



UCSC

R+D+I CAPABILITIES

ENERGY UCSC

SCIENTIFIC TECHNOLOGICAL PORTFOLIO





PROLOGUE

Welcome.

As the Research and Postgraduate Vice-Chancellorship of the Universidad Católica de la Santísima Concepción, we are pleased to present the UCSC Energy Capabilities Portfolio, which highlights the work in Applied Research and Innovation carried out by our university in this area and presents the services available for the external market.

We are a bi-regional university with a presence in the Ñuble and Biobío regions, committed to articulating, developing, and proposing technological solutions for existing problem areas in the energy field. For this reason, UCSC has established Energy as a priority area for research and innovation in order to make headway in this topic and generate initiatives to strengthen the area.

The UCSC Energy Capabilities Portfolio is the result of work done in the framework of the 68-InES institutional project “Strengthening of the innovation ecosystem based on R+D and technological transfer of UCSC”, financed by the National Research and Development Agency (ANID), which has among its specific objectives to strengthen the relationships with local and international players that promote the development of innovation based on R+D and technological transfer in response to the demands of the external market with a focus on the areas of Energy and Hydrological Resources.

Through this portfolio, we hope to promote more strategic links with the external market, revealing the professional and infrastructure capabilities that our university possesses in Energy.

Research and Postgraduate Vice-chancellorship.



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CAPABILITIES OF UCSC IN ENERGY

The profound and challenging energy transition in Chile has established the need to intensely incorporate the areas of Applied Research and Innovation. The country seeks to generate a safe, quality, trustworthy, and efficient energy sector that is compatible with the environment. Its commitments are oriented towards improving its energy policy, increasing the incorporation of renewable energies in the generation matrix, strengthening innovative technologies based on clean energy, and pushing the decarbonization of its economy forward. In this context, Chile was highlighted as a regional leader in the advance towards a clean and sustainable energy transition during the year 2022.

Since 2018, the university has been working in the area of energy, which has been designated an emerging area. Thanks to the advance in the multidisciplinary work in R+D+i, it was established as a priority area in the year 2023, allowing academia to provide advanced professional human capital for the implementation, operation, and maintenance of the new technological processes.

► UCSC ENERGY CENTER

With the aim of promoting the development of the economy of the energy sector, as a scalable alternative for local industry, the Universidad Católica de la Santísima Concepción created the UCSC Energy Center, which joins the capabilities of the Science, Engineering, and Economic and Administrative Sciences Faculties, allowing them to develop technical assistance, R+D+i projects, intellectual copyright, and advanced human capital formation. It is the only initiative of its type in higher education institutions in the Centre-South macrozone.

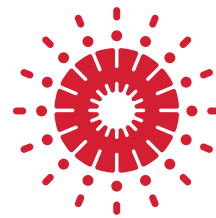
With a 400 square meter infrastructure, the “MicroRed UCSC” is noteworthy with its patio of photovoltaic panels, wind generators, and Green Hydrogen plant that is the first to be built





on a university campus anywhere in the country. This will have two lines of work. The first is the promotion of the adoption of green hydrogen for the forestry and port-logistics sectors of Biobio and Ñuble, through applications of industrial electromobility, static generation systems, and the formation of advanced human capital. The second is the creation of an urban and industrial electromobility hub.

The UCSC Energy Center is the result of collaborative multidisciplinary work and is a fundamental piece in the transformation of the region into an important pole of development through clean technologies and is key in our institutional commitment as a university to advance sustainably in the following areas:



CENTRO DE **Energía** **UCSC**

(UCSC Energy Center)

Areas

- BIOENERGY AND COMBUSTION
- ELECTROMOBILITY
- RENEWABLE ENERGIES
- ADVANCED MANUFACTURING
- ENERGY FROM GREEN HYDROGEN – H2V

BIOENERGY AND COMBUSTION

AREA DESCRIPTION

The concept of bioenergy refers to energy obtained from plant biomass, animal residues, and residues in general. Different types of chemical, physical, and thermal processes, are used in its production. This allows the production of liquid, solid, and gaseous biofuels, which have different uses and can replace petroleum-derived fuels. Some liquid biofuels are biodiesel and ethanol, while pellets and briquettes are examples of solid biofuels, and biogas is a type of gaseous biofuel.

