Inflation Reduction Act 2022

And its effects on clean energy technology

September 2022

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The Inflation Reduction Act of 2022 supports approximately a $369B investment in energy security and climate change efforts, benefiting clean energy generation, storage and manufacturing solutions

The Inflation Reduction Act of 2022 (IRA), signed in August 2022, represents the most significant climate legislation in U.S. history and addresses emissions from many fronts, including tech-neutral tax credits for net-zero GHG energy production, supporting carbon capture and battery storage, and growing green hydrogen subsidies

Provision (non-exhaustive)	Impact
Tech-neutral producer (PTC) and investment (ITC) tax credits providing investment to carbon-neutral energy generation	Expected to continue support of traditional (solar and wind) investments, but in 2025, will provide funding for all carbon-neutral energy production
Increased spending on **green hydrogen subsidies of up to $3/kg** (with lower tiers for less sustainable production) and hydrogen distribution	Increased commercial appeal of green hydrogen relative to substitutes and bias investment away from legacy methods (blue/gray)
12-year **increase in carbon-capture credits** with the rate depending on the method of capture/storage	Drive investment in carbon-capture technologies due to near break-even cost levels; an additional 80-85mmt of CO2 removal is expected
~$60B for U.S. clean energy manufacturing, including tax credits, grants and loans to support solar, wind, EVs, batteries and other green technology	Expansion of onshoring for key clean energy technologies, including battery, solar and wind turbine manufacturing
$7,500 **tax credit continuation for U.S.-manufactured EVs** under ~$55,000	Incentivized expansion of EVs from U.S. car makers that produce lower-cost models (e.g., Tesla, Ford and GM)
Extension of a 30% federal tax break for rooftop solar installations, expansion of the tax break to home battery systems and rebates for green appliances	Solidify demand for residential solar, expand adoption of home battery solutions and support green development
The rule provides **new taxes on O&G production**, including a methane production/emissions fee and a royalty increase for federal land leasing	In aggregate, these rules represent modest hurdles for O&G producers that are unlikely to limit fossil fuel production in the near/medium term
Methane-related **equipment upgrade funding,** and **renewed on- and off-shore federal leasing** sales	Methane emissions rules are unlikely to have a significant effect given previous state regulations, actions by large producers and subsidies to support equipment upgrades

Source: L.E.K. research and analysis

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The 2022 IRA provides support for a broad range of energy technologies and serves to accelerate the energy transition toward more sustainable production

Technologies supported

Energy transition

- Solar
- Wind
- Biomass
- Fuel cells
- Clean hydrogen (H_2)
- Combined heat + power
- Waste energy recovery
- Clean or zero-emissions generation
- Landfill gas
- Sustainable aviation fuel
- Energy storage
- Alternative/ bio-fuels
- Marine/ hydrokinetic
- Geothermal
- Hydropower
- Zero-emissions nuclear
- Small and microturbine

Oil and gas

- Carbon capture
- Pipeline concessions
- Emissions incentives
- New drilling sites
- Pollution monitoring

Other

- Environmental justice
- Fire-resistant forests
- Conserve/restore coastal habitats
- Sustainable agriculture

Inflation Reduction Act

- The Inflation Reduction Act of 2022 (IRA) is legislation signed into law August 2022 that addresses climate, healthcare and tax reform in a coordinated effort to combat inflation by simultaneously bringing down energy and healthcare costs, and bringing down the national deficit
- The IRA modifies/extends existing energy tax credits, creates new tax credits and directs funding to the Department of Energy for programmatic efforts addressing energy rebates, energy efficiency in buildings, electric transmission, and more
- The IRA aims to reduce U.S. carbon emissions by 40% and cut pollution in half by 2030, as well as position the U.S. to reach net-zero emissions by no later than 2050

