their escalating importance, thus far, there has been minimal legal scholarship on metals derivatives markets. Given the key role of these markets in the transition to a clean energy future, increased focus on

these markets is imperative as the agendas for the Committee’s most recent meetings suggest. Our article heeds this implicit call to action. It makes at least two contributions. First, it expands the minimal analysis of metals derivatives markets in the legal scholarship. Indeed, to the best of the authors’ knowledge, this is the first law review article to focus primarily on these markets.\footnote{Saule T. Omarova, The Quiet Metamorphosis: How Derivatives Changed the “Business of Banking,” 63 U. Mia. L. REV. 1041 (2009) (In legal scholarship thus far, this article has the most references to metal derivatives). See, e.g., Baker, supra note 29; Paolo Saguato, Climate Risk and Financial Markets: The Case of Green Derivatives, GEO. MASON U. L. AND ECON. RSCH. PAPER 23–19 (Oct. 2023), https://perma.cc/2D7Y-2ZZG (examining derivatives and the energy transition generally).}

Second, it explores the role of metals derivatives in preparing for the transition to a clean energy future. We provide a brief overview of metals derivatives, including new markets in development, and their regulation in Parts I and II, respectively. In Part III, we explore the central role of metals derivatives markets in securing a clean energy future.

I. A Brief Look at Metals Derivatives Markets\footnote{For additional background on derivatives and their regulation, see Baker, supra note 29; DAVID MURPHY, DERIVATIVES REGULATION (2022); GARY E. KALBAUGH, DERIVATIVES LAW AND REGULATION (3rd ed. 2021); JOHN HULL, OPTIONS, FUTURES, AND OTHER DERIVATIVES (7th ed., 2009); Colleen M. Baker, Regulating the Invisible: The Case of Over-the-Counter Derivatives, 85 NOTRE DAME L. REV. 1287 (2010).}

Derivatives, financial instruments that derive their value from an underlying reference entity, comprise some of the world’s most consequential financial markets. The underlying reference entity can be
almost anything, including equities, credit, foreign exchange, commodities, the weather, or even another derivative. Derivatives provide an important price discovery mechanism and a critical risk mitigation tool.

These financial instruments trade on regulated exchanges (where they are standardized and known as futures and options) and in the interrelated over-the-counter markets (where they are bespoke and generally termed swaps). At the end of 2022, the national amounts for the exchange-traded and over-the-counter (OTC) derivatives markets were approximately $80.6 trillion\(^{32}\) and $618 trillion,\(^{33}\) respectively. Exchanges promote transparency and price discovery. Both markets provide crucial assurance to commodity producers that they will be paid for their future production and to commodity consumers that they will not face shortages. Both producers and consumers must have this confidence to build the new clean energy supply chains required for a clean energy transition. They provide opportunities for participants to hedge (manage risk), to speculate (make bets aimed at profiting from market price movements), and to arbitrage.\(^ {34}\) Derivatives enable “cost-effective hedging,” a critical capability in managing the risks

\(^{32}\) *Exchange-traded derivatives statistics*, BANK FOR INT’L SETTLEMENTS, https://perma.cc/M48D-9UG6 (the national amount outstanding of futures instruments was $36.5 trillion and of options instruments was $44.1 trillion).


\(^{34}\) See generally HULL, supra note 31.
associated with a transition to a clean energy future, such as price risk and the risk of technology and infrastructure investments.\textsuperscript{35}

Metals derivatives are a type of commodities derivative. Metals are extracted from minerals and exist in many varieties, including precious metals (such as gold), base metals (such as copper), ferrous metals (such as cobalt), and non-ferrous metals (such as nickel).\textsuperscript{36} Examples of metals derivatives contracts currently trading include gold, silver, copper, nickel, aluminum, lead, and zinc. Commodities markets tend to be volatile.\textsuperscript{37} The escalating demand for metals, in addition to considerations such as infrastructure challenges\textsuperscript{38} and geopolitical risks as illustrated by the nickel trading fiasco on the LME, is likely to add to the markets’ traditional volatility.\textsuperscript{39}

The increased use of a variety of metals as inputs to energy production will create a concomitant demand for derivatives products,