The incorporation of the concept of biorefinery is added to that of bioenergy. The biorefinery, which is a similar concept to that of a petroleum-based refinery, aims for the production of bioplastics and diverse chemical products that are currently obtained from petroleum but, in this case, obtained through the processing of biomass.

Our country has advantageous conditions for increasing the production of biomass sustainably. The natural conditions of Chile, as well as its human capital, indicate that there are possibilities to increase the availability of raw material to supply industrial solid, liquid, and gaseous biofuel plants. However, Chile needs to grow in R+D in this field so it can compete and increase its participation in the energy matrix.

In the case of the Universidad Católica de la Santísima Concepción, researchers from different multidisciplinary areas have carried out projects related to reusing biomass for combustion, starting from sustainable forest management in order to diminish the atmospheric pollution and from the use of residual oils for the production of new biofuels such as biopropane.

In this research area, UCSC seeks to contribute to the socio-productive sector with its R+D capabilities to generate solutions in the area of safe, efficient, and sustainable energies for a better and greater energy diversification with regional and national implications.

► HIGHLIGHTED CASES

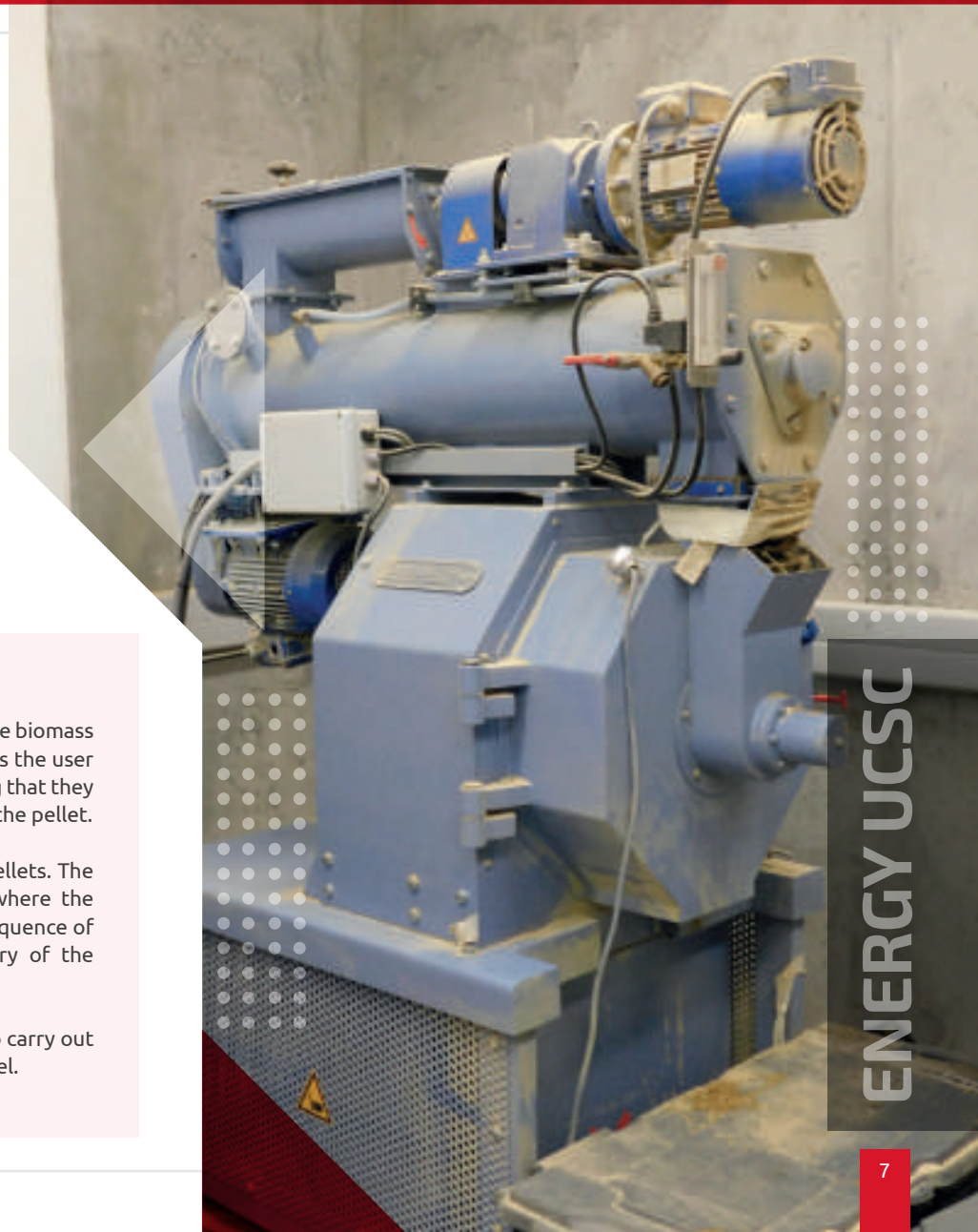
Biobío Pellets Project: UCSC, with the objective of improving and getting the most out of the production of pellets for home fuel from sustainable forest management, with direct benefits to “MiPymes”, developed this project with support from FIC-R of the Regional Government. The idea emerged from the coordinated work of researchers from the Science, Engineering, and Economic and Administrative Sciences faculties of UCSC, with the backing of the Innovation Office.