Source: Forbes, U.S. Senate

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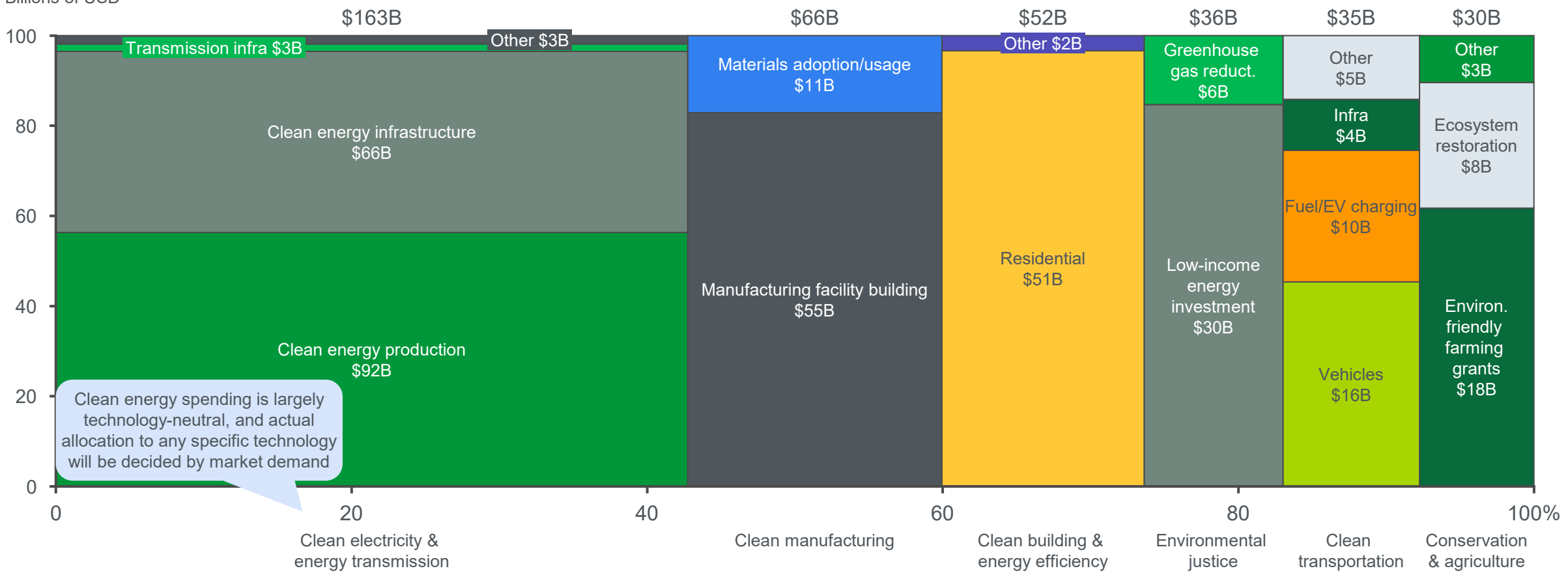
The Inflation Reduction Act includes more than $350B in spending, tax credits, and grants for climate-related initiatives; clean energy production makes up the highest portion of spend

Inflation Reduction Act climate spending plan, by category
(2022-31E)
Billions of USD



Source: White House; Congressional Progressive Caucus Center; Holland & Knight; L.E.K. research and analysis

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The IRA applies through the end of 2032 for most clean technologies; fuel legislation will be phased out in the next 2-4 years

Note: New programs and incentives in IRA take effect Jan. 1, 2023, unless specified otherwise
Source: Bipartisan Policy Center, U.S. Congress

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Policy approaches that incentivize increased production, transmission and storage of clean energy, and that incentivize reduced energy costs, include financial and nonfinancial support levers

Policy approaches

Tax credits

- New and enhanced production and investment tax credits decrease LCOE 10%-60% based on the respective renewable energy technology and its energy produced
- With incentives on both existing and emerging renewables, investors and developers have long-term certainty to build out clean electricity and transmission in the U.S.

Loans

- The IRA provides ~$70B in additional funds to the Department of Energy Loan Programs Office, which oversees disbursing loans to technologies
- Loan terms can vary; for example, for transmission facility financing, loans that have an interest rate based on market conditions are not allowed to exceed a certain term (~30 years) and cannot exceed 80% of project costs

Direct spending

- The IRA also outlines direct spending and grant programs overseen by the Department of Energy and EPA
- Programs help reduce emissions on existing energy projects (e.g., at oil and gas plants) and help consumers with installations of clean energy components

Other/ non-financial

- Change in tax deduction amounts, allowing businesses to reduce their taxable income
- Reinstatement of financing rate of excise taxes to disincentivize fossil fuels use
- Modification of oil and gas leasing provisions (e.g., increasing minimum royalty rates for oil and gas land leases)
- Bonus incentives to low-income communities for both residential and infrastructure installations of clean energy

 Source: L.E.K. research and analysis

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The Inflation Reduction Act is largely technology-neutral for zero greenhouse-gas energy production, and spending is determined by market demand

Starting in 2025, the IRA's ITCs and PTCs are technology-neutral, which means that investment and production tax credits can be received for any energy sources that generate clean energy and have zero greenhouse emissions regardless of source

