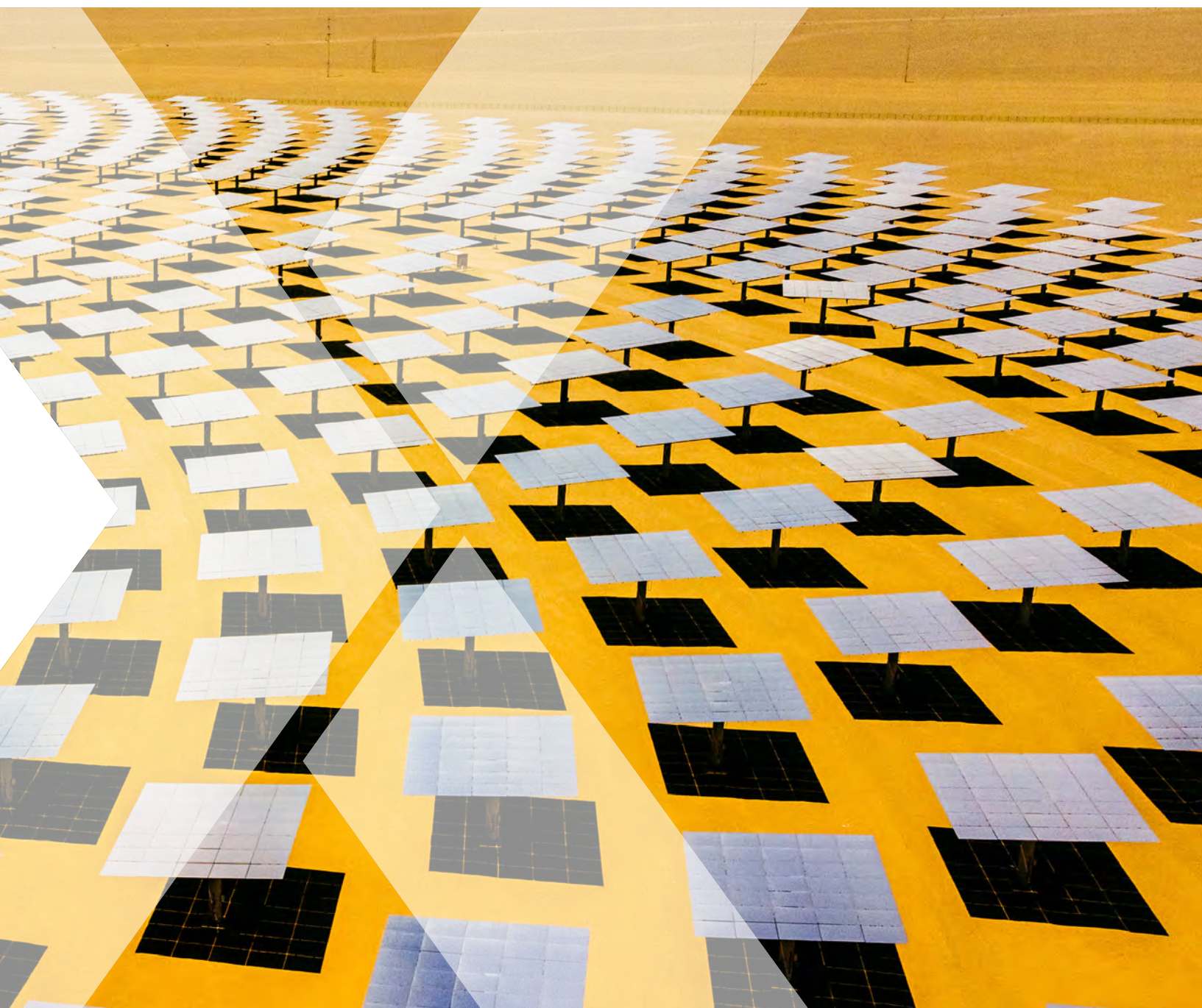
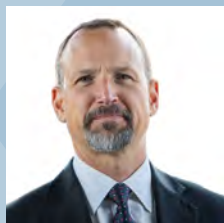


The transition will not be televised

Part 1 - Prospects for clean power in the US





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**“You will not be able to stay home,
brother. You will not be able to
plug in, turn on and cop out”**

Gil Scott-Heron (1971)

Introduction

We introduce this series with a homage to Gil Scott-Heron’s 1970’s classic, “The Revolution Will Not Be Televised.” Well before our own age of misinformation came his warning about the difficulty of gaining the meaning of current events from misleading mainstream narratives.