Second Generation Biopropane Production via an integrated biotechnological/thermochemical process: Due to the need to diversify the national energy matrix with new fuels that reduce carbon emissions and the need in the society (mainly in lower income areas) for low-cost fuels for home heating, while avoiding emissions of particulate matter, the university carried out the project "Second Generation Biopropane Production via an integrated biotechnological/thermochemical process". This consists of seeking to make the most of residual lipids for the production of this fuel and was financed by the National Agency for Research and Development through the Research and Development Idea Competition 2020 (IDeA I+D) Fondef and supported by Gasco and Rendering S.A.

ADDITIONAL INFORMATION

- UCSC has a laboratory for the analysis of chemical parameters, both for the biomass and for the final product (according to the norm ISO 17225), which allows the user to obtain information about the composition and emissions of the heating that they are using and, in this way, maximize the standardization of the quality of the pellet.
- The university carries out training and dissemination about the use of pellets. The most recent example was with Baldomero Lillo Highschool in Lota, where the educational community was trained in this type of technology as a consequence of the implementation of a pilot project of pellet heating in the library of the establishment.
- UCSC has an agreement with the Gasco company, which has allowed it to carry out an exploratory study for the production of biopropane from pellets as fuel.



ELECTROMOBILITY

AREA DESCRIPTION

Electromobility is the use of vehicles that use electricity as their main source of energy, with the aim of achieving more sustainable transport. These vehicles have total or partial electric functionality, storing energy on board. These electric means of transport are silent, efficient, have low emissions, and have been mainly used in cities.

At a national level, the need to advance towards sustainable development has been growing over the years, with the aim of improving quality of life for the population and slowing down, in some manner, the effects produced by greenhouse gasses. In addition to this, thanks to the updating of the National Strategy of Electromobility (which includes a roadmap with the objective of accelerating the implementation of electric transport) and the coming into effect of the Efficient Energy Law, this area has taken on increased strength at a national level.

UCSC has electric vehicles for cargo transport acquired for teaching and research into industrial applications of electromobility and they can be adapted to replace or complement the use of batteries with hydrogen fuel-cells for greater autonomy.

In this way, through the research that can be done and the capability already installed in the university, we expect to contribute to the Biobío region reaching its potential and becoming an important pole of development through this clean technology.



► HIGHLIGHTED CASE

Industrial Electromobility: The university has an Industrial Electromobility Laboratory, located in the UCSC Energy Center, equipped with two electric cargo vehicles and two electric forklift. The space includes advanced instruments for entering and analyzing data, equipment for measuring battery state, and georeferentiation devices for tracking the vehicles' routes, among others.

ADDITIONAL INFORMATION

- On the 18th of January 2022, the Electromobility Agreement, led by the Energy Ministry, was signed. UCSC participated, committing itself to “fostering R+D+i in the area of industrial electromobility through the implementation of laboratory, application to tendered initiatives, and the formation of advanced human capital”.
- The Electrical Engineering Department is leading different projects related to industrial electromobility that connect to the National Strategy for the accelerated development of electromobility.
- The diploma in sustainable energy is a program addresses technological, economic, environmental, social, and regulatory content for formulating and managing sustainable technologies for electrical and thermal generation, energy efficiency, and storage, among other applications, to contribute to developing a sustainable society.
- The diploma in electromobility is a program focused on providing the necessary tools to stay up to date on electromobility, with the knowledge to analyze the different electric vehicle technologies, charging and energy storage infrastructure, regulatory aspects, and business models to evaluate projects, associated with electromobility and thus contribute to the energy transition of our country.