Key Implications

The IRA does not allocate spending by technology and instead aims to distribute spending and grants across technologies; in this way, the market (and not the government) will decide which energy technologies "win" and receive the most funding

Both legacy and new renewable energy solutions will benefit from similar tax credit programs; incremental tax credits will be provided to projects that are placed in service after 2024 and meet the domestically manufactured requirement

Clean hydrogen is one exception to the technology-neutral program and has a special $3/kg production credit for hydrogen produced using renewable energy

In practice, **the already-commercialized scale technologies such as solar and wind will receive the bulk of the funding** from the IRA because they are mature technologies with developed markets and high volumes of production and planned investment

Source: L.E.K. research and analysis

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Subsidies have been made available to support land and technology that support the energy transition

	Technology impacted		Key Impact
Core renewables	• Solar • Wind • Energy storage	• Zero-emission nuclear • Hydropower	• Bolsters expansion of core renewables with new tax credits and extensions of existing tax credits to 2032 (e.g., ITC, PTC) for residential and commercial applications • **Extends long-standing reliance on solar and wind, and supports expanded nuclear production**
Emerging energy technology	• Geothermal • Fuel cells	• Clean hydrogen • Small and micro turbines	• Supports emerging technologies with new tax credits and extensions of existing tax credits (e.g., ITC, PTC), and expands ITC for geothermal and some fuel cells to 30% (from 10%) • Establishes a new tax credit to support clean hydrogen production • Compounded by potential multipliers associated with domestic production, and may combine benefits of ITC and PTC • **Supports meaningful expansion of the hydrogen economy, and bolsters geothermal**
Decarbon-ization	• Carbon capture	• Combined heat & power (CHP)	• Expands amount of credit for carbon capture and sequestration, and reduces threshold for qualifying facilities, enabling more facilities to apply • Extends deadline for construction start to 2032 for carbon capture • Expands ITC for CHP to 30% (from 10%) • **Reduced threshold will encourage more facilities to engage, while reducing barriers to entry**
Alternative fuels	• Biodiesel • Sustainable aviation fuel • Landfill gas	• Waste recovery energy • Biomass	• Extends tax credits for alternative fuels to the end of 2024 • New tax credit for sustainable aviation fuel, to sunset in 2024 • Expands to 30% (from 10%) ITC for facilities that convert biomass to methane for commercial use • **Reduces barrier to entry for biomass conversion, though short timelines for fuel tax credits (alternative and sustainable aviation fuels) may limit impact**
Emissions reduction	• Power, industry, transport, carbon removal	• Methane	• Funding provided to EPA to monitor and penalize methane emissions • **Lower emissions are expected across power, industry, transport and carbon removal due to increased monitoring and the mix-shift to clean energy sources**

 Source: L.E.K. research and analysis

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The IRA offers tax credits for renewable energy sources that make them more cost-effective and commercially viable in the long term

Technology	Commercial maturity	Impact on attractiveness	Relative advantages	Relative disadvantages
Green hydrogen			• High subsidies for green hydrogen leading to increased cost competitiveness	• Low subsidies on legacy, less-sustainable hydrogen solutions leading to reduced commercial attractiveness
Emerging renewables (Geothermal, biofuel, biomass, synthetic fuel, etc.)			• Investment and production-based tax credits for geothermal and biomass technologies are extended for projects beginning construction before 2025, which would serve to increase the number of projects in the respective sectors • Tax credits support the domestic production of biofuels, and to build the infrastructure needed for sustainable aviation fuel and other biofuels	• ITCs and PTCs related to geothermal projects have historically had frequent cycles of expirations and extensions that require several years from assessment to final commissioning; this could slow developments in the sector
Wind			• Tax credits for installing onshore wind farms will likely lead to increased energy capacity and rapid growth in investments in the space • ITCs will go from 26% to 30%, making it more cost-effective to install wind farms	• Supply chain bottlenecks may slow the development of offshore wind farms, resulting in slow energy generation capacity growth beyond existing forecasts
Solar			• Tax incentives for installing solar panels may lead to increased energy capacity that will grow expenditure in the space • ITCs will go from 26% to 30%, making it more cost-effective to install solar panels domestically and commercially	• Full effect of incentives will not be realized until 2024, as the sector is still recovering from backlogs and the anti-dumping and countervailing investigation into Southeast Asian panel imports

The bill increases the commercial attractiveness of green technologies and modestly hampers O&G production with increased taxes and emissions requirements

