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Presents

Results from the study of bio-diesel use in Cowichan Valley

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On behalf of all the people who contributed to this project, staff and president of the Cowichan Biodiesel Co-op, professors and students of Universidad Iberoamericana and Vancouver Island University - we appreciate the careful collaboration of all users who participated in the survey carried during May 2017, which aimed to find out your opinion regarding the quality of the bio-diesel, the operation of The Co-op and its contribution to the sustainability of Cowichan Valley.

The Cowichan Biodiesel Co-op team is aware of the necessity to always improve their internal processes in order to offer a sustainable product and quality service, so that its members will continue consuming bio-diesel for two main reasons:

1) The Co-op is a sustainable alternative for fuel consumption since there is a commitment to reduce the environmental footprint of Cowichan Valley by:
   - Ethically producing and distributing a sustainable fuel alternative.
   - Providing a community source for recycling local supplies of waste vegetable oil.
   - Providing a strong advocacy for sustainable fuel production and use.

2) The Co-op has the commitment with the satisfaction of users and inhabitants of Cowichan Valley by:
   - Ensuring a stable, high-quality and local fuel supply.
   - Working constantly so that The Co-op's distribution and sale services are comfortable and reliable.

- Stimulating local economic activity by producing and supplying bio-diesel at a reasonable and justifiable price.
- Sharing information about community-based bio-fuels to the wider community.

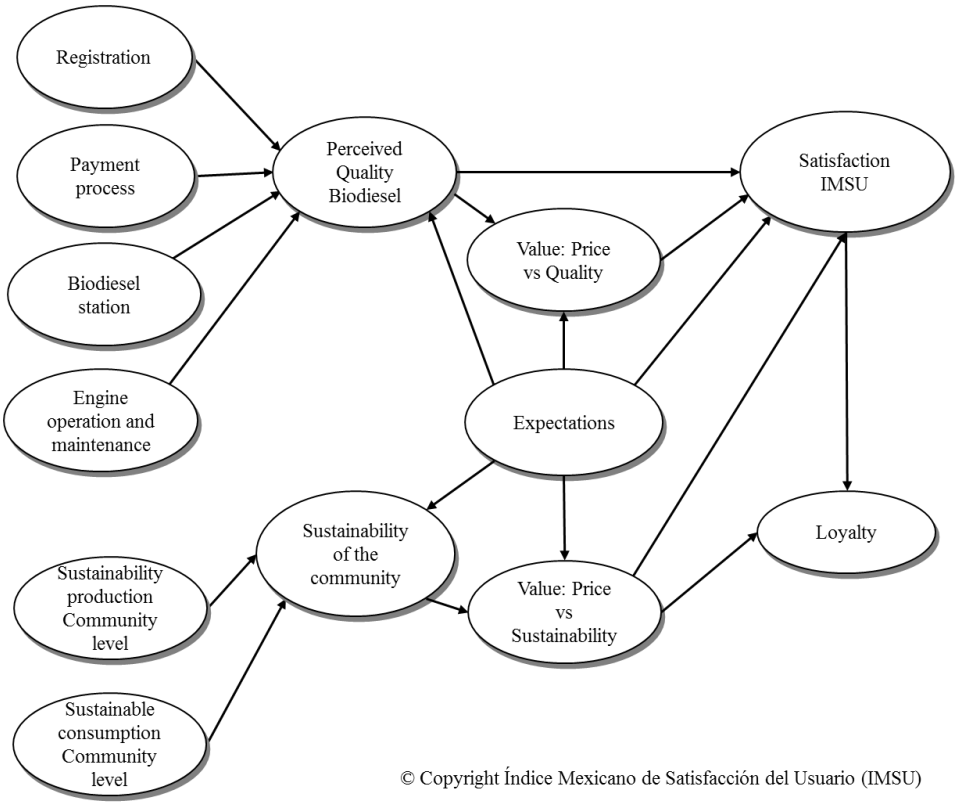
In order to learn more about user's satisfaction, user's experience and opportunity areas that allow The Co-op to improve, it was decided to establish a collaboration alliance between Universidad Iberoamericana Mexico City, Vancouver Island University and Cowichan Energy Alternatives; through which it was possible to test the research methodology developed by the Mexican User Satisfaction Index (IMSU) of Universidad Iberoamericana.

