



# RENEWABLE FUELS AND BIOFUELS

## Sacré-Davey Expertise

### Renewable Fuels & Biofuels

Sacré-Davey Engineering Inc. (SDE) is a 35-year-old engineering and project delivery company with decades of experience in providing sustainable energy solutions using low carbon-related technologies. We have extensive, current, worldwide experience delivering a complete suite of leading-edge biofuel, renewable fuel and technology scale-up solutions across all available technologies. Although the co-processing of biogenic feedstock to produce renewable fuels is an emerging trend, SDE's recent experience has facilitated the development of unique expertise and a database of biogenic feedstock properties. We believe that our solution set will aid your organization in mitigating the risks of integrating new feedstocks into your refinery operations.

## Capabilities

### Renewable Fuels & Biofuels

- Conceptual Process Design
- Business Case and Market Studies
- Detailed Engineering and Project Delivery
- Full Turnkey EPC Solutions
- Construction Supervision and Management
- Start-up and Performance Testing
- Operational training
- Asset Management
- Facility Debottlenecking
- Process & IP Development
- Permitting Support
- Technology Scaleup
- Owners Representative Services

## Key Projects

### Renewable Fuels & Biofuels

In the past 20 years, our team has worked on over 50 different natural oil processing projects ranging from lab/pilot trials and certifications to detailed design and full EPC delivery. Our experience covers the full range of all biodiesel and renewable diesel technologies.

#### PROJECT 1 (Imperium Renewables) – Detailed Design, Permitting, Const. Mgmt. and Commissioning



Design and construction of a 100 million gallon per year “world class” biodiesel plant. At the time, this was the largest biodiesel facility in the world and was the first to utilize refinery quality design standards. SDE was selected due to a combination of our biofuel experience and technology scale-up expertise. The scope included complete FEL, detailed design, permit submission, air emissions modeling, construction management, commissioning, start-up, and performance testing of the plant. The design included a unique distillation system that could fractionate the biodiesel to make a cold climate compliant product. The project won the American Council of Engineering Companies Industrial Project of the Year award which recognizes engineering excellence and annually honors outstanding engineering accomplishments.

## Key Projects

### **PROJECT 2 (Confidential) – Owner’s Representative (ongoing)**

SDE was requested to perform a techno-economic assessment for a repeat client seeking to invest in a 100 MMGPY renewable diesel plant. We identified a high degree of risk with the pretreatment unit operations due to the difficulty in processing waste oils (including corn oil). SDE worked with the technology provider to provide a technical solution allowing our client to invest and become a shareholder in the asset. SDE is currently reviewing and overseeing all design aspects of the plant including feedstock and product storage, pretreatment, main process, and balance of plant. SDE is also providing supporting engineering services such as vendor package review, procurement support, and integration engineering support. As a trusted consultant, SDE has been tasked with providing the schedule and financial milestone reporting to the financing entities.

### **PROJECT 3 (Primus Biovision) – Det. Design, Permitting, Const. Mgmt. and Start-up/Commissioning**

Development of a ~17.5 MMGal/year biodiesel plant utilizing local used cooking oil, yellow grease, and beef tallow as feedstock. SDE was responsible for the complete process design, detailed design, construction management, commissioning, start-up and warranty for the plant. Additionally, SDE was responsible for permit submittals, air emissions modeling and obtaining Alberta Boilers Safety Association certification (ABSA). ABSA certification was provided faster than scheduled due to the detailed and clear design reporting provided by SDE, which mitigated a key risk to the schedule for the owner. As part of the construction phase of the project, SDE commissioned the tank farm, loadout and winterization skid in January/February in Lethbridge, Alberta. This cold weather start-up plan allowed for upstream and downstream systems to be commissioned ahead of schedule with the commissioning, startup and performance testing complete ahead of schedule (2 weeks early on a 6 weeks start-up schedule).

### **PROJECT 4 (General Biodiesel) – Testing, Detailed Design, and Construction Supervision**

SDE performed a feasibility study to integrate General Biodiesel’s equipment and processes into their existing plant, producing up to 10 MMGPY of biodiesel. The success of the integration work led to SDE being retained to provide engineering services to bring the entire facility into operation. Late in the design phase two pretreatment reaction vessels were unexpectedly classified as hazardous. Given the congested layout and restricted plot requirements only high-cost solutions were initially evident. SDE developed a suite of potentially low-cost solutions and the client accepted a design with a dropped floor H-Class room that tightly fit inside the existing building. This solution satisfied regulators, met the owners cost expectations and required minimal schedule adjustment. In subsequent phases, SDE developed a design that allowed for lower cost feed stocks (such as used cooking oil) and staged the plant rebuild for process conversion. The transition from batch to continuous processing combined with the ability to throttle between 5 and 10 MMGPY minimized downtime, matched cash flow to construction costs, and allowed the owner the flexibility to use lower cost feedstocks to adjust to market conditions and maximize margins.

