Evolving LCA Challenges

Don O'Connor

(S&T)^2 Consultants Inc.

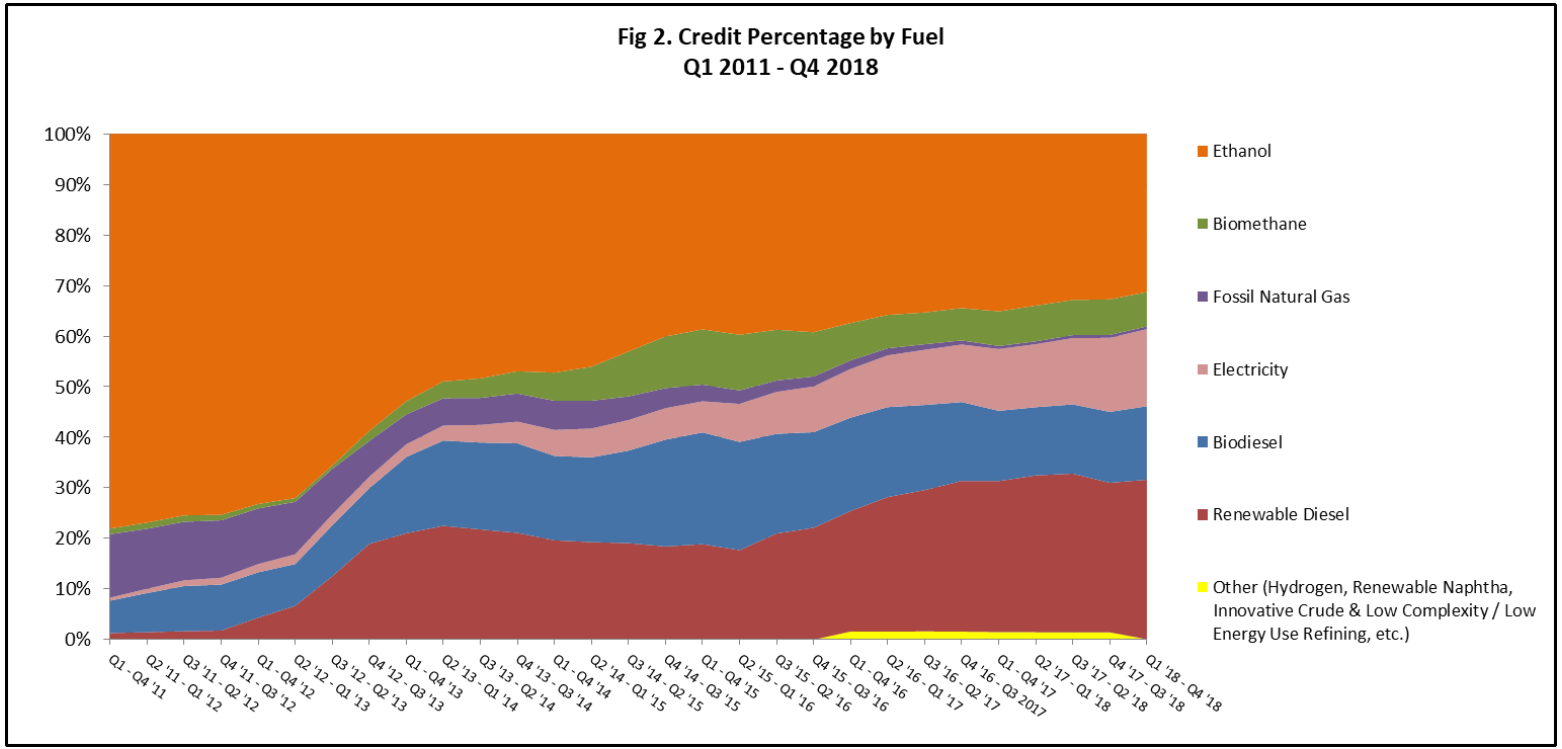
Agenda

- Drivers of Change
- Corporate responses
- Areas of Uncertainty

Drivers of Change

- Low carbon fuel programs with very aggressive targets are requiring obligated parties to investigate all options for reducing the carbon intensity of the fuels supplied.
- In North America, California, British Columbia and Oregon have been the leaders.
- The programs are open to all low carbon fuels but the majority of the reductions are currently been provided by liquid biofuels.