RENEWABLE ENERGIES

AREA DESCRIPTION

Renewable Energy refers to energy obtained from virtually inexhaustible natural sources, be it for the immense amount of energy they contain or because they are able to regenerate by natural means.

Energy transition plays a fundamental role in reaching carbon neutrality by 2050. With this objective in mind, Chile has committed to developing a safe, trustworthy, and efficient energy sector that is compatible with the environment and oriented towards improving its regulatory framework and energy policy, increasing the incorporation of renewable energies, strengthening innovative technologies based on clean energy, and encouraging the decarbonization of its economy.

Since 2014, the country has registered a growing participation of conventional and non-conventional renewable sources in its energy matrix. In 2020, the change was most noticeable, and clean sources reached 46.5% of the total generation, the greatest production in almost 15 years.

UCSC has done important work in renewable energies, highlighting its capabilities in infrastructure that allow it to develop pre and postgraduate teaching, as well as the possibility of applied research, thus contributing to the sustainable development of the region.

Thanks to the institution's initiatives, this area includes advanced human capital that evaluates different technologies or prototypes developed for the optimal conversion of renewable energy that is, by nature, variable. Along the same lines, it is possible to identify uses and applications of this energy, such as electromobility and the production of green hydrogen, considering the challenges involved in its implementation in a real scale system with variable environmental conditions.

► HIGHLIGHTED CASES

MicroRed UCSC: An emblematic project in the engineering area with 44kW photovoltaic solar and wind-powered self-generated electricity plant, installed in the San Andrés campus that supplies faculties and laboratories with renewable energy. The system is composed of different technologies of photovoltaic modules, inverters, and solar tracking equipment and allows different configurations of isolated electric networks or networks connected to conventional supply. The microgrid has distinct types of photovoltaic modules (polycrystalline, monocrystalline, and fine layered), inverters (on-grid, off-grid, hybrid, microinverters, inverters with and without transformers), three solar tracking systems (on one axis, on an inclined axis, and with two axes), and wind generators (vertical axle and horizontal axle).



It also allows distinct configurations of electrical networks.

Geosolar Drier: Another application of renewable energies is in technological drying processes that consume important amounts of energy and are present in varied industrial activities. To face this issue, the institution has a Geosolar Drier that uses geothermic, thermic-solar, and photovoltaic-solar energy in order to reduce energy usage and contribute to the economic feasibility of the process. The geothermic system possesses three subterranean heat exchangers, two surfaces for capturing thermic solar energy, and a hybrid photovoltaic system composed of photovoltaic modules, inverter chargers, and a battery bank to supply electric energy for the process.

ADDITIONAL INFORMATION

- Study for the implementation of a photovoltaic park (solar energy plant) in the Chacalluta Airport, organized by the Sociedad Concesionaria Aeropuerto de Arica (Sacyr-Agunsa consortium) and developed by Universidad Católica de la Santísima Concepción.
- Design of the ad-hoc energization system for submergible ocean cage rafts required by EcoSea Farming SpA and developed by Universidad Católica de la Santísima Concepción.
- H2V CAP Project, in the context of the first call for project finance for Green Hydrogen in Chile, successful bidder for US\$3.6 million to develop a prototype project for the production of green hydrogen in Compañía Siderúrgica Huachipato S.A., and formulated by Universidad Católica de la Santísima Concepción.



▶ ADVANCED MANUFACTURING

AREA DESCRIPTION

Advanced Manufacturing is a set of activities that depend on the use and coordination of information of the process, on automatization, on data handling, and on hardware and software. In addition, it makes use of cutting-edge materials, along with emerging manufacturing capabilities that are enabled by science. This is a new way of making existing products, as well as the manufacturing of new products that emerge from new and original technologies.