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\textsuperscript{35} Livestream: Nov. 13, supra note 19 (Presentation of Sharon Theodore of the Electric Power Supply Association, slide and remarks on “What Role the Derivatives Markets Play in Helping to Facilitate the Energy Expansion”).  
\textsuperscript{36} See Metals and Minerals, ICMM, https://perma.cc/H3SH-8QUF (last visited Nov. 19, 2023) (explaining some of the science regarding metals and minerals).  
\textsuperscript{38} Livestream: Nov. 13, supra note 19 (remarks of Tim Fitzgerald, Chair of the Energy and Env’t Mkts. Advisory Comm. (EEMAC) Physical Energy Infrastructure Subcommittee).  
\textsuperscript{39} See generally, Roland Rechsteiner et al., The Future of Commodity Trading, MCKINSEY & CO. (Jan. 29, 2023), https://perma.cc/U9S4-7W5F (projecting “increased susceptibility of [commodity] markets to both short- and long-term volatility and boom-and-bust”).
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including new ones. Indeed, as of June 2023, “metals” was “the fastest growing asset class” for CME Group.\textsuperscript{40} Examples of new metals derivatives products include lithium carbonate futures,\textsuperscript{41} cobalt hydroxide futures,\textsuperscript{42} and molybdenum oxide (Platts) futures.\textsuperscript{43} However, derivative markets do not currently exist for all critical metals.\textsuperscript{44} Metals derivatives markets develop over time and require a sufficiently robust spot (cash) market, and the market developmental generally includes a progression from forward contracts, to swaps, then futures, and eventually more complex products (for example, options and indexes).\textsuperscript{45}

However, a plethora of challenges confronts the development of metals derivatives.\textsuperscript{46} Indeed, some of the CME Group’s metals derivatives

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\item \textsuperscript{40} CFTC, Livestream: CFTC’s Energy and Environmental Markets Advisory Committee to Meet June 27, "\textsc{You\textsc{tube}}" (June 27, 2023), \url{https://www.youtube.com/watch?v=TsEZTxU6Rlg} [hereinafter \textsc{Livestream: June 27}].
\item \textsuperscript{41} Press Release, CME Grp., CME Group to Launch Lithium Carbonate Futures as Electric Vehicle Demand Surges (June 20, 2023), \url{https://perma.cc/C9F7-83JH}.
\item \textsuperscript{42} Press Release, CME Grp., CME Group to Launch Cobalt Hydroxide Futures on October 23 (Sept. 18, 2023), \url{https://perma.cc/8552-2C52}.
\item \textsuperscript{43} Press Release, CME Grp., CME Group Announces First Trades of Molybdenum Oxide (Platts) Futures (Mar. 14, 2023), \url{https://perma.cc/6UZV-5U7K}. See also Christy Goldsmith Romero, \textit{Statement of Commissioner Christy Goldsmith Romero: Keeping the Lights and Head on in America}, EEMAC (Nov. 13, 2023), \url{https://perma.cc/CX9Y-3SGL} (discussing how the derivative market can help protect the energy industry and consumers).
\item \textsuperscript{44} CFTC, Livestream: CFTC’s Energy and Environmental Markets Advisory Committee to Meet February 28, "\textsc{You\textsc{tube}}" (Feb. 28, 2023), \url{https://www.youtube.com/watch?v=eFX2hpCynzQ} (remarks of George Pullin, CFTC economist) [hereinafter Livestream: Feb. 28].
\item \textsuperscript{45} Presentation: CFTC’s Energy and Environmental Markets Advisory Committee to Meet February 28, CFTC at 85 (Feb. 28, 2023), \url{https://perma.cc/K5PR-PCZE} [hereinafter Presentation: Feb. 28].
\item \textsuperscript{46} Livestream: November 13, supra note 19 (remarks by Ian Lange, Chair of the EEMAC Role of Metals Markets in Transitional Energy Subcommittee).
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contracts took ten years to come to fruition.\textsuperscript{47} Minerals markets can also be small and trading limited.\textsuperscript{48} Questions also surround issues such as selection of the right product (mineral grade) for price discovery, mineral geopolitics, the disruptive demand potential of technological developments, the price impact of additional investment leading to increased supply, and relationships among U.S. and global markets.\textsuperscript{49}

Traditionally, metals derivatives markets were largely the province of commercial hedgers, but financial participants now increasingly constitute a substantial segment of these markets.\textsuperscript{50} Consequently, the financialization of these markets is also increasing.\textsuperscript{51} One example of this is the copper derivatives market.\textsuperscript{52}

