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The Importance of Carbon Intensity and Compliance to Meet Decarbonization Goals

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Determining a product's carbon intensity is the first step in understanding the value of that product and taking advantage of the carbon markets and carbon credits available to companies today.

The long road to net-zero carbon emissions is necessarily a collaborative effort between policymakers, industry, and consumers (Figure 1). To achieve this broad and ambitious goal, it will take considerable time to develop a framework for stakeholders to adopt. The U.S. Clean Air Act began reducing greenhouse gas emissions decades ago and opened the way for future environmental initiatives, and with each proposal came further refinement of the tools needed to measure and report emissions.

With regulations often changing, it is likely that many stakeholders take a forward look at the carbon markets and forget how much progress has already been made. The names involved in some of the most important milestones may sound somewhat anachronistic; remember, California's Low Carbon Fuel Standard was signed into law by Governor Arnold Schwarzenegger and the Renewable Fuel Standard was signed into law by President George W. Bush. This era of incremental progress included the Kyoto Protocol, which created a carbon emissions trading market; and the Paris Agreement in 2015, which, after the readmission of the U.S., covers over 98% of human emissions and marked

the strongest global commitment to net-zero carbon emissions. California's Low Carbon Fuel Standard in particular can be considered an environmental policy juggernaut. This program puts a price on altruistic commitments, and that price hinges on two important details for anyone in the transportation fuel supply chain that wants to participate in the program: carbon intensity (CI) and compliance.

Reducing the CI, or decarbonizing, the global supply chain will require bigger partnerships between investors, manufacturers, and shippers. Nearly everyone in the supply chain will have to be involved because everyone will be auditable for their contribution to a final product's CI. "Responsibility" in this context will account for more than direct emissions. Consider the breadth of those responsibilities involved in the following emissions:

- Scope 1 emissions are direct greenhouse gas emissions that occur from sources that are controlled or owned by an organization (*e.g.*, emissions associated with fuel combustion in boilers, furnaces, vehicles).
- Scope 2 emissions are indirect greenhouse gas emissions associated with the purchase of electricity, steam,



heat, or cooling.

- Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain like business travel, water, and waste treatment.

With responsibilities covering the entire supply chain, there are now new drivers for decarbonization solutions. Industry financials and progress are no longer driven by simple economic principles like supply and demand. Customers, industry, and governments are pushing for increased sustainability and circularity. Carbon-neutral and net-zero carbon pledges have proliferated within company messages. Thousands of companies have committed to net-zero targets, but different baselines, methodologies, and calculations often make the results of these commitments murky.

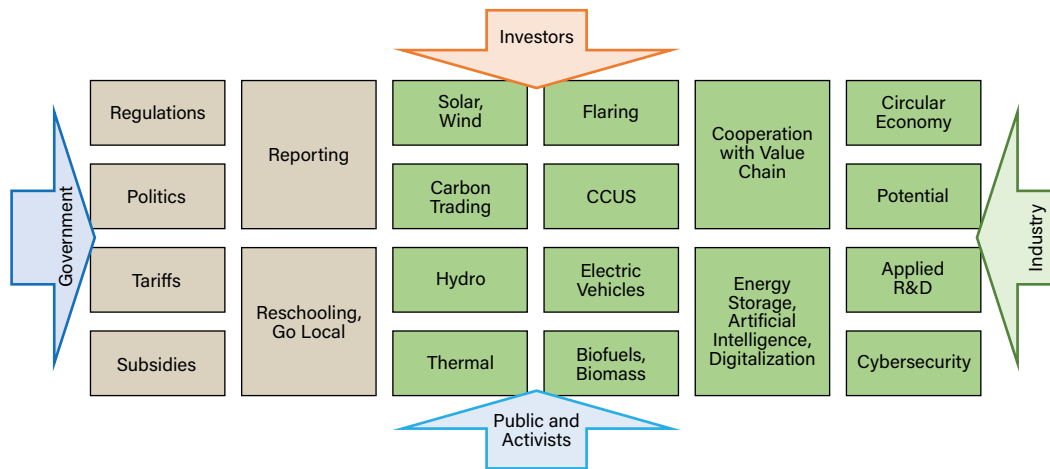
Carbon markets

The global energy market is transforming rapidly as billions of dollars move toward carbon markets and low-carbon fuel production. Refiners can take advantage of government incentive programs including the U.S. Inflation Reduction Act. In addition, companies producing low-carbon material might also take advantage of corporate procurement policies and voluntary programs — and, they may even profit from

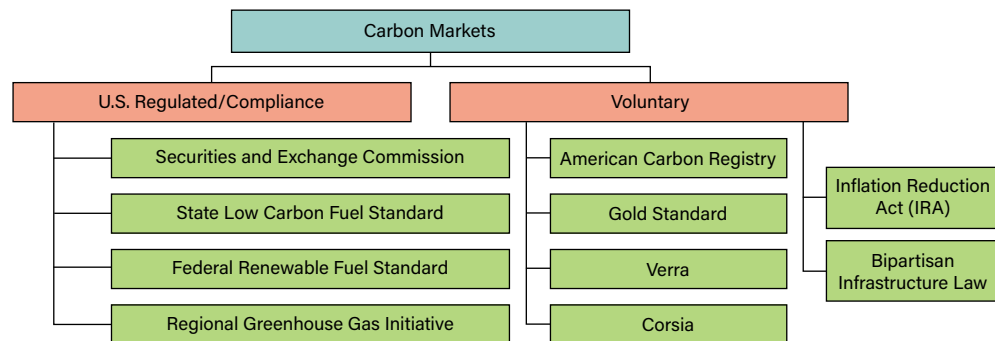
these programs. With the goal of achieving the highest value of their carbon avoidance, companies should be aware of the protocols and standards set by regulatory bodies and by the registry they join (Figure 2). Compliance is key in all these markets, and companies must ensure the accuracy and validity of their data.

In the U.S., the federal renewable fuel standard, various state-level clean fuel regulations, various cap-and-trade programs, the Inflation Reduction Act, and the U.S. Environmental Protection Agency’s (EPA’s) Renewable Fuel Standard have provided large sums of money for projects that reduce carbon. In addition, the U.S. Bipartisan Infrastructure Law has allocated billions of dollars for carbon sequestration efforts. For businesses to be eligible for this funding and to receive credits, they need to have a good target CI score and understand the guidelines to participate. It’s important for companies to remember that if they do not comply with all these regulations, they cannot monetize their investment sourced from the regulations.

With these credits and incentives comes a responsibility to accurately determine CI. CI is the lifecycle emissions impact of producing a fuel, for example, standardized to grams of carbon dioxide equivalent per megajoule or kilograms of the fuel. It is important to understand the impact



◀ **Figure 1.** Achieving net-zero carbon emissions will require collaborative work between government, industry, citizens, and investors. There is no simple solution to achieving “net zero.” Instead, a complicated framework involving policy, technology, and cross-cutting initiatives will be necessary.



◀ **Figure 2.** A vast network of carbon markets — both regulated and voluntary — has surfaced over the past two decades. Certain regulations have implemented carbon credits, cap-and-trade programs, and incentives for low carbon technologies like wind, solar, and carbon capture. Companies must be aware of the protocols and compliance standards set by regulatory bodies to take advantage of these programs.

that the production pathway CI score has on capital projects driven by decarbonization targets set by the U.S. government or downstream customers.

As corporations large and small around the world pledge to reduce carbon emissions, monetizing their carbon reduction is becoming an increasingly important part of their overall company strategies. The two main ways to monetize carbon are via the regulated and voluntary carbon markets.

Regulated carbon market

Many refiners are transforming from traditional hydrocarbon businesses to renewable fuels factories. With that transformation comes an abundance of new terminology and rules that are vital to understand to ensure return on investment (ROI). To participate in the U.S. federal and state renewable fuel programs, fuel suppliers to the U.S. market have to follow the compliance guidelines, including calculations and validations of CI scores, traceability of feedstock, and proper documentation, as well as reporting standards.

The regulated market is typically focused on fuels production and has been in existence since lead was taken out of fuels. This market is heavily regulated, and greenhouse gas reduction measurements are mandated by U.S. federal regulation on a volumetric basis, with minimum thresholds of greenhouse gas reduction.

Voluntary carbon market

While regulated markets are by-and-large focused on transportation fuels, how can non-fuel-related companies meet decarbonization pledges? In short, they can reduce their Scope 1, 2, and 3 emissions and consider entering the voluntary carbon markets to purchase offsets.

As the name implies, voluntary carbon markets are optional. Offsets created by reforestation, for example, are available for purchase. Voluntary markets are driven by renewable energy and forestry programs, although more diversification is on the horizon, including farming practices, carbon sequestration, waste diversion, and landfill projects. These projects are often global.

We've heard many corporate climate commitments lately. With steady policy adoption and guidance in the U.S., industry can now formulate long-term strategies and woo investment to capture some of the new drivers of business: taxes, credits, and incentives. In this leg of the race to decarbonization, we have available two new incentives: the \$350 billion Bipartisan Infrastructure Law and the \$391 billion Inflation Reduction Act.

Online retailer and rocket-launching entertainment company Amazon represents how big the commitments can be. A short list of their strategies to become net zero by 2040 include recycled steel; lighter packaging; decarbonized shipping; purchase of 100,000 electric vehicles; solar projects

in South Africa, United Arab Emirates (UAE), Singapore, Japan, Australia, and China; offshore wind in Europe; three million packages delivered by bikes; and so on. Other companies have pledged reductions as well:

- FedEx: Carbon-neutral by 2040
- Unilever: Carbon-neutral by 2030, replace fossil-fuel-derived carbon with renewables or recycled carbon in laundry products by 2030
- Cemex: Net zero by 2050
- Lululemon: 75% sustainable materials, 60% reduction in greenhouse gases by 2030
- Dow: Reduce net annual carbon emissions by five million tons (15% reduction) by 2030, carbon-neutral by 2050
- McDonald's: 36% reduction of greenhouse gases and 31% reduction in CI by 2030, net zero by 2050
- Maersk: Net zero by 2040
- Sasol: 100% of energy to chemicals to be from renewables by 2030, net zero by 2050.

In 2021, the voluntary carbon market grew at a record pace, reaching \$2 billion — four times its value in 2020 — and the pace of purchases was still accelerating in 2022. By 2030, the voluntary carbon market is expected to reach between \$10–40 billion.

Often the target of environmental angst, the plastics industry is making progress in the voluntary market. Increasingly, targets are set by government and industry toward reusable, recyclable, or compostable products. Understanding the financial opportunity at stake, the plastics industry is making huge investments in designing packaging, collection, sorting, infrastructure, and technology using biomass.

Credible carbon reduction

To take advantage of carbon markets, companies must determine the CI score for their business or product. CI scores calculate the environmental aspects and potential impacts associated with a product, process, or service. Consistent lifecycle assessment methodologies, with clear assumptions and calculations, help compare technologies and identify drivers for environmental improvements. A reliable lifecycle assessment will be objective and it will include a view of the entire supply chain as well as mass and energy balances. In short, to calculate a CI, an organization must be able to measure carbon emissions throughout a product's

Table 1. A major oil and gas company published their carbon-reduction targets, most of which are based on carbon intensity (CI).

Segment	Goal
Corporate-wide	20–30% reduction in CI
Upstream	40–50% reduction in CI
Methane	70–80% reduction in methane intensity
Flaring	60–70% reduction in flaring intensity



lifecycle. Increasingly, we see companies publish their targets based on CI score reductions. For example, Table 1 shows a major oil and gas company's carbon reduction goals, many of which are based on CI.

Know your CI score

Knowing your CI score throughout the supply chain is essential to earning credits and benefitting from your carbon reduction activities. It is also essential that this is measured by or conforms to recognized models with clear assumptions and a well-defined approach. To be considered for tax credits through the Inflation Reduction Act, proper CI scores will also have to be provided. Some tax credits included in the Inflation Reduction Act include:

- 45V: Hydrogen Production Tax Credit. This tax credit is worth \$0.60–3.00 per kg of hydrogen produced and is dependent on a CI of less than 0.4 kg CO₂ per kg of H₂. In addition, the company must meet prevailing wage and apprenticeship requirements.

- 45Y: The Clean Electricity Production Tax Credit. This is a tax credit for the production of clean electricity, for facilities that have a 25% reduction in greenhouse gas emissions from 2022.

- 45Z: Clean Fuel Production Credit. This tax credit can be taken by producers who make fuels with a CI of less than 50 kg CO₂ equivalent per million Btu.

- 45Z: Sustainable Aviation Fuel Credit. For those who produce sustainable aviation fuels, this tax credit goes up to \$1.25/gal, depending on the CI.

Additionally, California is driving the shift to cleaner fuel sources by requiring all fuel entering the state to report its CI. Refiners are producing renewable diesel from used cooking oil, tallow, canola, and virgin vegetable oils, and using renewable natural gas and hydrogen to reduce the

CI of their product mix delivered to California. Likewise, electric cars are using electricity generated from renewable sources in western states to receive Low Carbon Fuel Standard carbon credits. Some renewable natural gas achieves a –700 CI score. Since 2011, California has seen a continuous increase in the supply of biofuels, such as renewable natural gas and renewable diesel, into their fuel pool. This shift is allowing for the displacement of traditional fuels and products with products having better CI scores.

To adapt to the changing energy paradigm, refiners need to determine the CI of the entire process and refining outputs — from feedstock to high-value products such as renewable gasoline and renewable diesel. They also need to focus on optimization of their supply chains.

This can be seen in the example of a refiner producing renewable diesel from used cooking oil. The U.S. EPA requires all the obligated parties to identify the restaurants that provided used cooking oil, as well as restaurant locations, volume of oil provided, and date of collection. With 70 aggregators and 2,000 restaurants supplying used cooking oil in a refiner scenario, the EPA requires 140,000 datapoints to be collected and verified in order to generate valid Renewable Identification Number (RIN) credits for the renewable diesel. Failure to comply with these requirements can mean denial of RIN credits or invalid CI calculation and disqualification from selling in the U.S. market. As the energy sector continues to expand, it is essential for refiners to be aware of the importance of their CI score and all the compliance requirements to ensure continued success.

Monetizing carbon reduction: Compliance

Companies can minimize risk by knowing their CI score. A company's reputation is more important than ever, as news travels fast these days (Figure 3). Thus,

◀ **Figure 3.** In past incidents where a company reported inaccurate carbon intensity (CI) or Renewable Identification Number (RIN) metrics, the media was swift to cover these transgressions, leading to reputational damage, fines, and penalties for these companies, among other negative consequences.

reporting an incorrect CI can have detrimental effects to a company's reputation. Reporting inaccurate information to state and federal agencies can also have serious legal and financial ramifications.

Credit stacking. While the federal government has implemented the Renewable Fuel Standard to categorize fuels based on the amount of greenhouse gases they reduce, California has gone a step further. California has set a goal of reducing carbon emissions by 20% by 2030; this goal may increase to 25%, 30%, or 35% by 2030, and may even target 90% reductions by 2045 compared to the base year of 2020.

In response, refiners have become increasingly creative in their pursuit of low-carbon renewable fuels that offer increased credits and meet the targets set by the government. Renewable natural gas and renewable diesel have become popular options in California, and recent investments by major oil and gas companies such as BP suggest the trend is likely to continue.

As refiners across the U.S. seek new ways of meeting the industry's growing demand for low-carbon products, the "stacking" of various incentives is proving to be an effective strategy. A refiner that sells their fuel in a state that offers low-carbon fuels incentives — *i.e.*, California, Washington, or Oregon — can combine the normal market energy value with a \$1/gal blenders' tax credit and a cap-and-trade cost. They will benefit from their RIN's value under the federal program. This is also supplemented by the Low Carbon Fuel Standard (LCFS), which offers an additional 0.4 cents/gal per CI point for renewable diesel. At large refineries, this can equate to a daily revenue of roughly \$5 million.

The Inflation Reduction Act will support the development and commercialization of new technologies that can support the industry to further reduce carbon emissions and CI score. These technologies include:

- carbon capture and storage (CCS)
- carbon capture, utilization, and storage (CCUS)
- direct air capture (DAC)
- e-fuel production.

Captured CO₂ can be stored underground or used for various industrial applications. For example, captured CO₂ can be used to upgrade gray hydrogen to lower-CI blue hydrogen. E-fuels technology combines CO₂ capture with hydrogen produced by solar or wind power electrolysis to produce extremely low-CI synthetic fuels.

These technologies can provide new ways to reduce greenhouse gas emissions and create new carbon credits that can be traded on the voluntary market. Additionally, with the rise of renewable power generation, new carbon credits can be generated from sources such as wind and solar that are replacing traditional fossil fuel sources.

Ultimately, the stacking of incentives is proving to be an effective way for refiners and other industrial players to reduce emissions and meet their financial goals. The challenge now lies in finding new ways to continue this trend and ensure that the government's emissions targets are met within the allotted timeframe.

Knowing your CI score is the most important part of monetizing your decarbonization efforts. Understanding the regulations, as well as the voluntary carbon markets, is essential. With the ever-changing regulatory landscape, the many new feedstocks, and the plethora of new process technologies in various stages of technological readiness, it is often difficult for refiners to keep up, so finding experienced market experts and compliance consultants to help can be key to gaining the maximum benefit from tax credits and carbon markets.

Finish line

Thousands of companies throughout the supply chain have made commitments to net-zero targets. All of these companies and their suppliers will need to reduce their carbon footprint as well as buy and retire credits to meet their climate commitments.

When completing strategic planning, the two most important questions to ask are: Does this have the climate impact that we think it does? And, is there an equal positive impact on the climate compared to the negative impact that our company had on the climate? Asking those foundational questions will reveal that carbon removal is likely going to be an important component of the future when it comes to corporate climate commitments.

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