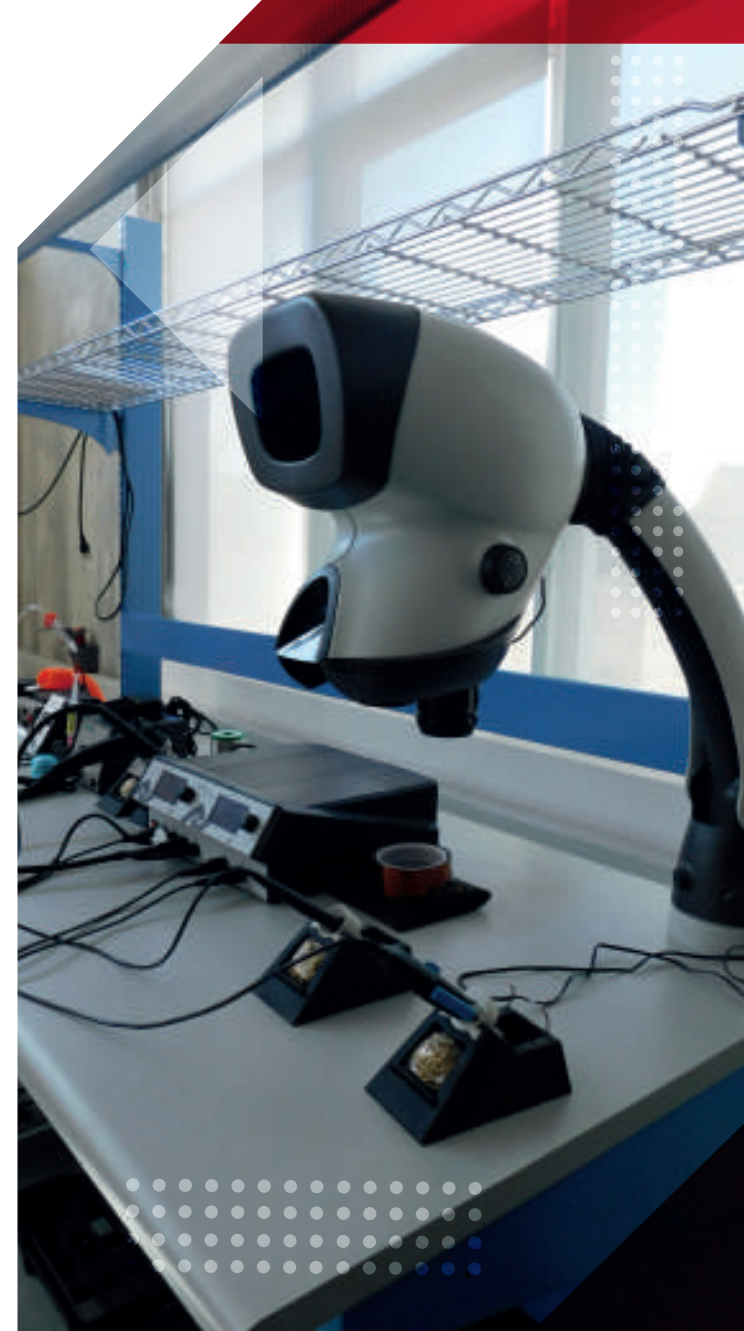
UCSC has an interdisciplinary technological program in the area of 'sonorización' and additive manufacturing that seeks to be an enabling axis in the development of critical and groundbreaking technological solutions that allow national industry to advance towards advanced manufacture. The initiatives have a nationwide impact through the strategic alliance with different, associated, and interested industries, which has allowed the development of diverse R+D projects with multidisciplinary teams that include more than 40 specialists and professionals.

▶ HIGHLIGHTED CASE

Strategic Technological Program: supported by CORFO, led by UdeC, and co-executed by UCSC and Inacap, this is the base station for a multidisciplinary team of researchers, engineers, technicians, and designers that work together to develop methodologies, create products, optimize technologies, and develop capabilities to increase the generation of high-performance products for attractor industrial sectors.

UCSC Advanced Manufacturing participates by contributing to creating a collaboration platform that allows the validation, scaling, and commercialization of technological solutions that deal with the challenge of advancing from traditional manufacturing towards an advanced one, thanks to the intensive use of enabling technologies and new business models that will positively impact productivity and quality of goods and services, as well as installing technological capabilities in Chile to capture new business opportunities based on modern, flexible, and scalable manufacturing processes.