California Credits

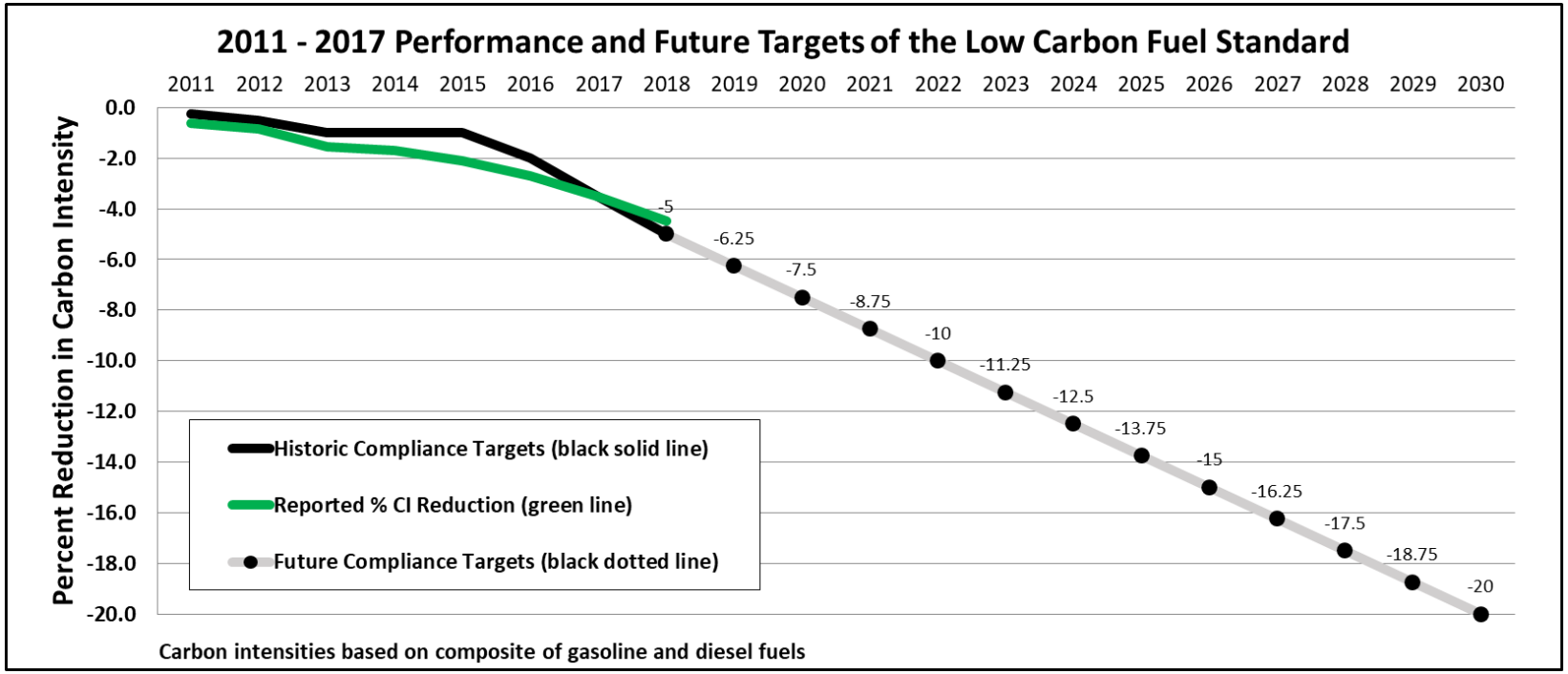


(S&T)²

Liquid Renewable Fuels

- Blend levels in 2018
  - Ethanol 10.4%
  - Biodiesel 4.9%
  - Renewable Diesel 10.2%