Copper has been termed “the metal of electrification”\textsuperscript{53} and a “key component of the global energy transition.”\textsuperscript{54} It is used in electrical grid

\textsuperscript{47} Livestream: June 27, supra note 40 (remarks by Derek L. Sammann).
\textsuperscript{48} Livestream: November 13, supra note 19.
\textsuperscript{49} See id.
\textsuperscript{50} Livestream: June 27, supra note 40; Presentation: CFTC’s Energy and Environmental Markets Advisory Committee to Meet June 27, CFTC at 14 (June 27, 2023), https://perma.cc/A7X6-MYKP (remarks of Derek L. Sammann) [hereinafter Presentation: June 27].
\textsuperscript{51} See id. See generally Herbert Mayer et. al, Financialization of Metal Markets: Does Futures Trading Influence Spot Prices and Volatility, 53 RES. POL’Y 300 (2017) (discussing the financialization of the commodity trading market).
\textsuperscript{52} Livestream: June 27, supra note 40 (remarks by Derek L. Sammann); Presentation: June 27, supra note 50, at 13.
\textsuperscript{53} Daniel Yergin et al., Growing Appetite for Copper Threatens Energy Transition and Climate Goals, S&P GLOB. Mkt. INTEL. BLOG (Jul. 18, 2022), https://perma.cc/Z6FZ-BYGT (discussing the challenges surrounding the growing need for copper in the economy).
\textsuperscript{54} Presentation: June 27, supra note 50, at 3.
infrastructure, batteries, electric vehicles and more.\textsuperscript{55} For example, some estimate that electric vehicles can have about thirty times the copper requirements of a fuel combustion engine.\textsuperscript{56} Not surprisingly, financial derivatives contracts critical to the promotion of a clean energy future are copper futures and options.\textsuperscript{57} These instruments are traded on exchanges such as the CME Group’s COMEX Exchange.\textsuperscript{58} In fact, the global pricing of copper is increasingly occurring on derivatives exchanges in the U.S.\textsuperscript{59}

A copper future is merely a contract between a buyer who agrees to purchase a certain amount of copper at a future date for a fixed price from a seller who agrees to sell this amount of copper to the buyer at that future date for that fixed price. Copper futures contracts are highly beneficial products for copper producers and for those whose business operations depend upon copper because it enables them to manage the risk of fluctuations in the market price of copper. Speculators who bet on the direction of the market price of copper also buy copper futures, aspiring to profit from their directional bets. Copper futures contracts also contribute to

\textsuperscript{55} Yergin et al, \textit{supra} note 53.
\textsuperscript{56} Livestream: Sept. 20, \textit{supra} note 2 (remarks by Derek L. Sammann).
\textsuperscript{57} See Caroline D. Pham, Commissioner, CFTC, \textit{Opening Statement of Caroline D. Pham before the Energy \& Environmental Markets Advisory Committee} (June 27, 2023), https://perma.cc/ZC58-D9YZ.
\textsuperscript{59} Livestream: June 27, \textit{supra} note 40 (remarks of Derek L. Sammann).
price discovery in the copper spot market, ultimately impacting the totality of the copper value chain.60

Another example of a metals derivatives market critical in the energy transition is the nickel market. Currently, market participants are focused on improved price discovery for this market,61 likely prompted by the LME’s March 2022 nickel troubles described in the opening paragraph of this Article. Nickel is used in electric vehicle production and is increasingly used as a substitute for cobalt in batteries.62 This development illustrates the potential impact of technological innovations (substitution risk) on demand for a specific metal.63

In addition to metals derivatives, other categories of derivatives are also essential to the energy transition.64 In addition to metal price and availability risk, the production of electric vehicles faces several additional types of financial risks including interest rate, credit, and foreign exchange risk.65 For example, the wind power industry is currently experiencing many

60 Pham, supra note 57.
62 Livestream: Nov. 13, supra note 19.
64 See generally Baker, supra note 29 (discussing the role of derivatives in the energy transition).
65 Presentation: Feb. 28, supra note 45, at 84.
challenges, notably increased financing costs due to rising interest rates. Derivatives markets exist for hedging all types of financial risk. CFTC Commissioner Christy Goldsmith Romero explained that: “[w]ell-functioning derivatives markets can help manage risks of the major projects that states and utilities are pursuing to meet their goals of cleaner and more resilient power markets. Larger projects by states and companies, like offshore wind turbines, require borrowing over many years. The ability to use derivatives markets to hedge risks like changing interest rates will help project developers make investments with confidence.”