The available infrastructure, technological capabilities, and advanced human capital allow the development of embedded sensors for operation in industrial environments; intelligent and autonomous embedded electronic systems including advanced energization and



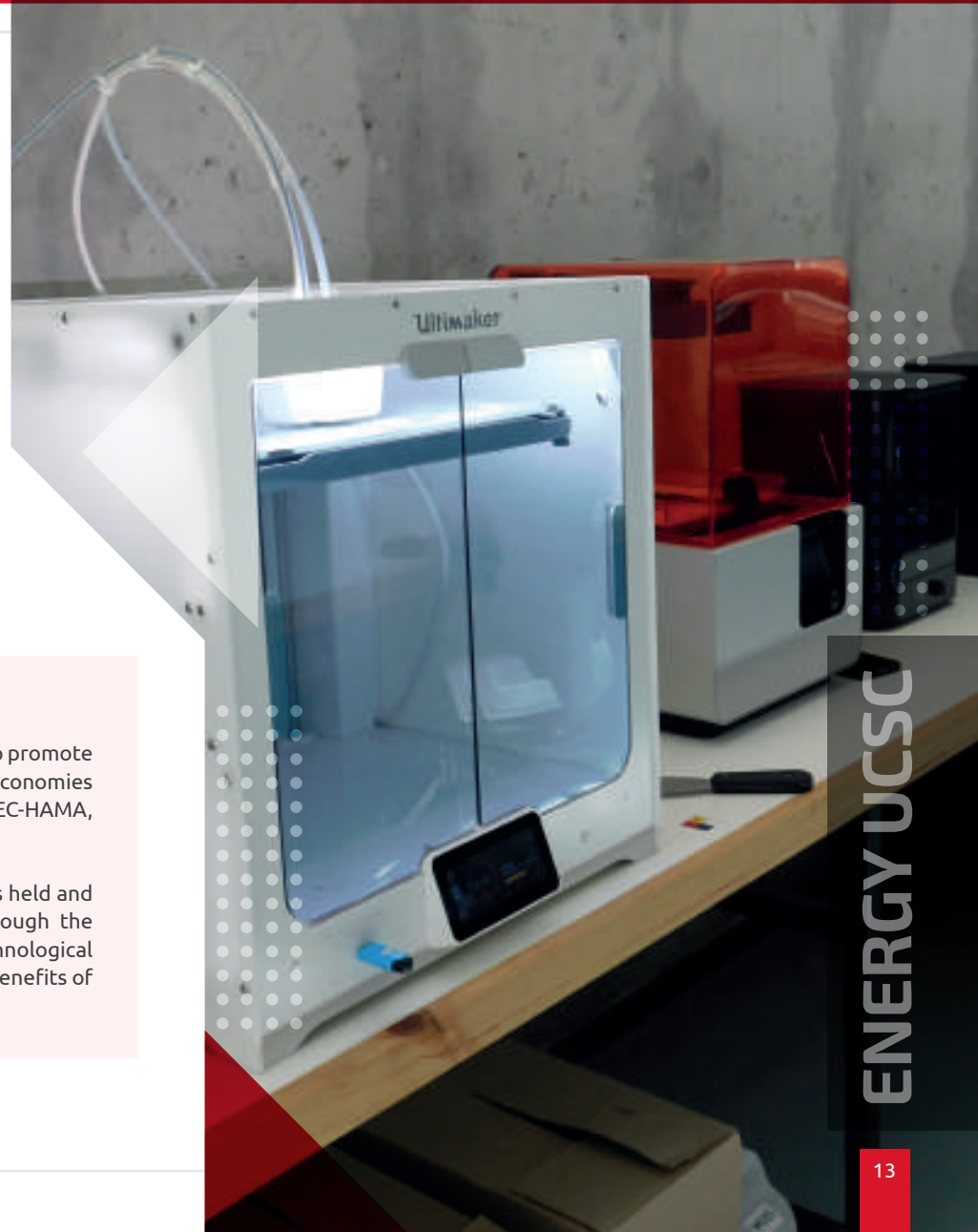
communication techniques; laying out of data communication systems for the implementation of cyberphysics systems; and designing of technological and artificial intelligence tools to generate dynamic recommendations for decision making in industrial processes. Additionally, the available capabilities allows the design and implementation of personalized parts of complex shapes from additive manufacturing processes, improving response times, considering multiple material natures for low productive volumes, and integrating different sonorización solutions.