IMSU methodology is based on the development of satisfaction indexes implemented in different countries, such as the American Customer Satisfaction Index (ACSI) and was created in response to the increasing necessity to evaluate and compare the satisfaction of Mexican users about goods and services generated by governmental institutions, educational organizations, private companies, and socially responsible and sustainable economic companies.

The essential part of the methodology is to develop and test a model that allows evaluating the causes of user's satisfaction. Satisfaction is usually studied from an aspect where users compare their expectations about a product or service before consuming it against the quality they perceive and the price they pay after consumption. However, the model developed by Dr. Lobato (leader of the IMSU) in this research, also studies the substantive factors that lead Cowichan Bio-Diesel Co-op members' decision to consume bio-diesel as a means of reducing pollution in the Cowichan Valley.

In the following figure, we present the model developed by Dr. Lobato, which measured the answers that co-op members gave through the questionnaire.

Evaluation Model



For the research team, it was important to measure users' perceived quality through four characteristics: i) the registration process to become members of the cooperative, ii) the payment process to consume bio-diesel, iii) the location of the pumps and the availability of the bio-diesel blends, and iv) the efficiency and maintenance of the vehicles when using bio-diesel.

The study of bio-diesel as a means of contributing to the reduction of pollution in the community of the Cowichan Valley was measured through the consumption and sustainable production. Sustainable consumption focused on the importance that users gave to their personal health and the health of the community, as well as their commitment to reducing their own pollution through the purchase of bio-diesel.

Meanwhile, sustainable production was measured through the importance for users of the fact that bio-diesel is manufactured by a local company that stimulates the economy of the region and uses raw material waste from restaurants and residences to prevent the drain from clogging and polluting the water.

The price of bio-diesel was compared from two points of view, quality and sustainability. The comparison between the price and the quality of the bio-diesel allows users to analyze the level of quality that they receive against what they pay, for the co-op to increase its understanding whether members are satisfied with the price with respect to the quality they receive. On the other hand, the comparison between price and sustainability allows users to analyze among the potential economic savings they achieve by not having to buy an electric car to contribute to the sustainability of their community versus the price of bio-diesel.

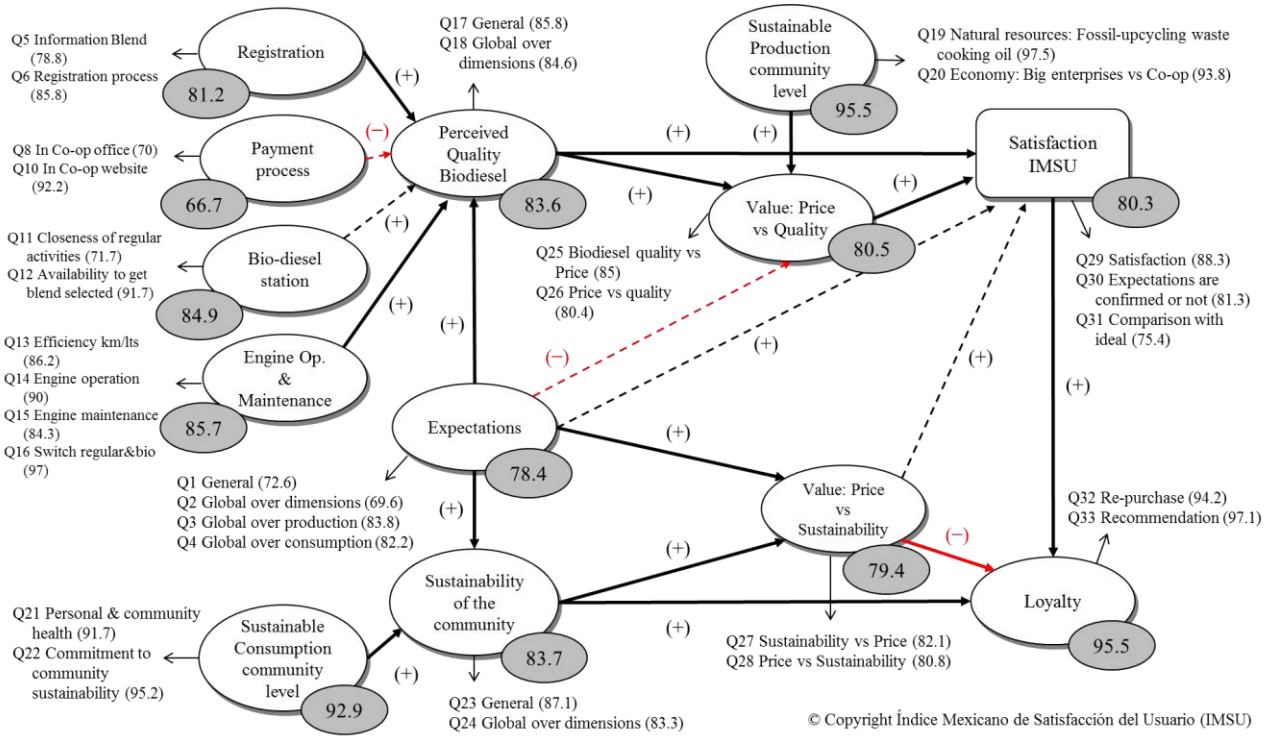
The evaluation of this model allows us to analyze the relationship of cause and effect that exists between the different characteristics of the Co-op and the level of satisfaction and loyalty that users have to motivate them to continue consuming bio-diesel. On the other hand, it also allows The Co-op to understand the reasons why some users have stopped using bio-diesel to make internal improvements to regain the users' confidence to continue being part of this sustainable project.