### **PROJECT 5 (Benefuel) – Beatrice Design, Retrofit and Start-up/Commissioning**

SDE used their experience with solid metal catalysts in renewable fuels to design a pretreatment process for a broader range of feedstocks (40% FFA max) to suit Benefuel’s high-temperature and high-pressure catalytic technology. Additional variations of the standard pretreatment methods: degumming (water and enzymatic) and bleaching (batch atmospheric, batch vacuum, and continuous vacuum), were evaluated. The final pretreatment process included a creative solution that included a continuous vacuum drying system to meet moisture requirements and a guard column as an additional purification step for assurance in meeting feedstock specifications.

## Relevant Project List

Project*	Responsibility
Seed Crushing Facility and Biodiesel Plant, 7.5 MMGPY	Site selection, permitting, and preliminary design for a canola seed crushing facility and biodiesel plant integrated facility.
Rendered Fat Biodiesel Plant, 20 MMGPY	Process development and technology comparison for a 20 million gallon per year biodiesel plant supplied by an adjacent chicken fat rendering plant.
Rendered Fat Biodiesel Plant, 15 MMGPY	Environmental assessment, permitting and detailed design for a 15 million gallon per year biodiesel plant located inside a yellow grease and beef tallow rendering plant.
Seed Crushing Facility and Biodiesel Plant, 40 MMGPY	Process development and detailed design for a dual seed crushing facility for both soybean and cottonseed coupled to a biodiesel facility.
Multiple Feedstock Integrated Biorefinery, 160 MMGPY	Process development, permitting, and preliminary design for a 160 million gallon per year biodiesel plant coupled with a biogas plant, a CHP generating plant, and a rendering facility.
Used Cooking Oil and Chicken Fat Biodiesel Facility, 5 MMGPY Innovative Biofuels (2013-2014)	Design, detailed engineering, construction supervision and start-up/commissioning for the retrofit and upgrade of an existing biodiesel plant's pretreatment system to process higher FFA and lower quality feedstock.
Used Cooking Oil Biodiesel Plant, 30 MMGY	Construction management and process design for a 30 mmgpy biodiesel plant using waste oils for a feedstock.
20 MMGY Biodiesel Plant and Soybean Oil Facility	Process Design and equipment specification for a 20 million gallon per year integrated soybean oil extraction and biodiesel production facility.
18 MMGY Modular Biodiesel Plant	Detailed design of an 18 mmgpy yellow grease to biodiesel modular plant.
30 MMGY Biodiesel Plant Restart Study	Plant restart study for a 30 mmgpy biodiesel plant. Developed costs for plant restart, repair of plant deficiencies and bottlenecks. Provided an analysis of feedstock availability and costs, biodiesel offtake opportunities, and developed a complete project pro-forma. Provided presentations to potential investors and worked with owner to select plant operator.
20 MMGY Biodiesel Plant Certification	20 million gallon per year biodiesel plant process certification study for shareholder C round funding.
40 MMGPY Biodiesel Plant Study	Project development study, environmental analysis, and federal funding application for a 40 mmgpy biodiesel plant.
10 MGY Coconut Oil Biodiesel Plant	Process development for a coconut processing plant producing coir, copra and 10 mmgpy of coconut oil biodiesel.
Corn Oil Extraction & Biodiesel Plant	Process technology development for a 2.5 million gallon per year biodiesel plant. The feedstock was to be corn oil extracted from the DGS of an existing corn ethanol plant.
5 MMGY Chicken Fat Biodiesel Plant and 2.5 MW Cogeneration	Process development and siting study for a 5 mmgpy chicken fat to biodiesel plant coupled with a 2.5 MW chicken litter cogeneration system.
Biodiesel Production Plant, 5 MMGY	Process development, detailed design, and construction management for 5 MMGY biodiesel facility utilizing tallow and yellow grease feedstocks.

\*Additional project details can be provided upon request.