Today, there’s another societal transition simmering below the surface – the shift to cleaner energy and a more sustainable economy. And while the invasion of Ukraine propelled oil and gas markets back into the headlines, system pressure had been building for years. Now, more than ever, we see that long-term economic growth depends upon breaking the dependency on fossil fuels.

Here, we set out our views on drivers for an accelerated energy transition in North America. We focus in this first briefing on solar and wind power, technologies that are poised to take on material roles as suppliers of primary energy to the US economy.

Summary

- The drive to reduce carbon emissions is likely to generate a sharp rise in total electricity demand. We see wind and solar power poised to become heavyweights in the new digital upstream of the US energy sector.
- It won’t be all smooth sailing. Uncertainty about the expansion of high voltage transmission capacity, potential renewal of trade conflicts with China, the prospects for permitting reform, and industry adjustment to higher borrowing rates are concerns we’re monitoring.
- For the US to meet its net-zero goals, the transition to clean energy needs to happen more quickly. But it’s already moving faster than most people think.

Clean energy is already winning on price

The news has recently been filled with conflicting stories about the prospects for renewable power. One day, we read about concerns that projects have become too profitable. The next, major industry players have announced slowing orders and job losses. Investors can be forgiven for wondering if a new dawn for sustainable energy has arrived or whether dark days lie ahead.

Start with the fundamentals

Renewable power is the cheapest way to generate electricity in most regions and nearly every country in the world.¹ This is true in the US, even with its abundance of natural gas. Remove subsidies, tax credits and incentives, and new wind and solar power in the US can still be produced at less than half the cost of new electricity from natural gas or coal.²

But while renewable power is deep in the money for utility-scale projects, changes are not necessarily permanent. The gap could narrow from a host of tail risk events – for example, a collapse in US natural gas prices or sustained rise in polysilicon prices (a key contributor to cheaper solar panels).

The economic competitiveness of renewable power has been driven by relentless cost reductions. A 99% fall in solar PV module costs since the 1980s seems miraculous, but the root causes are no different than the miracle that's put the power of mainframe computing in our phones. First came advances in government R&D, then supportive economic policies, and finally economies of scale.³ The semiconductor industry is not done driving advances in smartphones. They're not done making energy smarter, either.

Project developers in America have taken notice

By the end of 2021, nearly 700 GW of prospective solar projects were waiting for grid connection across the US. That's more than 10 times the country's cumulative installed capacity to date.⁴ How much of this can get built? China meanwhile appears well on track to add more than 800 GW of new solar PV power stations in its current five-year planning period.⁵ That's more than US\$1 trillion of new investment on the ground by the end of 2025.

Gains in wind energy have been impressive, too. With a major innovation in Northern Europe now moving across the Atlantic, floating offshore wind platforms will open the US seaboard to new projects. Fixed seabed mounting had previously confined viable offshore wind projects to a small sliver of the Northeast US coast.

If there's one thing that's stayed the same about the renewables industry over the past few years, it's that growth keeps getting revised upward. Forecasters at the US Department of Energy (DOE) proved notoriously bad at estimating wind and solar penetration. Investors can't afford to make the same mistakes. In the US, the Inflation Reduction Act (IRA) is expected to double annual additions of new wind power over the next five years. Growth in solar generation is expected to be five times the previous pace.⁶

Renewables will get even cheaper

Renewables remain the only sources of energy proving themselves to be deflationary. But clean energy is not just disruptive because it's the technology of choice for new demand in the power sector. A further fall in prices should accelerate a profitable replacement of old generation capacity. At a smaller scale, cheaper solar PV modules will absorb the additional costs of installation on commercial and residential buildings, making it profitable to integrate solar tiles, glass, and facades. And then there's the ultimate prize: clean power that serves as the backbone of networks for synthesized fuels and clean energy carriers such as methanol, ammonia, and hydrogen.

1 International Renewable Energy Agency, 2022: Renewable Power Generation Costs in 2021

2 GS Sustain, October 2022: Green Capex: Accelerating the Energy Transition

3 Massachusetts Institute of Technology, 2018: Explaining the plummeting cost of solar power

4 Lawrence Berkeley National Laboratory, 2022: Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection



Overcoming obstacles to the energy transition

Transitions take time, although how long is a matter of considerable debate.⁷ A rapid energy transition faces many obstacles, including monopolistic market structures. But as the competitive pressures from clean power grow, barriers to competition will weaken. For the energy transition in North America, these are among the issues investors need to consider.