Results of the American Customer Satisfaction Index for 2017 for Gasoline Stations sector indicated that user's satisfaction was 76 on a scale from 0 to 100. While the result of our evaluation made by the IMSU was 80.3 for active bio-diesel users - those who renewed their membership and consumed bio-diesel during 2017 - and 67.2 for non-active users - those who did not renew their membership and their last consumption was before December 2016.

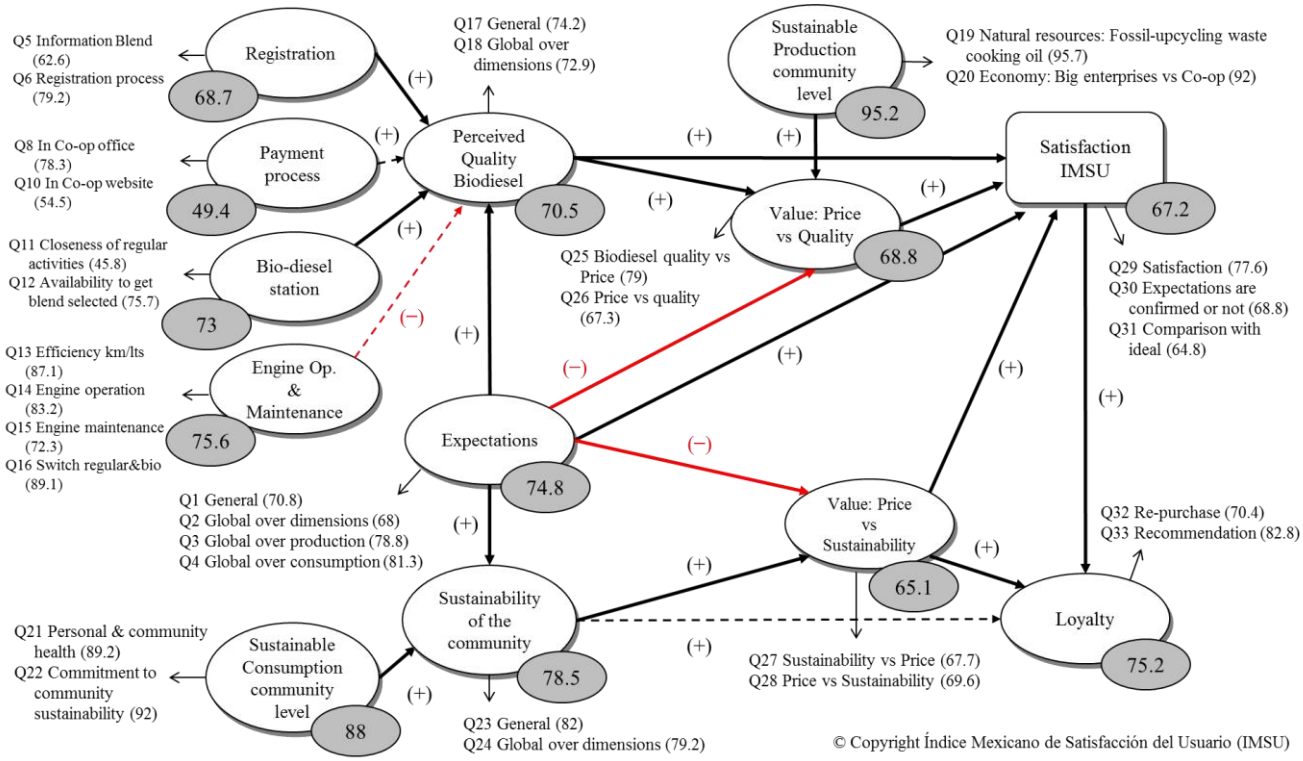
The following figures show the results of the models' evaluation, which will soon be published in the Business Process Management journal and in this regard, we have:

- The values within the circles indicate the scale index from 0 to 100 of each of the evaluated characteristics.
- The values within the parentheses indicate the scale index from 0 to 100 of each of the questions in the applied questionnaire.
- Continuous arrows indicate the existence of this cause-effect relationship at a 95% probability.
- Dashed arrows indicate the existence of this cause-effect relationship was not proven above 95% probability.
- The signs indicate whether the relationship between the characteristics is positive or negative.

Active Users Model



Non-active Users Model



The latter results depict as the possibility of a substantial difference between the indexes of the active user model versus the indexes of the non-active user model. We understand that the reasons why these customers stopped using bio-diesel are reflected in this model, which helps us to detect the areas of opportunity to improve and recover users' confidence to help motivate them to be part of the organization again.

We know that one of the main factors that decreases the satisfaction in users is the price of bio-diesel; however, the price of diesel is associated with the oil price which in recent years has been lowering its cost considerably. These decompensations in the oil cost can sometimes not be absorbed by the Co-op because the processes of bio-diesel production is an added value to the price of diesel, i.e. the processes of collection and transformation of oil generates costs that are tied to the final price of bio-diesel; however, this extra cost is transformed into the added value that is offered as part of an organization that seeks to contribute to the economic development of the region and reduce greenhouse gas emissions.

Consequently, through the consumption of bio-diesel, users can have short-term savings, since they contribute to the reduction of polluting emissions without the need to buy an electric car or make additional modifications to their cars. It has been shown that the bio-diesel presents better conditions of lubrication in the engine and at moderate speeds the power and torque increase. With regard to emissions, bio-diesel made from cooking oil contributes to the reduction of CO2 by up to 17%, CO2 by up to 8% and hydrocarbons by up to 36%.