Technology	Commercial maturity	Impact on attractiveness	Relative advantages	Relative disadvantages
Battery storage/ production			• Battery and energy storage solutions sourced and manufactured in the U.S. will receive tax credits • The U.S.-based lithium-ion battery cell supply chain will experience end-to-end growth as tax incentives could expand jobs in the sector and promote more energy storage solutions	• The eligibility for installation and production-based tax credits for energy storage are complex, and the ITC can range from 30% to 60% depending on specific rules; this can affect the level of investment that companies put into energy storage solutions
Electric vehicles			• Electric vehicles assembled in the U.S. that are valued below $55K (or SUVs/vans under ~$80K) qualify for a $7.5K tax credit and used EV qualify for a $4K tax credit • Purchasers of medium and heavy electric trucks qualify for a $40K tax credit; electric trucks that weigh 14K lbs. or less qualify for a $7.5K tax credit	• Electric vehicles that are not manufactured in the U.S. or are valued above $55K do not qualify for any tax credits • Electric vehicles that qualify for tax credits are expected to have a portion of battery components manufactured in the U.S.
Carbon capture			• Tax incentives make it more lucrative to participate in projects that capture carbon from polluting sources as $60-$85 can be earned per metric ton of CO2 • The bill also supports “direct air capture” that removes CO2 that has already been emitted into the atmosphere	• Carbon capture systems are energy-intensive and require power plants to operate, which may create a new source of carbon pollution, undermining the goal of the technology • Power plant owners may face pressure to pursue carbon capture projects even when it is not financially viable
O&G			• The IRA provides beneficial provisions for offshore and onshore lease sales by making them a prerequisite for renewable energy leases • ~$1.5B of funding allocated to upgrade facilities to lower methane emissions • Carbon capture funding helps subsidize emissions improvements for legacy fossil fuel technologies	• Introduction of methane emissions fees that apply to a small subset of the O&G industry and are likely to have a limited effect on most large players • Federal leasing rates are to increase from 12.5% to a maximum rate of 18.75%

Five major themes for investors are a green hydrogen production boom, green manufacturing acceleration, renewable energy investment, advanced technology support and low-carbon fuel development

Theme	Description	Investment areas	
Growth in green hydrogen production	• $3/kg green hydrogen subsidy and lower operating costs expected to drive commercial viability • Lower tiers of funding for blue hydrogen	• Electrolysis components • Hydrogen fuel stations • Renewable energy for hydrogen production	• Hydrogen storage facilities • Hydrogen fuel cell production
Green technology/ battery storage manufacturing	• ~$60B in funding to spur U.S. green energy manufacturing and expand battery storage production	• Onshore battery storage supply chain • Solar cell production	• Wind turbine componentry • EV components
Renewables development	• Green energy developments, particularly solar and wind power projects, expected to see strong investment	• Solar and wind EPCs • Solar and wind transmission and distribution	• Solar and wind electrical services
Advanced technologies	• Research into nuclear fusion, modular HALEU nuclear fission and deep geothermal technologies • Advances in carbon capture technologies, including smaller scale and direct-air devices	• Nuclear fusion development • Ultra-deep-well geothermal • Carbon capture	• HALEU nuclear development • Modular nuclear facilities
Acceleration in alternative fuels, including for aviation	• ~$500M to support the development of biofuel infrastructure • New tax credits for sustainable aviation fuels (SAF) and related infrastructure • Increased investment in low-carbon fuel infrastructure	• SAF fuel production • Biofuel infrastructure • Low-carbon transportation fuel production and distribution	• SAF fuel and low-emission aircraft technology research

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The IRA failed to include several measures to streamline project permitting, did not provide strong support for raw materials acquisition and politicians urge it is not aggressive enough on climate change

Omissions/limitations	Description
Streamlined energy project legislation	While both Democratic leaders in Congress and the White House have publicly claimed alignment on a comprehensive permitting reform deal that would set maximum review timelines and statutes of limitations for court challenges of energy projects, including renewables and O&G, the IRA does not put these changes into law
Support for acquiring raw materials needed for EV batteries	The IRA increasingly puts pressure on automakers through tax credits to localize raw materials in North America or trade agreement critical minerals without providing support to do so
Limited climate resilience spending	No spending in the IRA is allocated to reinforcing or rebuilding buildings/infrastructure affected by climate-related natural disasters
Climate-change specific considerations	The IRA largely ignores measures **directly** tied to greenhouse gas emissions targets (e.g., Paris Accords) and does not regulate fossil fuel emissions or add any carbon tax to industrial emitters