Electricity is part of a broader story

In the US, electricity accounts for only slightly more than one-third of primary energy consumption, but it has the clearest pathway to decarbonization.⁸ The economics of solar and wind make them obvious choices for new power generation.

The bigger question is how quickly other economic sectors can switch from hydrocarbons to electrons.

For all the focus on carbon emissions, they are a trailing indicator. Going forward, the rate at which the US economy is electrifying will become the telltale sign of the pace of transition.

The shift is already underway for new cars and homes. Electrification of heavy industry is further out on the horizon. Contrary to how it's often portrayed, technology is rarely the bottleneck.

Commodity prices matter, and so does their volatility

Too many studies about the competitiveness of renewables have taken a static view on the cost of coal, oil, and natural gas. As the last two years have demonstrated, they are anything but. In the US, the best utility-scale solar projects outcompete gas-fired power projects at natural gas prices below US\$2/MMBtu. The US spot price stood at almost US\$8/MMBtu at the end of September 2022.⁹

Given the ups and downs of fossil fuel prices, the cost advantage for renewables cannot be taken for

granted. Indeed, an economy that's having trouble adjusting to US\$100 oil seems to scarcely remember the extraordinary lows of just two years earlier.

Perhaps even more than elevated prices, it's the inherent volatility of fossil fuel prices that threatens the economy. Policymakers need to find a better way to tap the price stability offered by renewables.

We can deal with intermittency

Clean power is highly reliable and (mostly) intermittent. High reliability delivers a system benefit, but intermittency imposes a cost.

How high is this cost? Conclusions vary, depending on where you live. Integration is easy in regions with a lot of water, where it can be pumped uphill when it's sunny or windy for it to flow downhill for hydroelectric generation when it's not. Demand-side management, better forecasting and smart electric vehicle (EV) charging are some of the tools available in areas that are not so lucky. On the hardware side, the cost of load-shifting using battery storage has fallen dramatically, but it will never be a free lunch.

Achieving 100% renewable generation may sound exciting but ask any power system operator and they'll tell you that a boring target works better. Reducing the goal to having renewables make up 95% of the power system reduces system costs dramatically. By shaving off just that 5%, energy storage needs to deliver at US\$150/kWh.¹⁰ That's what lithium-ion batteries can do for four-hour load shifting today.¹¹

The US remains conflicted on energy

The recent legislative trifecta of the IRA, Infrastructure and Investment Jobs Act and the CHIPS & Science Act has generated enormous momentum for America's domestic clean energy industry. On the one hand, they provide immediate long-term incentives and provide a much-needed boost to domestic manufacturing. On the other, however, there remain long-standing tensions between climate policy, monetary policy, and trade policy. These are not going away any time soon.

5 Zhongtai Securities, 2022

6 Princeton University, August 2022: Rapid Energy Policy Evaluation and Analysis Toolkit

7 Please see Smil, V., 2021: Grand Transitions: How the Modern World Was Made

8 US Energy Information Agency, 2022

9 Henry Hub Natural Gas Spot Price

There remain long-standing tensions between climate policy, monetary policy, and trade policy. These are not going away any time soon.



As the world's leading energy producer, it's no surprise that American incentives are mostly designed to support supply. Tough challenges lay ahead in dealing with fossil-fuel demand and adjusting land use to solar and wind farms that require ten times as much land per unit of power generation as compared to coal or gas. Above all, to make political support sustainable in the context of strategic competition with China, the US will have to regain a lot of clean energy manufacturing from the world's second largest economy.

Debt capital markets must change their tune

Fossil fuels work much like the 'razor blade' business model. Consumers buy because the acquisition cost is low (cheap shaver) and ignore the escalating costs over time (expensive cartridges). Sustainable energy works in the opposite way. Whether its renewable power or energy efficiency, you can pay more upfront and save over time. In an inversion of the traditional energy model, there is high CAPEX (capital expenditure) but low OPEX (operating expenditure).