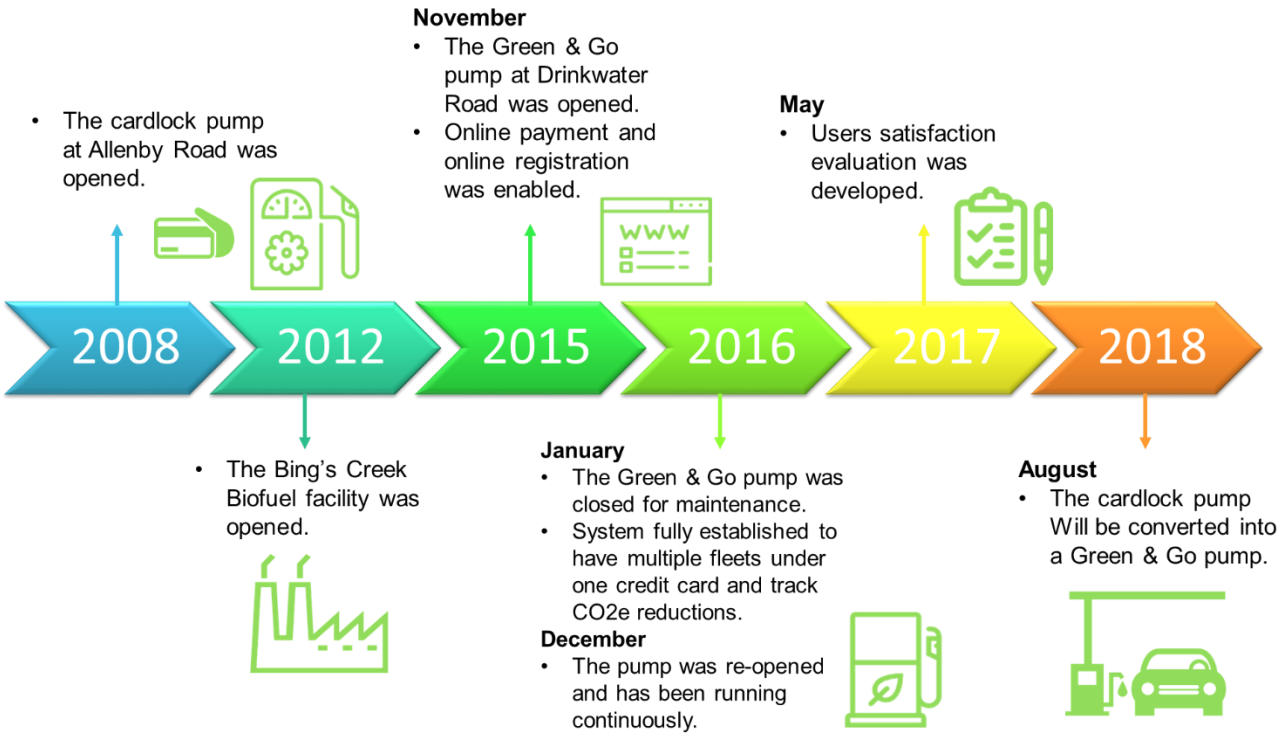
Based on the characteristics that obtained the lowest results such as the registration process, the payment process, the availability of the mixture in the pump or the location of the pumps, The Co-op staff is working to improve the way in which some of these features are carried out and can be observed in the following table:

Feature	Improvement actions
Registration: 68.7	The registration process of new users in our offices is no longer available. We decided that this process is more efficient if it is done through our web page, in this way the data is automatically stored in our system.
Payment process: 49.4	Our online system was improved which now allows multiple fleets under one credit card so you can track the CO2e reductions in total in a single fleet and how much your business is using in terms of bio-diesel and all the receipts are e-mail to members.
Bio-diesel station: 73	Because the cardlock pump located on Allenby Road stopped working, funding was obtained to transform it into a Green & Go™ pump, which will facilitate the purchase of bio-diesel by paying directly into the pump with a credit card, it will no longer be necessary to make a pre-payment in our offices or by phone. This new pump will be accessible to our members 24/7 and will also be available to the general

	public starting September 2018 from Monday to Friday from 8:00 am to 5:00 pm.
Value: Price vs Sustainability: 65.1	We are working to make the price of bio-diesel cheaper for our users compared to the price of diesel and we will start issuing gift cards in order that they can obtain free bio-diesel.

The following figure shows the evolution of the last changes that have taken place in The Co-op in order to keep our members satisfied and that more inhabitants of Cowichan Valley join this project.

Timeline



Thanks to the evaluation conducted, we were able to confirm that active and non-active members have a great interest in the sustainability of the Cowichan Valley community, which is why 100% expressed a positive opinion regarding the actions of the Co-op on the production of bio-diesel with cooking oil, support for the growth of the local economy and the commitment to maintain the health of the inhabitants of our community.