I. An Overview of Derivatives Regulation in the U.S.

In the U.S., the Commodity Futures Trading Commission (CFTC) regulates financial derivatives markets under the Commodity Exchange Act. Congress created the CFTC in the Commodity Futures Trading Commission Act of 1974. Its mission “is to promote the integrity, resilience, and vibrancy of the U.S. derivatives markets through sound regulation.”

66 See Elliot Smith, Wind Power Industry in Moment of Reckoning As Stocks Fall and Earnings Crumble, CNBC (Nov. 13, 2023), https://perma.cc/3NGM-RCU7.
67 Christy Goldsmith Romero, Comm’r, EEMAC, Statement of Commissioner Christy Goldsmith Romero: Keeping the Lights and Head on in America (Nov. 13, 2023), https://perma.cc/D6DY-DZSX.
68 See Baker, supra note 29.
70 The Commission, CFTC, https://perma.cc/93DK-WJFC.
71 Id. (noting that the Securities Exchange Commission has jurisdiction over a very narrow slice of the derivatives markets); see Digital and Digitalized Assets: Federal and State Jurisdictional
the helm of the CFTC, an independent federal agency, is a Chairman and four additional Commissioners. The CFTC also oversees the National Futures Association (NFA), a nonprofit self-regulatory organization (SRO) to whom most trading exchanges, themselves SROs, have delegated many of their regulatory responsibilities.

The CFTC has several advisory committees whose role is “to provide input and make recommendations to the Commission on a variety of regulatory and market issues that affect the integrity and competitiveness of U.S. derivatives markets. The committees facilitate communication between the Commission and U.S. derivatives markets, trading firms, market participants, and end users.” One such committee is the Energy and Environmental Markets Advisory Committee (EEMAC). It is “a statutorily mandated advisory committee, which conducts public meetings; submits reports and recommendations to the Commission… and otherwise serves as a vehicle for discussion and communication on matters of concern to

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72 Chairman & Commissioners, CFTC, https://perma.cc/V8LL-BYTR (last visited Feb. 8, 2024) (Rostin Behnam is the current Chairman and fellow Commissioners are Kristin N. Johnson, Christy Goldsmith Romero, Summer K. Mersinger, the current sponsor of the Energy & Environmental Markets Advisory Committee, and Caroline D. Pham).


74 Baker, supra note 29, at 749.

exchanges, firms, end users, and regulators regarding energy and environmental markets and their regulation by the Commission.”

The International Swaps and Derivatives Association (ISDA) is the industry association for the OTC derivatives markets, and, in essence, it is the “transnational private regulator” of these markets. “ISDA has over 1000 member institutions from [seventy-seven] countries. These members comprise a broad range of derivatives market participants, including corporations, investment managers, government and supranational entities, insurance companies, energy and commodities firms, and international and regional banks. In addition to market participants, members also include key components of the derivatives market infrastructure, such as exchanges, intermediaries, clearing houses and repositories, as well as law firms, accounting firms and other service providers.”

From September 2022 to November 2023, the Energy and Environmental Markets Advisory Committee (EEMAC) has held four meetings. In each, a significant portion of the agenda has focused on metals.

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78 Membership, ISDA, https://perma.cc/V8NL-9N8W (last visited Feb 8, 2024).
79 See Livestream: Sept. 20, supra note 2; Transcript: Feb. 28, supra note 14; Livestream: June 27, supra note 40; Livestream: Nov. 13, supra note 19.
markets.80 Indeed, this Article incorporates material from these meetings. The EEMAC has also formed two metals-related subcommittees: the Physical Energy Infrastructure Subcommittee and the Role of Metals Markets in Transitional Energy Subcommittee (Metals Subcommittee).81 The latter’s purpose is: “[t]o provide a report to the EEMAC that will examine the role of critical metals in transitional energy sources and their potential impact on derivatives markets.”82 As CFTC Commissioner Christy Romero Goldsmith succinctly explained, “[t]he metals markets are an important source of commodities and hedging opportunities for the U.S.’s historic investments in electric vehicles (‘EVs’) and batteries”83 and “investments [in metals] are encouraged by the ‘triple whammy’ of new laws—the Inflation Reduction Act (IRA), the Bipartisan Infrastructure Law (BIL) and the CHIPS and Science Act.”84