California

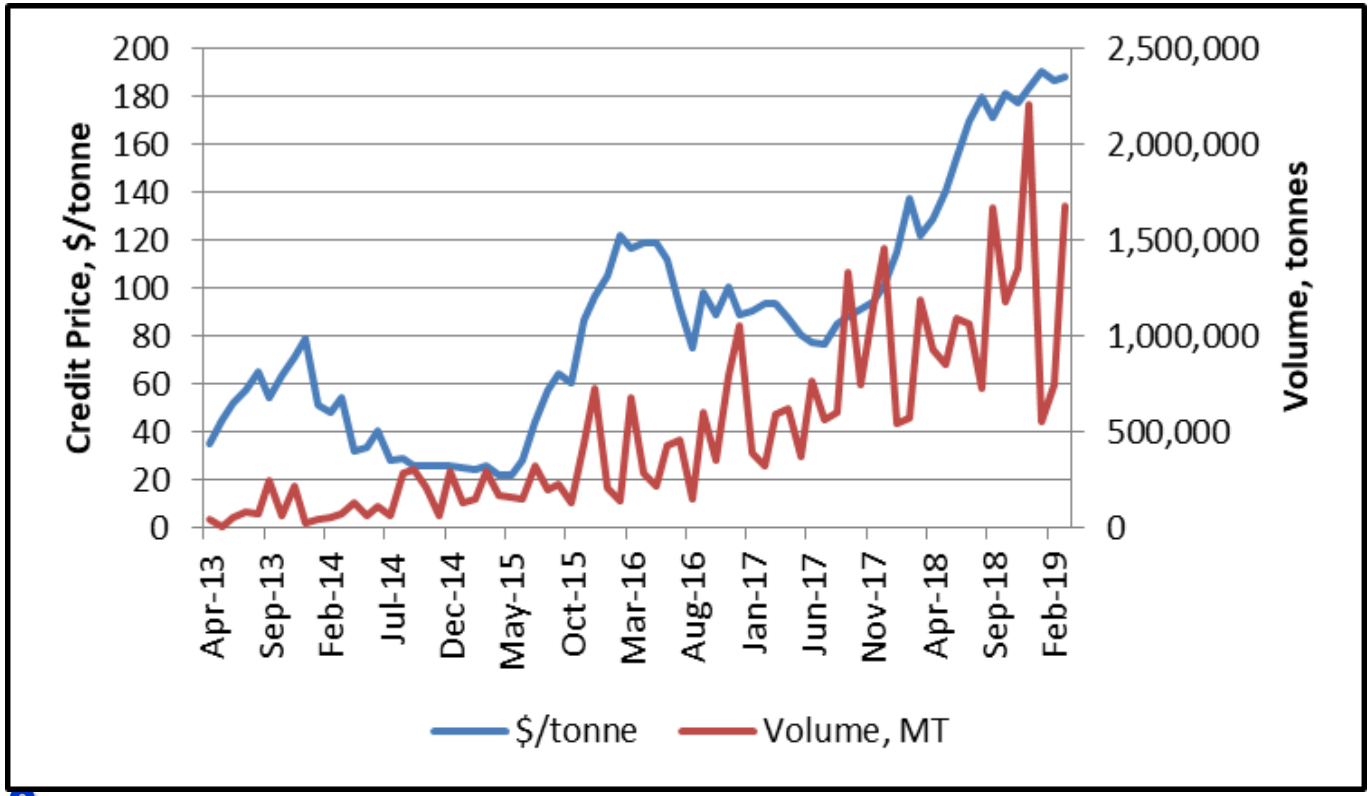


(S&T)²

Debits and Credits

- A debit is created from the sale of gasoline or diesel that has a higher CI than the target.
- A credit is generated by a fuel that has a lower CI than the target.
- The market built credits between 2011 and 2017.
- It withdrew credits from the bank in 2018.
- Things get more difficult ever year to 2030.