However, we want to share that more activities are carried out in The Co-op through which the commitment to the environment is kept constant, among which are:

- In 2017, the Co-op's membership collectively consumed approximately 114,000 Lt of bio-diesel.
- In a month, the Co-op fleet trucks consume about 1,000 Lt of bio-diesel.
- During 2017 around 450,000 liters of wasted cooking oil (WCO) were collected in Southern Vancouver Island (Nanaimo region to Victoria region).
- When using bio-diesel, the Co-op sells carbon credits through the Community Carbon Marketplace (CCM) program, where each credit corresponds to 1 tonne of CO2e that was

prevented from being expelled into the environment. During 2017, the Co-op sold 171 credits = 171 tonnes of CO2e reduced through member use of Co-op biodiesel.

- The Co-op staff produces and uses their own WCO-based cleaning products, such as laundry detergent, degreaser, and hand soap.
- For the production of bio-diesel, the Co-op recycles the containers it uses as oil containers, drums and totes, since CO2e production increases when replacing and using new equipment.
- The staff delivers recyclable and portable jugs to customers for the WCO, thereby decreasing the use of disposable plastic bottles.
- For the oil heating process at the Cowichan Bio-Fuel Facility, The Co-op uses solar thermal energy.

Through the publication of this report, we would once again thank all members for their valuable participation in the satisfaction evaluation and recognize mthe great impact that their consumption decisions have on the reduction of CO2 emissions and the development of local companies that contribute to the environmental, social and economic growth of the region, since they support the opportunities towards diverse solutions to counteract the imminent effects of pollution and climate change.

About the authors

Maria Odette Lobato-Calleros is Professor-Researcher at Iberoamerican University Mexico City and leader of the development and implementation of Mexican Index of User Satisfaction (IMSU). She received a Bachelor's Degree in Industrial Engineering, with specialization in Sustainability, a Master's in Quality Engineering, as well as a PhD Degree in Education with a specialization in Organizational Studies. She specializes in Gestalt Psychotherapy and holds a degree in Quality Management Program for Mexico and Japan and Quality Engineering in Mexico. Since 1994, she has taught courses in Industrial Engineering degree, Master courses in Quality Engineering, Master courses in Human Development and PhD courses in Sciences at Iberoamerican University. Dr. Lobato is the project leader and is responsible for the development and application of IMSU methodology, in addition to being the designer of the conceptual model for sustainable consumption in this case-study.

Karla Fabila has a Master's degree in Quality Engineering, and is a student of PhD in Engineering Sciences at Iberoamerican University and current collaborator in the IMSU projects. She received a degree in Industrial Engineering, and is Black Belt certified by the ASQ. She has worked in various branches of industry in the departments of Quality, Process Engineering and Safety and Hygiene. In the last two years, she has collaborated in the publication of articles on IMSU methodology and the recent investigations regarding the social and environmental impact of organizations and their consumers. She collaborated in the application of IMSU methodology in this case-study.

Pamela Shaw, PhD MCIP RPP FRCGS, is Director of the Master of Community Planning Program at Vancouver Island University, Research Director with the Mount Arrowsmith Biosphere Research Institute, Senior Editor of the International Journal of UNESCO Biosphere Reserves, Adjunct Professor at the University of Victoria (Geography) and Fellow with the Royal Canadian Geographical Society. She is an urban planner with experience in community planning and consultation and a proponent of community based applied research like an Action Plan to address Child Poverty in Nanaimo, an Environmental Assessment for Lyackson First Nation and the District of Ucluelet Official Community Plan. Dr. Shaw contributed in this case-study to the conceptual part of sustainability in the communities.

Brian Roberts, MSc, PAg, PGeo, Master of Science degrees in Earth Sciences from Simon Fraser University, British Columbia, Canada. He has worked as an environmental consultant and researcher. He is a founding member of the Cowichan Bio-Diesel Co-op (CB-DC), and in 2008, he helped found

Cowichan Energy Alternatives Society (CEA), a non-profit created to research and implementer of renewable energy solutions. In 2012, Brian initiated the creation of the Community Carbon Marketplace as a means of helping communities reduce greenhouse gas emissions while growing local, green economies. Brian also teaches Environmental Science in the Department of Geography at Vancouver Island University BC, Canada. In this project, Mr. Roberts contributed with his knowledge about the case-study.