80 Livestream: Sept. 20, supra note 2; Transcript: Feb. 28, supra note 14; Livestream: June 27, supra note 40; Livestream: Nov. 13, supra note 19.
82 Presentation: June 27, supra note 50, at 31.
84 Id.
In sum, demand for metals, especially those essential to the energy transition such as cobalt, lithium, and copper, has escalated\(^85\) and is widely expected to continue increasing. In turn, the demand for metals derivatives—both existing and new products—should likewise increase to ensure continued management of price risk and to promote price discovery and investment in underlying markets. Given that metals are expected to be a linchpin of the U.S.’s future energy production, an important question is whether the current regulatory framework of metals derivatives markets is congruous with their increasing role in energy security.

II. The Crucial Role of Metals Markets in Building a New Energy System

If the United States hopes to spearhead a global shift from a fossil fuel economy to a low-carbon economy, it faces a huge challenge: the United States is by far the world’s leading producer of oil and gas\(^86\) but it is not in the world’s top ten producers of key metals such as cobalt and lithium\(^87\). And processing supply chains for these metals are dominated by China\(^88\). Thus,

\(^{85}\) See generally id.
\(^{88}\) Id.
building supply chains for the metals in the United States and other friendly
countries is a key priority for achieving a secure transition to cleaner energy
sources. Building these supply chains will require huge long-term financial
investments and financial innovation of the kind that metals’ derivatives
markets are uniquely suited to facilitate.

The scale of the challenge is nearly unfathomable. The Inflation
Reduction Act is now the centerpiece of the United States’ climate policy,\(^9\)
and it aims to fund two drastic shifts in the U.S. energy system: (1) a move
to electrify huge economic sectors such as transport and heating that now
rely on burning fossil fuels, and (2) a move to produce electricity from zero-
carbon sources including solar and wind power, backed up by batteries.\(^9\) The
Act authorizes $400 billion to $1 trillion in spending on clean energy—$3,000
to $8,000 per American household.\(^9\) Specifically, it provides funds for
electric vehicles, electric heaters, electric appliances, and electric industry to

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\(^9\) Coral Davenport & Lisa Friedman, *Five Decades in the Making: Why It Took Congress So Long


\(^9\) Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II
 ($391 billion); Budget Model, Senate-Passed Inflation Reduction Act: Estimates Of Budgetary And
 Macroeconomic Effects, PENN WHARTON U. OF PA (Aug. 12, 2022), https://perma.cc/JH2S-
 D2UY ($384.9 billion); Update: Budgetary Cost of Climate and energy provisions in the Inflation
 Reduction Act, PENN WHARTON U. OF PA. BUDGET MODEL (Apr. 27, 2023),
replace use of fossil fuels, and funds solar, wind, nuclear, hydrogen, and carbon capture to ensure the bulk of that electricity comes from carbon free sources.\textsuperscript{92}

These twin shifts have in common a dramatic expansion in the energy sector’s consumption of metals such as copper, cobalt, and lithium. Each electric vehicle will require a staggering amount of metal—far more than required by a gasoline vehicle. For example, the electric Hummer weighs almost 10,000 pounds, twice as much as a gasoline Hummer,\textsuperscript{93} primarily because of its massive battery, which weighs over 2,800 pounds, and includes over 300 pounds of lithium.\textsuperscript{94} Similarly, new electric appliances to heat homes, food, and water, will require large amounts of copper wiring.

Furthermore, providing huge surges of zero carbon electricity to drive these new cars and appliances will mean thousands upon thousands of new solar plants and wind power plants, demanding iron, copper, zinc, and