Credit Value



(S&T)²

Credit Value

- A barrel of crude gasoline creates 0.51 t of CO_2eq.
- A $200/tonne credit is equivalent to almost $100/bbl of product.
- An extra $100/bbl
  - Starts to make a lot of new fuels economically attractive
  - Makes a lot or efficiency gains or CI reductions projects at existing fuel producers very attractive.

Corporate Response

- It has taken more than 5 years but obligated parties and fuel producers are finally taking the programs seriously and are starting to look at opportunities for new fuels and fuels with lower CI.
- Never underestimate the ingenuity of developers or the persistence of snake oil salesmen.

Ethanol

- Installing an AD system to process organic waste into biogas to replace natural gas.
  - What are the avoided emissions from not landfilling the organic waste and how should that be accounted for in an ethanol LCA?
- A lot of plants capture the CO_2 from fermentation and sell it to the industrial gas market.
  - Some are now looking at sequestering that gas underground or using it for enhanced oil recovery. How to account for a potential lack of permanence?

Biomass Based Diesels

- Feedstock accounts for most of the CI for these fuels.
  - New feedstocks.
    - Do we have the system boundaries consistent for all feedstocks?
    - Do we have real world data for new crops?
  - Integrating renewable hydrogen or renewable methanol into the production systems.
    - What are the trade-offs between minimizing CI and maximizing profits?
    - Do these depend on the regulatory LCA accounting?

LCA Principles

- Life cycle assessment is supposed to be done between systems that provide equivalent goods and services.
- Consider one system that refines crude oil to produce diesel fuel and has MSW landfilled. The other system produces diesel fuel from the MSW.
  - How do we account for the avoided landfilling emissions?

Emerging Fuels

- Co-processing
  - Processing biomass in a petroleum refinery.
  - How much of the biogenic carbon end up in which liquid fuel?
  - Does the biogenic carbon which doesn't end up as a liquid reduce the energy consumption and GHG emissions at the refinery?

Combined Systems

- Biomass pyrolysis systems
  - Bio-oil is co-processed in a petroleum refinery.
  - The biochar could be sequester or gasified to produce syngas for ethanol fermentation.
  - Syngas could be used to produce power or used for ethanol fermentation.
  - What is the CI of the gasoline, diesel, ethanol, char or power?
  - How do we allocate the emissions between the products?

Areas of Uncertainty

- Avoided emissions
  - We don’t do a good job of tracking the emissions of waste products.
  - The avoided emissions can be different in different regions due to local regulations. Do you provide an emission credit based on where the fuel is produced or where it is consumed? Is your choice politically acceptable?

Allocation

- How do we ensure that the choice of allocation (displacement, energy, mass, economic, etc.) captures all of the emission benefits of a project.
- While at the same time keeping a relatively level playing field between feedstocks, fuels, and regions.

System Boundaries

- Are we capturing all of the emissions in the lifecycle?
  - The lack consensus on what is waste and where the system starts has a huge impact on the CI of some systems.
  - Palm fatty acid distillate and animal fats are two classic examples of very different treatment in different regions.

Data

- How do we ensure that we have adequate data for modelling these emerging pathways.
  - From a regulatory perspective the actual process data isn't a large concern because most systems require the use of actual primary data.
  - It is a concern from a policy perspective. How can good policy be developed if we don't really know if the data is accurate.

Data

- The secondary data that is not under the operator's control is a concern.
  - The avoided emissions in CARB’s manure based AD systems don’t appear to be consistent with the US national GHG emission inventory. Yet these avoided emissions drive huge value for system operators.

Final Thought

- Will we get the investments that we need to reduce GHG emissions if the rules of the game aren't clear or if they change at half time?

Questions?