<https://ptechama.cl/>



ADDITIONAL INFORMATION

- In 2021 the first Advanced Manufacturing Summit was held and helped to promote the development of the manufacturing industry in the different local economies of the country through its strategic technological programs: PTEC-HAMA, Innovation in Advanced Manufacturing (IMA+), and CEM3D.
- In 2022, the second version of the Advanced Manufacturing Summit was held and had, as its aim, to provide companies with the chance to learn, through the application of real cases, the capabilities and activities of the technological programs supported by CORFO and give them an approximation of the benefits of incorporating new technologies.



ENERGY FROM GREEN HYDROGEN - H2V

AREA DESCRIPTION

Renewable or green hydrogen (H2V) is obtained by electrolysis of water by renewable energy. Its production is a chemical process that uses electric energy from renewable energy sources, which feeds an electrolyzing system that separates the water molecule into hydrogen and oxygen. In this way it is possible to separate the hydrogen from the water molecule to then store/dis tribute it or use it directly.

In our country it is a technically feasible, economically viable, and socio-environmentally friendly solution. The energy future must be supported by low emissions technologies, production at competitive costs, as well as being inclusive and resilient. The unique conditions for the generation of renewable energy in Chile have placed the country in a privileged position to lead the production of HV2, and with this become protagonists of the worldwide energy transition.

UCSC has proposed having an active role in the execution of initiatives for the implementation of phase production plant and the use of Green Hydrogen for the development of prototypes for industrial applications for the Biobío region. For this reason, and thanks to a grant from the Biobío Regional Government, the H2V production

plant is being implemented, together with the construction of storage systems and posterior use in energy systems and electromobility. To produce H2V, energy from the microgrid will be used to complete the whole chain of value of Green Hydrogen inside the San Andrés campus of the university, i.e., the generation of renewable energy, the electrolysis process, storage, fitting out, and use of H2V in industrial applications in the Biobío region.

► HIGHLIGHTED CASE

FNDR Project “UCSC green hydrogen plant construction for industrial applications in the Biobío region”: The “MicroRed UCSC” is the infrastructure responsible for producing the electric energy necessary to feeding the electrolysis systems that will produce the H2V. The Green Hydrogen produced will be stored and used in two families of applications:

- Static applications that use H2V as a source of energy storage, to use it and provide support and stability to the national electrical system, as well as opening the option of replacing the electricity generated by generators that use fossil fuels and replacing them with H2V-based generators that emit, when in operation, only steam into the atmosphere.



- Mobile applications, focused on implementing H2V in applications in industrial electromobility. For this reason, UCSC has a 100% electric truck and pick-up truck, along with an electric forklift with a cargo capacity of 1.6 tons which will be modified to integrate H2V to obtain equipment whose operation will be equivalent to that of conventional vehicles, but without a carbon footprint, for operations like those of industry in the southern macrozone.

Having the laboratory for the production of Green Hydrogen and the necessary equipment will allow the university to foster R+D activities in conjunction with the public and private sectors in the context of generating early experiences for transfer to industry, like for example, static applications (energy sources) or mobile ones (electromobility).

The advantage of this initiative is that it is directed at solving real industry problems through the piloting of different technologies.

ADDITIONAL INFORMATION

- UCSC is working on implementing green hydrogen in the forestry sector and in port logistics.
- Agreement with the Municipality of Mulchén for the formation of students and teachers of technical-professional high schools in the municipality in the area of Green Hydrogen. This is an initiative aligned with the Energy Ministry's National Strategy of Green Hydrogen.
- The UCSC team formulated the CORFO project that CAP Huachipato successfully bid for, equivalent to US\$ 3.6 million, for the implementation of an H2V production plant inside the Huachipato site, which generates a significant impact for the Biobío region.
- The entire H2V value chain will be in operation in the central campus of the university. The equipment available will allow training and specialization with a strong practical component that differentiates us from any other institution in the country. At this moment the total investment in the H2V value chain implemented in UCSC approaches CLP \$1.000 million.

UCSC CAPABILITIES





ENERGY UCSC

MACHINE AND ELECTRIC DRIVE LABORATORY

DESCRIPTION

Created in 2014 for teaching and applied scientific research in the area of electric drive systems.