\textsuperscript{92} Bistline et al., \textit{supra} note 90.
\textsuperscript{93} Eric Stafford, \textit{2023 GMC Hummer EV SUT, CAR AND DRIVER}, https://perma.cc/9EVU-6DZ5(indicating that an electric Hummer weighs 9,640 pounds); 2010 Hummer H3 4WD 4dr Features and Specs, CAR AND DRIVER, https://perma.cc/MQ8D-HAVV (indicating that the most recent gasoline Hummer, the H3, weighs 4,696 pounds).
\textsuperscript{94} Dan Mihalascu, \textit{GMC Hummer EV Battery Teardown Reveals Excessive Complexity, Weight, INSIDE EVS} (May 22, 2023), https://perma.cc/FUS2-EQK8; Giles Parkinson, \textit{Your Model Y has $6,350 of lithium in its batteries, your Hummer has $17,000}, \textit{THE DRIVEN} (Dec. 2, 2022), https://perma.cc/TA3P-W58E. And yet, even with these giant batteries, electric vehicles still do not have the range of gasoline vehicles; they will need even bigger batteries as they seek to replace gasoline vehicles in applications that require long-distance travel.
rare earths such as neodymium. Production of minerals, such as graphite, lithium, and cobalt, may have to increase by nearly 500% by 2050 to meet the growing demand for clean energy technologies.

If the United States is not able to quickly find friendly sources for these minerals, it will face a harrowing choice between slowing the transition to low carbon energy and undercutting its own energy security. The United States has often taken for granted the geopolitical security that its dominance in oil production has provided. From 1901 to the turn of the 1970s, the United States’ was by far the world’s largest oil producer, which brought it industrial and military dominance, helping it win world wars and eventually emerge as the sole global superpower. When the Soviet Union and Middle Eastern powers surpassed its production in the 1970s, the U.S. keenly felt the resulting insecurity and economic malaise. With the dawn of fracking, the United States is again, by far the world’s largest producer of oil and gas and again can almost take for granted the unique geopolitical security that brings. As just one example, the United States’ incredible ramping output

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95 Kristen Hund et al., Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition, WORLD BANK GRP.  37 https://perma.cc/MQ76-Y6VU.
96 Id. at 73.
98 Id. at 408.
99 Id. at 418; see James W. Coleman, Rebuilding the Texas Railroad Commission, OIL, GAS & ENERGY L. J. (2022).
of liquefied natural gas exports helped Europe survive Russia’s efforts to starve the continent of natural gas during the winter of 2022-23.\textsuperscript{100}

Thus, the United States desperately needs new metal supply chains to maintain the geopolitical strength it has often taken for granted in the fossil fuel energy system. As of now, the United States is not a significant producer of many of the needed metals; metal processing mostly takes place in China, a geopolitical rival. The challenge for developing those supply chains is that mines are some of the world’s most challenging long-term capital investments, especially for free market economies.\textsuperscript{103} Capital markets often favor more liquid investments that do not require so many years, or even decades, to pay off.\textsuperscript{102} This challenge is further exacerbated by the growing number of permit delays for projects that, like mines, often require searching environmental reviews.\textsuperscript{103} Such delay has also grown more costly as interest rates have risen dramatically, exponentially increasing the cost of

\textsuperscript{100} Europe ended winter 2022–23 with the most natural gas in storage on record, U.S. ENERGY INFO. ADMIN. (May 8, 2023), https://perma.cc/9HQZ-ND7G.


\textsuperscript{102} Id.

delays and the cost to investors of sinking their money into long-term capital investments such as a mine.\textsuperscript{104}

This is where metals derivatives markets can play a crucial role in encouraging free world investment. Derivatives markets help producers hedge the risk they face when they must invest capital today in the hopes of meeting demand ten or twenty years in the future. Hedging risks can also encourage capital infusions from otherwise hesitant investors. And of course, consumers can also benefit from hedging their risks by locking in future prices for commodities that they will need as part of the new cleaner economy.

In addition to the increased supervision described above to facilitate the growth of metals derivatives markets, the government could also assist the liquidity, stability, and reliability of metals markets by facilitating metals storage. Derivatives markets in commodities have long had a symbiotic relationship with storage of those commodities—the cost of infrastructure for storage is often financed in partial reliance on derivatives markets and storage eases trade in commodity futures.\textsuperscript{105} Therefore, metals derivatives


markets might be bolstered by government-financed or provided storage of key metals for the energy transition as some policy analysts have recently recommended. More metal storage and the futures markets and hedging that it would encourage could be a key facilitator for investment in mining, processing, and the entire supply chain of metals to drive the low carbon energy transition.

III. Conclusion

The low carbon transition needs vast quantities of metal to drive the machines and electricity that will displace our fossil fuel economy. However, mines require huge capital investments that are challenging for the free market economies in the United States and its allies. The free world needs confidence in its metals markets to facilitate new metals supply chains and to drive the clean energy transition.