While renewable power projects lose some competitiveness when interest rates rise, the sharp monetary tightening will have repercussions for fossil fuels, too. Loose monetary policy is the central explanation for how US shale producers continued to survive the low-price environment of the last decade, despite their widespread failure to break-even on a per-barrel basis.¹²

Focus on payoffs from the transition

The amount of total spending required to achieve net zero will be at least US\$1 trillion per annum above firms' current plans.¹³ And while estimates of the true magnitude vary, the real question is whether these additional investments can be expected to deliver a financial benefit. Put another way, will the net present value (NPV) of clean energy work out to be positive or negative? According to recent research by the IMF, it's not even close.¹⁴ Just considering an early retirement of coal plants around the world, the shift to renewables would lead to an estimated cumulative net benefit of US\$78 trillion this century. It's something to keep in mind the next time you hear someone talk about the "cost" of moving to a better energy system.

10 Ziegler et al, 2019: Storage Requirements and Costs of Shaping Renewable Energy Toward Grid Decarbonization

11 Lazard, 2021: Levelized Cost of Storage Analysis Version 7.0

12 McKinsey & Company, 2019: Value over volume: Shale development in the era of cash

13 McKinsey Global Institute, 2022: The net-zero transition: What it would cost, what it could bring

Unlocking larger flows of capital

Central to concerns about the energy transition are where finance will come from and what the rates of return will be to capital providers. To look forward, it may be helpful to first look back.

What have been the historical returns on clean energy investing amongst publicly traded firms? Using a customized universe of listed clean energy and fossil fuel companies, the IEA documented investment returns over the period from 2010 to 2020. The result? On a one-year, five-year and 10-year basis, clean energy stocks outperformed in both absolute terms and on a risk-adjusted basis.¹⁵

These findings were consistent with work by financial researchers at the University of Chicago who divided US equities into ‘green’ and ‘brown’ assets and looked at their investment characteristics. Those with positive environmental characteristics outperformed.¹⁶ But with a nod to the mean-reverting tendencies on which traditional economics thrives, the authors speculated that it would be hard for these differentials to persist. And while the US oil and gas sector has indeed staged a broad recovery over the past two years, the market also seems to be passing its judgement on industry decline. Forward price-to-earnings (P/E) multiples have been cut in half compared to their historical averages.¹⁷

Of course, the most important question is not about what happened last year or even last week; it’s what expectations are forming about the future. On that count, we believe that something fundamental is changing.

The clean energy technology wave will shape industry cash flows and the cost of capital for years to come. It will not only affect energy markets but every industry on the planet.

While recent trends have been dismissed by some large incumbents, there’s a lesson from past technology waves that will surely apply to this one: value creation occurs as firms grow in stature. Equity markets are incredibly adept at sensing inflection points when new industries begin to steal growth from old ones. From communications to retailing, transitions tend to follow rates of exponential growth as they take hold.

In Europe, government intervention to shield consumers from fossil fuel price increases won’t work indefinitely. As rising interest rates force a re-think about fiscal discipline, capital markets find themselves at an inflection point. For investors committed to the transition, there is a range of policy developments that may push the balance further in their favor:

- **Fixing an unlevel playing field.** The US oil and gas sector benefits from a range of tax advantaged vehicles that sweeten the pot for US investors. These include energy-focused real estate investment trusts (REITs), master limited partnerships (MLPs) and royalty trusts. For MLPs alone, a market capitalization of more than US\$300 billion helps sustain funding to the industry.¹⁸ Their rules should be broadened to accommodate renewable power projects.
- **Tapping new sources of demand.** The shift from hydrocarbons to electrons implies a sustained uptick in demand for electricity. From road vehicles to home heating, we’re likely to see a step change in how – and how much – electricity the US economy uses. And it’s not just the need to reduce pollution; adapting to climate change will increase the need for air conditioning and irrigation, further increasing demand for electricity.
- **States succeeding with their decarbonization plans.** 25 states (including heavyweights like California and New York) have targets to reduce fossil fuel use. Political opposition in the remaining states may soften as they seek inward investment for clean tech manufacturing. As the employment benefits of an energy transition are recognized, a positive feedback loop on state-level economic policies could ensue.

¹⁴ IMF, 2022: The Great Carbon Arbitrage

¹⁵ IEA and the Centre for Climate Finance & Investment, 2021: Clean Energy Investing: Global Comparison of Investment Returns

¹⁶ Pastor et al, 2022: Dissecting Green Returns

¹⁷ Financial Times, 13 October 2022: Oil valuations: gushing cash flows are not being reinvested

¹⁸ Stock Market MBA, October 2022

- **Scaling domestic manufacturing.** Nearly US\$30 billion in new clean energy manufacturing investment has been announced in the US since the IRA came into law.¹⁹ Much more will be needed to reduce China's dominance. The country is now home to more than half of world's wind turbine manufacturing²⁰ and has more than 75% global market share in both polysilicon manufacturing and PV module production.²¹ Watch for 're-shoring' to play a significant role in future Congressional action on additional clean energy incentives.
- **Resolving transmission constraints.** The IRA is expected to cut atmospheric pollution by billions of metric tons over this decade. Modelling by researchers at Princeton has revealed that to make that happen, the electricity transmission build rate needs to more than double.²² Their work suggests that new transmission makes economic sense, but real-world obstacles remain —primarily, streamlining the approvals system.
- **Achieving permitting reform.** Wind and solar power projects (as well as the wires that connect them) require a scaffold of local, state, and national permits. There is broad consensus that reform of the federal process is needed, although debate is vociferous on what should be included. Senator Manchin's withdrawal of the draft Energy Independence and Security Act,

which would have reduced barriers to approval for transmission projects (in September 2022), reflected how much Democrats and Republicans have to work out before a successful vote. Expect the issue to be taken back up shortly after the US mid-term elections.

- **Don't forget about carbon pricing.** For the foreseeable future, cap-and-trade is off the federal agenda in the US. This will inevitably constrain further development of state and Canadian provincial-level systems. As Europe is finding in its complex debate over a carbon border adjustment mechanism (CBAM), it's challenging to resolve large differentials between trading partners. It's not just taxes that matter, but the entire policy and regulatory landscape. On that score, the implied cost of emitting carbon in the US has moved up sharply in recent years. The Biden Administration's aim is for it to reach US\$51 per metric ton and continue upward. The State of New York has already set its benchmark at US\$125.



As rising interest rates force a re-think about fiscal discipline, capital markets find themselves at an inflection point.

19 Forbes, 12 October 2022: \$28 Billion In New Clean Energy Manufacturing Investments Announced Since Inflation Reduction Act Passed

20 Global Wind Energy Council, 2022

21 Rysted Energy, 2022: Solar Supply Chain Whitepaper

22 Princeton University, August 2022: Rapid Energy Policy Evaluation and Analysis Toolkit



Realizing the transformational potential

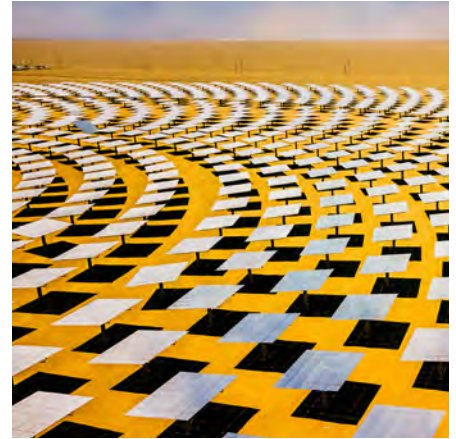
Capital markets must adapt to the new direction in energy. The rate of new wind and solar power project installations will need to run at double-digit annual growth rates over the next 15 years for the US to come anywhere close to achieving its national objectives. Some see it as too tall a task. Ironically, most of the oil and gas industry once said fracking would never work either.

We remain optimistic. The energy industry has been a source of innovation for decades. Clean energy is now marrying its industrial skills with a tech mindset. Whether it's bifacial modules or advanced materials in solar, bigger turbines or offshore rigs in wind, the profit motive will be a catalyst for huge changes in the years ahead.

For the industry to reach its true potential, however, the financial plumbing needs fixing. Our international financial system was designed to help move massive volumes of US dollar-denominated hydrocarbons all around the world. It has succeeded. The next step is to adapt a global system built for oil to the needs of a multi-regional system powered by electricity. The financial architecture needed for net zero will be of increasing focus for Impax's policy and advocacy work.

Coming soon

In our next update, we'll explore the prospects for a broad range of new energy technologies. Some sit along solar and wind in the digital upstream, while others are found further down in the value chain. How do these technologies fit in the emerging transition narrative in the US? Where do they fit in the spectrum of investment risk and return? We'll address these questions and more in our next issue.



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