DEPARTMENT

Electrical Engineering, Engineering Faculty.

AREAS OF KNOWLEDGE

- Electric drive systems.

TECHNOLOGICAL OFFERING

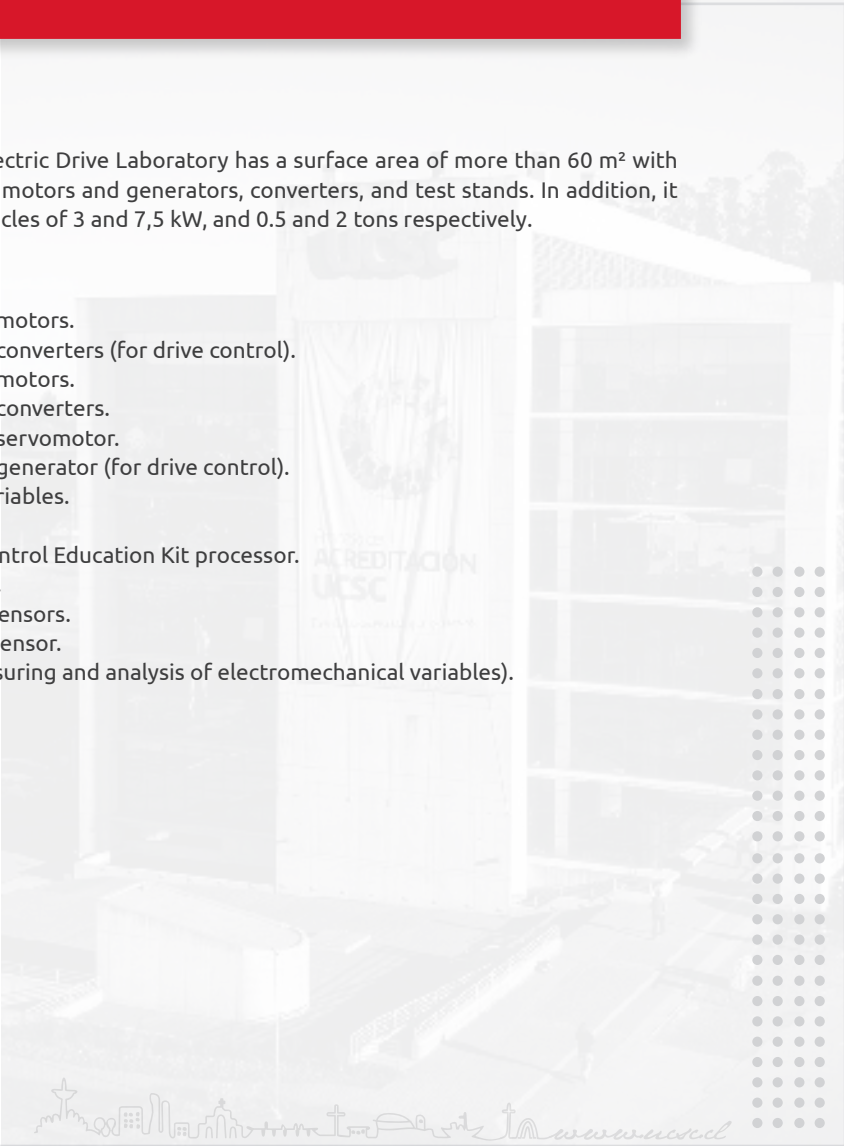
- Studies and consulting in electric drive systems.
- Training in electric drive systems.

▶ INFRASTRUCTURE

The UCSC Machine and Electric Drive Laboratory has a surface area of more than 60 m² with different types of electric motors and generators, converters, and test stands. In addition, it has two electric cargo vehicles of 3 and 7,5 kW, and 0.5 and 2 tons respectively.

▶ EQUIPMENT

- 2 continuous current motors.
- 2 continuous current converters (for drive control).
- 4 alternating current motors.
- 4 alternating current converters.
- 1 alternating current servomotor.
- 1 alternating current generator (for drive control).
- Logger for electric variables.
- Vibration analyzer.
- DSPACE Advanced Control Education Kit processor.
- MicroLabBox DS1202.
- Current and voltage sensors.
- