



# Carbon Lifecycle Assessment (LCA)

## Calculate your plant's carbon footprint

With carbon's growing role in world commerce, knowing your plant's carbon 'number' is becoming increasingly important.

In conjunction with internationally recognized energy consultant, Econergy, ICM developed an up-to-date software model to determine the carbon intensity of your facility's ethanol. We use this ICM/Econergy model to prepare a Carbon Lifecycle Assessment (LCA), providing your facility with a comprehensive report documenting your carbon number.

The LCA report:

- Supports categorization as an "Advanced Biofuels" producer, depending on carbon mitigation strategies and feedstock
- Establishes a carbon intensity baseline upon which to base future carbon output reductions

Due to existing regulations capping various industrial emissions, the recent California Air Resources Board (CARB) ruling, and the Obama administration's staunch support of immediate action to reduce green-house gas emissions. We expect that our industry will see restrictions on carbon emissions in the near future.

Carbon modeling using the ICM/Econergy model can help your plant be prepared for these changes. Additionally, the LCA can help your plant determine steps necessary to produce ethanol that qualifies as an "advanced biofuel," and it can provide you with the information to facilitate future trading of validated carbon credits to open up a potential new revenue stream.

### Draw a line in the sand

Reasons our environmental experts recommend a professionally prepared Carbon Lifecycle Assessment (LCA) include:

- Knowing your ethanol's present carbon intensity can help establish your "line in the sand" from which to compare all future carbon reductions. A professionally calculated third-party carbon intensity number, like the number you'll get with the LCA prepared by the ICM/Econergy model, is more likely to be recognized by regulatory bodies than one your plant prepares internally with GREET or BESS models.
- Knowing your number helps your plant, and your lenders, make smart business decisions with regard to the integration of carbon-reducing technologies.
- If you can document a voluntary reduction in your carbon intensity number, you may be able to sell those reductions on the Chicago Climate Exchange (CCX) at \$2 to \$3 per ton. International markets are trading carbon credits at \$20 to \$30 per ton.
- Depending on feedstock, the fuel your plant is producing may be considered an "advanced biofuel." Our LCA report will help determine whether or not that is the case.
- If CARB's ruling or a cap-and-trade system is implemented, you will be required to know the carbon intensity of your fuel in order to sell it.

### How do I get my number quickly?

The ICM/Econergy model includes the necessary field-to-wheels pathways to reliably generate your ethanol's carbon intensity number. The model includes such information as detailed zip-code-specific agricultural practices, transportation, and plant production data. The comprehensive LCA report that can be produced in about 30 days after modeling is completed also includes potential carbon mitigation strategies as well as the anticipated results they will have on your carbon emissions.

### More about ICM's LCA

The ICM/Econergy model provides your facility with a documented field-to-wheels (FTW) carbon intensity number (measured in grams CO<sub>2</sub>e/MJ).

The model has already been used to help one producer classify its ethanol as an "advanced biofuel." This plant estimates the value of this "advanced biofuel" classification (based on < 46 grams CO<sub>2</sub>e/MJ; non-corn feedstock), at a premium of up to \$0.10 per gallon. While the classification only applies to ethanol produced from non-corn feedstocks like milo, in the future it may apply to all ethanol, based on the percentage that comes from a non-corn source.





## Do the Math: Behind the numbers

According to the GREET model, US gasoline has a carbon intensity of 92.6 grams CO<sub>2</sub>e/MJ. Ethanol's carbon intensity is measured in reference to gasoline. The GREET model puts the average ethanol plant in the US at 70.4 grams CO<sub>2</sub>e/MJ.

ICM/Econergy's model calculates the average ICM-designed Midwest natural gas/corn plant well below the average, coming in at about 55 grams CO<sub>2</sub>e/MJ.

The following example payback calculations are based on that example ICM plant, if it were to install our APC+ Advanced Process Control system:

- Initial carbon intensity=55 grams CO<sub>2</sub>e/MJ.
- Cost of ICM Carbon Model and LCA: \$35,000
- Modeling results show 5 grams CO<sub>2</sub>e/MJ
- reduction with APC installation (50 grams CO<sub>2</sub>e/MJ )
- Basis: Assume 80.16 MJ/gal ethanol (76,000 Btu/gal)
- 5 grams CO<sub>2</sub>/MJ x 4,008,000,000JG/454 grams/lb/ 2000 lb/ton = 22,070 tons/yr CO<sub>2</sub> reduction

### Conclusion

At \$3/ton on CCX, the average 50 MGY corn-to-ethanol plant could potentially expect the trade value of surplus CO<sub>2</sub> to reach \$66,210/year, bringing the payback period for the LCA to just over six months.

## Carbon mitigation is good for the environment, but what's the ROI?

That question is best answered on a plant-by-plant basis. The primary determining factor is your plant's feedstock; milo and/or wheat versus a standard corn-to-ethanol facility. Our team would welcome the opportunity to talk to you about the benefits a LCA can add to your specific plant.

### Recover your investment in about 6 months

If you are considering reducing carbon emissions now or in the future, you need to establish a baseline with which to compare those improvements. The LCA generated by the ICM/Econergy Model will not only establish that initial baseline, it will help you determine approximate potential reductions from potential plant improvements, including which mitigation strategies will be most cost effective. This is true whether you are reducing carbon out of necessity to comply with regulations or whether you are planning on taking advantage of your carbon credits by trading in US or international markets.

### Trading on CCX

Currently, ICM recommends CCX as the venue to sell surplus carbon reductions. ICM has a contract in place with WSP Environmental, formerly Econergy, to assist in validating your carbon credits for trade on CCX or in international markets. We can also help market any surplus credits you generate above your initial baseline. Because each plant we design is unique, ICM cannot estimate your number without generating an LCA with our ICM/Econergy Model.

### Estimated carbon reductions

The chart below will give you an idea of the potential carbon reductions your facility may realize when incorporating various carbon mitigation technologies.

Mitigation Action	Near-term Prioritization	Offsets Eligible for Sale?	Estimated Reduction Potential (gCO <sub>2</sub> e/MJ)
Industrial energy audit & installation of ICM's Advanced Process Controls (APC+)	High	Potentially	3-5
Switch percentage of fuel source to biomass or biogas	Medium/High	Yes	10-25
If ΔP high enough, install natural gas letdown turbine to help meet plant energy requirements, offsetting other energy sources	High	No	0.5
Install Combined Heat & Power (CHP) onsite	Medium	Yes, but only direct portion	4 for NG CHP 14 for Biomass CHP
Build Anaerobic Digester to process manure from a nearby CAFO	Low/Medium	Potentially	Depends on use
Capture CO <sub>2</sub> for permanent sequestration (not food or beverage industry)	Medium	Potentially	Up to 30 for CCS

## Contact us for more information

Learn more about this and other ICM services by calling our Customer Service department.

**877.456.8588**

