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## Generating Credits Under California’s Low Carbon Fuel Standard (LCFS)

Carbonomics®, a leader in helping businesses realize the potential of emission reduction credits in the US and international markets, was asked by PowerTap Hydrogen Fueling Corporation to provide a brief memo to PowerTap on California’s Low Carbon Fuel Standard (LCFS).

### *LCFS Program*

Of all the emission trading markets around the world, the LCFS market may be the most unique, reflecting California’s commitment to greenhouse gas reductions. The LCFS program, established in 2009, was one of the first to focus solely on the transport sector – the hardest sector to de-carbonize. In a nutshell, the state’s program requires the main fuel suppliers to reduce the carbon intensity of their fuels by 10% by 2020 – from a 2010 baseline. The program was extended to require a further reduction of 10% by 2030 – thus, a 20% reduction. This is measured in grams of CO<sub>2</sub> (gCO<sub>2</sub>) emitted per megajoule (MJ) of fuel. The current baseline for gas and diesel is approximately 92-93 gCO<sub>2</sub>/MJ, which drops each year, and any fuel supplied to the state and put into motor vehicles that has life cycle emissions less than the baseline can generate what are called LCFS credits. Based on weekly volumes, the value of the market transactions in 2020 totaled \$3.1 billion and we expect volumes to increase each year. In 2021, the total number of credits traded were approximately 15.2 million credits (<https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm>).

### *LCFS Credit Pricing*

The market demand for these credits have been increasing since the start of the program because the baseline ratchets down every year, yet it is particularly challenging to reduce the carbon intensity of the conventional fuel mix. Below shows the gradual increase in LCFS credit prices over time, which have hovered around \$200 for the last two years. The unit for an LCFS credit is a ton of CO<sub>2</sub> equivalent reduced.

Low Carbon Fuel Standard credit price (Jan 2013 - Sep 2018)  
U.S. dollars per metric ton of carbon dioxide equivalent



eia Source: Argus Media

When a company like Chevron or Valero is working toward meeting their annual LCFS target, they rely in large part on the purchase of LCFS credits. These credits can be generated from electrical vehicle charging, biogas (for CNG vehicles), ethanol, other biofuels, and hydrogen.

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***Hydrogen Refueling Infrastructure (HRI) Credits***

Hydrogen fueling posed an interesting challenge for California regulators because of the current “chicken-and-egg” aspect of the alternative fuel, but the resultant program works in the favor of PowerTap. Consumers will not buy hydrogen vehicles until there is a more robust fueling infrastructure in place. But there will not be more fueling stations until there are more hydrogen cars that use them.

So, the regulators who oversee the LCFS program at the California Air Resources Board (CARB) created the Hydrogen Refueling Infrastructure (HRI) credit in 2019, which allows LCFS credits to be issued simply if the hydrogen capacity were installed, even if no hydrogen were dispensed. The theory is that once the stations are in place, more consumers will buy hydrogen cars and the use of these stations will rise. This leads to two types of credits – the capacity or HRI credit and the more traditional LCFS credit, which is based on the amount of fuel that goes into vehicles. As the station begins to dispense hydrogen, the proportion of HRI credits goes down and the number of “dispensing” credits goes up, generally keeping revenues stable.

To get HRI credits, CARB has a clear process in place, which involves an application to ARB and building stations that meet specific criteria (i.e., the station must be open to the public, be available to all drivers, allow all major credit cards, have confirmation from three OEMs that their customers can use the station, and other criteria that we are exceedingly confident can be met). The hydrogen itself must meet a certain level of renewable content, and there is a whole range of record keeping and monitoring requirements, which PowerTap will ensure are met. HRI credits are available for 15 years from the quarter following CARB’s approval of the application.<sup>1</sup> Recently, a revised regulation limited HRI eligibility to a capacity of 1,200 kg per day per station. If a station were larger, it could still generate HRI credits but only up to that 1,200 kg per day limit.

Once approved and operational, the calculation of HRI credits follows a set methodology that includes several variables including the capacity of the station, availability or uptime, the carbon intensity of the hydrogen, the energy density of hydrogen in MJ/kg and a couple of other variables. Since PowerTap will be using renewable natural gas (RNG) (i.e., biogas or renewable natural gas, which comes from various sources, such as landfills, livestock operations and wastewater treatment plants), the carbon intensity of the hydrogen we produce will be zero. Plugging in our numbers into this methodology and at around \$200 per credit, we estimate the HRI value for a station with a capacity of 1,200 kg per day comes to \$5.60 per kg of capacity as reflected in the calculation below, assuming a carbon intensity or CI (a parameter in the equation) of zero given our use of RNG.

The formula is as follows – HRI credits are equal to:

$$= (CI_{standard}^{XD} \times EER - CI_{HRI}) \times E_{H2} \times (Cap_{HRI} \times N \times UT - H2_{disp}) \times C$$

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<sup>1</sup> § 95486.2 (3)(E)



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Where:

$CI^{XD/Standard}$  = the average carbon intensity requirement of gasoline (XD = “gasoline”) for a given year (assume 93.3)

EER = the dimensionless Energy Economy Ratio for H<sub>2</sub>/FCV relative to gasoline (2.5)

$CI_{HRI}$  = the carbon intensity used for HRI crediting. Company-wide weighted average CI for dispensed hydrogen during the quarter, given PowerTap’s use of biogas or RNG that would otherwise be vented or flared to the atmosphere, is zero (0).

*Note:* Use of a blend of biogas and bio-methane results in a significant net carbon reduction and leads to a zero CI score. Some CI calculations from biogas are negative, particularly if the methane would have otherwise been vented to the atmosphere. PowerTap has had extensive discussions with RNG marketers who have indicated their commitment to deliver PowerTap RNG with a zero CI.

$E_{H_2}$  = the energy density for hydrogen in MJ/kg (120 for H<sub>2</sub>)

$CAP_{HRI}$  = the HRI refueling capacity for the station in kg per day (assume 1,200)

N = the number of days during the quarter (assume 91.25)

UT = the uptime multiplier which is the percentage of time that the station is available (assume 100%)

$H_{2disp}$  = the quantity of hydrogen dispensed during the quarter (kg) (assume 0 when all the value is from HRI credits)<sup>2</sup>

C = factor to convert credits to units of metric tons from gCO<sub>2e</sub> (10<sup>-6</sup>)

**Thus, HRI = (93.3 \* 2.5 – 0) \* 120 \* (1,200 \* 91.25 \* 100% - 0) \* 10<sup>-6</sup> = 3,064.9**

**3,064.9** the number of HRI credits that would be generated in that quarter from that station. At \$200 per credit, that would equal \$612,981 in LCFS credit revenues per quarter (or \$2,451,924 per year). If you divide that by the maximum allowable capacity for HRI credits (1,200 kg per day) and by the number of days in a quarter, the result is **\$5.60 per kg per day**.

### ***Other Potential Environmental Commodities***

While the LCFS represents the most lucrative and immediate environmental credit opportunity, there are a few other value streams worth mentioning:

- **Renewable Fuel Standard:** For years, the federal government has managed the RFS program which mandates a certain percentage of biofuels be blended with conventional fuels. Ethanol has been the biggest beneficiary of the program. But other fuels such as biogas can generate credits, known as Renewable Identification Numbers (RINs). To get RINs issued and sold, an applicant gets a fuel pathway approved by the Environmental Protection Agency (there is not currently one approved for hydrogen). Based on a RIN being equal to 77,000 BTU (one gallon of ethanol) and at current RIN prices, we would

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<sup>2</sup> Note that as H<sub>2</sub> dispensed goes up, HRI credits go down.



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expect 1 kg of hydrogen dispensed to provide **\$1.71 per kg** in additional value<sup>3</sup>. Note that these are not capacity credits – they are only available when hydrogen is sold. *This credit is reflected in the below Hydrogen Station Financial Summary.*

- The PowerTap technology includes the possibility of capturing emitted CO<sub>2</sub> and using it as a source of renewable energy. The capture and permanent sequestration of CO<sub>2</sub> could be eligible for another federal tax credit, known as 45Q. The 45Q tax credit is worth between \$35-\$50/ton of CO<sub>2</sub> sequestered depending on several factors. This tax credit has been slow to be adopted since the IRS has been slow to issue rules related to defining what is permanent and what penalties might occur if CO<sub>2</sub> is released. There are also thresholds on minimum amounts of CO<sub>2</sub> capture to ensure eligibility. We expect the IRS to start moving faster on these issues and, if available, the 45Q tax credit would be worth another **\$0.36 per kg**, as reflected in the below Financial Summary<sup>4</sup>. Note the 45Q is a tax credit, and thus to capture this value, there would have to be enough taxable revenue.
- Renewable Energy Credits: A carbon capture-to-renewable energy generation solution is not currently eligible for California renewable energy credits (RECs) like solar and wind. But we would apply to the various state agencies to make every MWH from such a system eligible for RECs, which are currently trading at around \$15 per MWH. If we could generate 1 MW from this system, we estimate it would produce another \$120,000 per year in REC value (8,000 MWH \* \$15 per MWH). *This potential credit is not reflected in the below Hydrogen Station Financial Summary.*

**Hydrogen Station - Financial Summary**

Hydrogen Station - Capacity of H<sub>2</sub> 1,250 kg<sup>5</sup>

Revenue Source	Rate	kg/day	185 kg/day	500 kg/day
Hydrogen Sales	\$16.00 per kg/day	\$ -	\$ 2,960	\$ 8,000
LCFS/HRI (Carbon Credits)	\$2.95 per kg	\$ 6,720	\$ 5,684	\$ 3,920
Conventional LCFS (Carbon Credits)		\$ -	\$ 1,036	\$ 2,800
Total LCFS Value		\$ 6,720	\$ 6,720	\$ 6,720
RIN (RFS Credits)	\$1.71 per kg	\$ -	\$ 316	\$ 855
45Q (Tax Credits)	\$0.36 per kg	\$ -	\$ 67	\$ 180
Total Revenue - Daily		\$ 6,720	\$ 10,063	\$ 15,755
Total Revenue - Monthly		\$ 201,600	\$ 301,889	\$ 472,650
Total Revenue - Annual		\$ 2,452,800	\$ 3,672,977	\$ 5,750,575

While the LCFS credit is the immediate opportunity, we would seek all available environmental credits and would share in the value with PowerTap.

<sup>3</sup> Energy density of H<sub>2</sub> = 120 MJ/kg = 113,738 BTU/kg = 1.48 RINs. Assume price of \$1.15/RIN

<sup>4</sup> Assume that 1 kg of H<sub>2</sub> generates 9 kg CO<sub>2</sub> that is captured. Assume a tax credit value of \$40/tCO<sub>2</sub> captured. \$40/1000 (kg/mt)\*9kg CO<sub>2</sub> = **\$0.36 per kg** of H<sub>2</sub> produced.

<sup>5</sup> Under the most recently updated LCFS regulations, there is a limit of 1,200 kg/day capacity (§ 95486.2 (a)(2)(F))



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***Background on Carbonomics®***

Seth Baruch is president of Carbonomics®, a leader in helping businesses realize the potential of carbon offsets in the US/International emission-trading markets. Carbonomics identifies greenhouse-gas (GHG) reduction opportunities, determines how projects can generate credits, and guides companies through the entire process from project inception to verification. The GHG protocols written by Carbonomics are reducing more than 20 million tons of emissions per year, making a major impact on the carbon market. Carbonomics also has several clients in the LCFS market and has deep familiarity with the LCFS fuel pathway process. Another important component to this project is for the LCFS pathway to include carbon capture, and Carbonomics developed the first approved capture and utilization methodology for the voluntary offset market.