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After the passage of the IRA, questions remain about the relative attractiveness of competing technologies and which new developments can successfully spur further innovation

Topic	Continuing areas to monitor
Investment 	• Within mobility, how does the future proliferation of hydrogen or low carbon fuels compare to battery storage? • For energy production, how will new investment balance within the primary legacy renewables (solar, wind, etc.) change? • How will the IRA affect investment in the broad universe of emerging alternative energies (modular nuclear, geothermal, etc.)? • Given new IRA subsidies, which parts of the value chain become the most attractive (e.g., equipment supply, installation, MRO, transmission and distribution)?
Technology 	• How well will emerging technologies (e.g., nuclear fusion, HALEU modular fission, ultra-deep-well geothermal) meet technical and commercial needs, and what are their respective timelines for widespread adoption? • As each technology continues to scale and new advances are made, will any technologies see faster-than-expected declines in LCOE?
Implementation 	• How quickly can the U.S. government mobilize and deploy funding, including grants, loans, etc. to aid development of new technologies, promote environmental justice and support key projects? • How will future administrations adjust the IRA to address policy goals (e.g., meet Paris Climate Accord obligations) and how will these changes affect investor thinking?

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Impact of the Inflation Reduction Act on hydrogen

Impact overview

Hydrogen

- Investment in facilities that produce hydrogen for power production, industrial applications and heavy transportation
- Multiple tax benefits are presented for hydrogen production, storage and utilization
- Limited

Stated policy changes / incentives

Credit/ incentive	Current policy	IRA – new policy	Comments/limitations
PTC	n/a	Clean hydrogen projects (emissions below 4 kg of CO2 per kg of hydrogen)	4 tiers of carbon intensity and corresponding credits up to $3/kg/H2; facilities must begin construction before 2033
ITC	n/a	Clean hydrogen projects (emissions below 4 kg of CO2 per kg of hydrogen)	30% credit similar to other technologies
Hydrogen fuel cell vehicle incentive	Currently expired	Extended through 2032	Credit is up to $7,500 per vehicle

Economic impact and technological competitiveness

- Electrolysis-produced hydrogen (green hydrogen): $5.5/kg without IRA; $2.5/kg with IRA
- Natural gas- or coal-generated hydrogen (blue hydrogen): $1.7-$2.4/kg without IRA; $0.7-$1.4/kg with IRA

Implications

- The IRA would provide hydrogen solutions a strong financial backing to play a key role in the renewable energy transition
- Clean hydrogen production is better distinguished from legacy methods to ensure limited greenhouse gas emissions

Source: JD Supra; National Law Review; Resources for the Future; Evolved Energy Research; National HydroPower Association; Bipartisan Policy Center; Vinson & Elkins; U.S. Dept of Energy; Utility Dive; PV Magazine; Wind Exchange; The Wall Street Journal; CNBC; Energy Storage News; Time.com; Center of American Experiment; Rhodium Group; L.E.K. research and analysis

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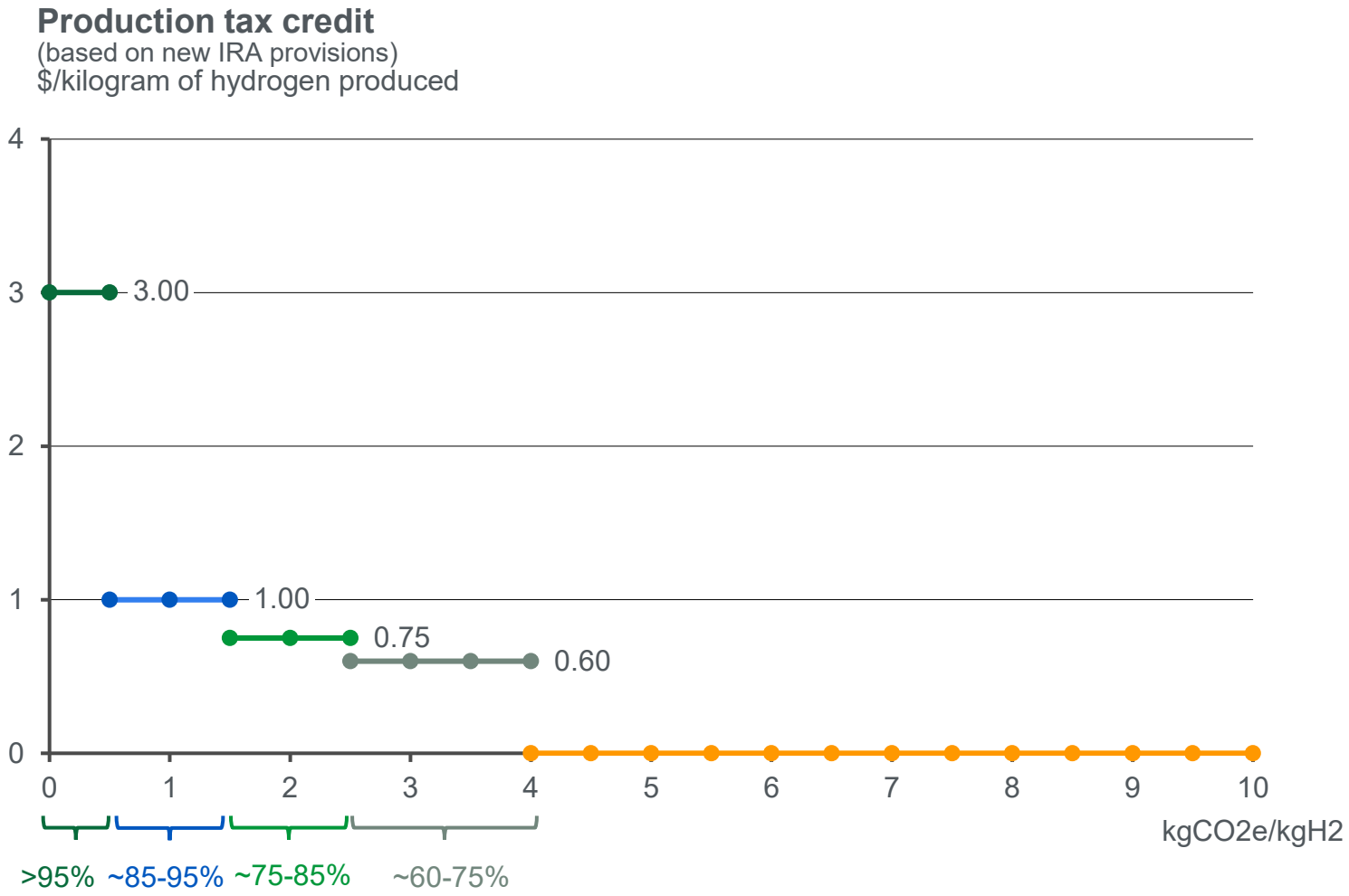
The IRA's new production tax credit, based on a sliding scale, incentivizes the use of clean hydrogen and is expected to significantly increase the use of green hydrogen, in particular



- The PTC is eligible for "clean hydrogen," any hydrogen source that delivers at minimum ~60% GHG reduction relative to gray hydrogen
- The credit follows a sliding scale – the higher the GHG reductions, the higher the credit
- Based on current and projected technology, green hydrogen (or pink hydrogen produced by emissions-free nuclear power) is the only type of energy that can qualify for the $3/kg credit
  - As a result, green hydrogen is poised to compete closely with gray hydrogen in some places in the U.S. and in most places by 2030

Source: Natural Resources Defense Council; L.E.K. research and analysis

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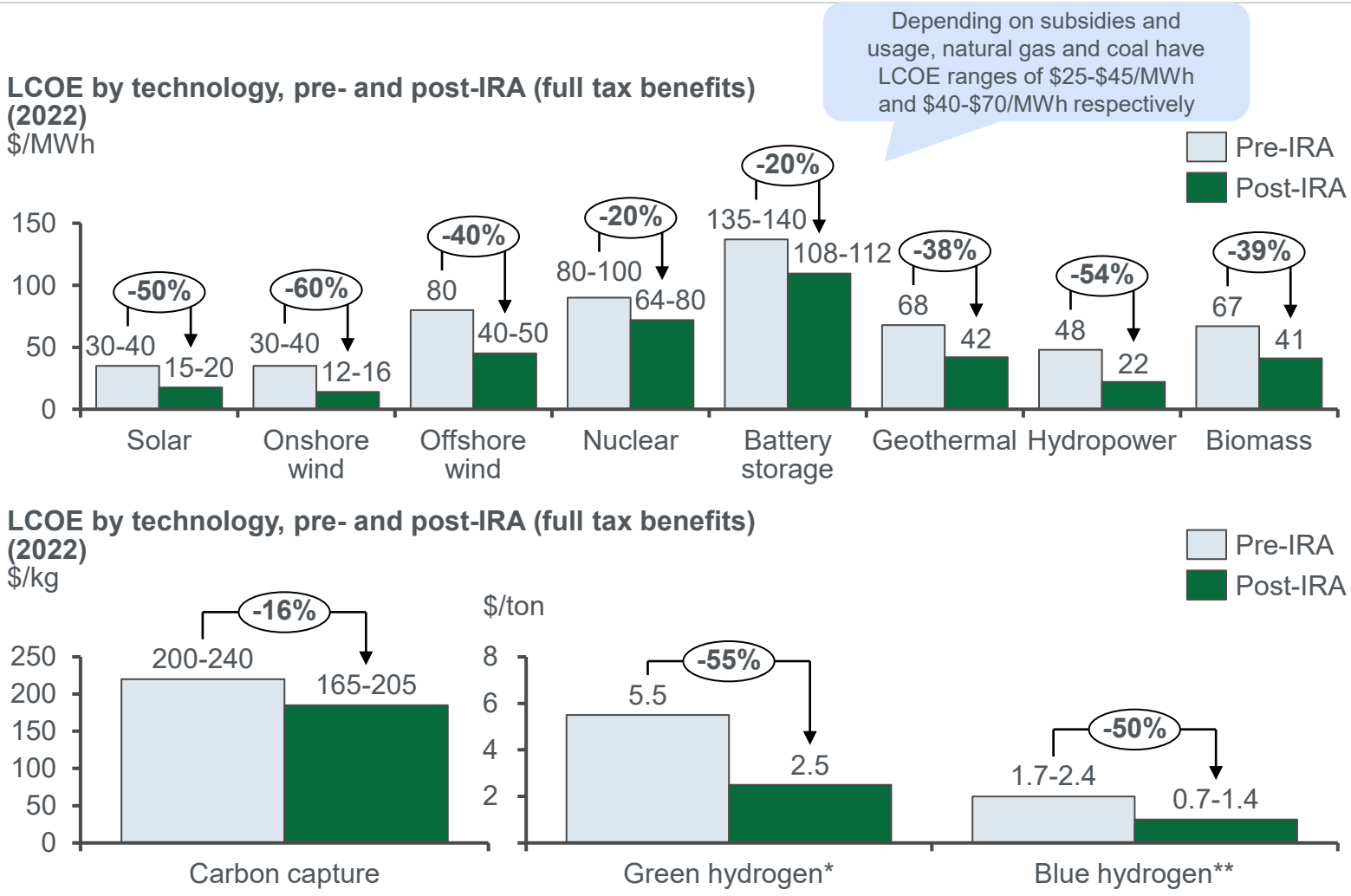
While green hydrogen is not cost competitive today, declines in production and transport costs are expected to drive cost competitiveness in the near term

Outlook for hydrogen economics and demand evolution

- Today, green hydrogen is 2-4x more expensive than natural gas and coal, similar to the 3-4x cost discrepancy for solar PV in 2009
- Production costs are expected to decline 40% from $4-8/kg to $2-3/kg from 2020 to 2030
  - The most significant factors in expected production declines are electrolyzer efficiency (rising from 50%-60% in 2020 to 70%-80% by 2030) and declines in renewable energy input costs, which are expected to continue to fall 2%-3% p.a. through 2030
- Transport/distribution challenges also exist for hydrogen (due to its low temperature and density), which vary by hydrogen application, but costs are expected to decline 60% from 2020 to 2030
  - As green hydrogen production costs decrease, key industrial use cases (e.g., industry feedstock, energy transport) are expected to overcome cost barriers and drive initial adoption of green hydrogen more broadly in the short term
  - Other applications that have higher transportation costs (e.g., mobility) are expected to adopt green hydrogen in the longer term due to scaled investments in downstream production and improvements in distribution technology and infrastructure
- Overall, hydrogen costs (production and transportation costs) are expected to rapidly improve as the technology spreads out across applications, with cost decline moderation as the market matures, akin to the cost evolution of solar PV
  - Solar PV costs have declined ~35% over the past 5 years with solar now representing an alternative source of power that is on par with more traditional sources (e.g., coal, gas, wind)

Source: L.E.K. research and analysis

With full use of the outlined tax benefits, onshore wind, green hydrogen and hydropower stand to benefit most from the IRA



- Onshore wind stands to benefit most from the enhanced tax incentives in the IRA and can lower in levelized cost by up to 60%
- With full tax incentives, solar, onshore wind and hydropower can all reach lower LCOE than natural gas plants
- The incentives for carbon capture bring the technology closer to cost competitiveness; it needs to reach $85-140/kg to be competitive
- While the maximum IRA subsidy would lower the LCOE of green hydrogen by 55%, an ~40% decrease would make the cost of green hydrogen competitive for use in heat and power, trucking, and passenger vehicles

*Green hydrogen assumes emissions are less than 0.45 kg CO2/kg hydrogen and prevailing wage and apprenticeship requirements are met
**Blue hydrogen assumes emissions are between 0.45 and 1.45 kg CO2/kg hydrogen and prevailing wage and apprenticeship requirements are met
Source: International Renewable Energy Agency; Rhodium Group; EIA; WECS Renewables; JD Supra; Lazard; L.E.K. research and analysis

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Glossary of key terms (1 of 2)

Term	Definition
Advanced manufacturing production tax credit	A new production credit created by the IRA for eligible solar, wind, battery and mineral components that are produced domestically and sold to an unrelated third party.
Blue hydrogen	Derived from natural gas with a process of steam methane reforming (where natural gas is mixed with very hot steam and a catalyst) and considered carbon-neutral if the CO2 emissions are captured and stored underground. Considered a clean hydrogen.
Clean energy infrastructure	The IRA has allocated spending for building and operating clean energy infrastructure, which includes building and installing new energy assets (e.g., power plants, wind farms).
Clean energy production	The IRA has allocated spending for the generation of clean (wind, solar, nuclear) energy with negligible GHG emissions.
Combined heat and power (CHP)	The simultaneous generation of electrical or mechanical power and useful thermal energy from a single fuel source. Uses thermal energy that would have gone to waste, increasing the fuel efficiency of the fuel source while reducing GHG. Also known as cogeneration.
Fuel cell	A device that generates energy through an electrochemical reaction of hydrogen and oxygen rather than combustion. Does not need to be recharged like batteries and can instead produce electricity as long as a fuel source is provided. Considered clean, efficient and reliable.
Green hydrogen	Derived from the separation of water into hydrogen and oxygen using electrolysis powered from renewable sources (e.g., wind, water, solar) and does not emit CO2. Considered a clean hydrogen.
Gray hydrogen	Derived from natural gas, with its production resulting in the emission of CO2.
Greenhouse gas (GHG)	A gas such as CO2 or methane that is known to absorb and trap heat and thereby increase global warming.
Hydropower energy	Uses the natural flow of falling or fast-running water to generate electricity, often utilizing elevation difference created by a dam or diversion structure.
Hydrokinetic energy	Uses the movement of a body of water (e.g., earth's tides, waves, ocean currents and free-flowing rivers).

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Glossary of key terms (2 of 2)

Term	Definition
Investment tax credit (ITC)	Provides a direct tax rebate of a certain percentage of the investment in qualifying renewable projects.
Levelized cost of energy (LCOE)	A measure of the average net present cost of electricity generation for a generator over its lifetime. Used to assess and compare different methods of energy production on a consistent basis.
Low carbon fuel	Substitutes for traditional fossil fuels (i.e., gasoline and diesel) that meet the Low Carbon Fuel Standard, an emissions trading rule designed to reduce average carbon intensity of transportation fuels. Primary examples include biofuels, biodiesel and natural gas.
mmt	Million metric tons
Production tax credit (PTC)	Provides a tax rebate based on the amount of energy a producer generates; the IRA provides PTCs for renewable energies such as wind, solar and nuclear power.
Sustainable aviation fuel	A biofuel produced from sustainable feedstocks (e.g., cooking oil, forestry waste, algae, solid waste from homes and businesses) that has chemical properties similar to conventional jet fuel but with a smaller carbon footprint. SAF can reduce up to 80% of carbon emissions over the life cycle of the fuel compared to the traditional jet fuel it replaces.
Synthetic fuel	An artificially produced liquid or gaseous fuel that is not derived from naturally occurring crude oil. Used as an alternative to conventional gasoline or diesel. Sources can include coal, shale oil, tar sands or biomass.
Transmission and distribution (T&D)	T&D refers to the transportation of energy from generators/producers to homes and businesses. In the case of electricity, transmission involves higher voltages and longer distances, while distribution refers to lower voltage, shorter distances delivering power to homes/businesses. Similarly, in the case of liquid/gaseous fuels, transmission generally refers to higher volume, longer-distance transportation, while distribution involves shorter distances and volumes delivering fuel to end users.

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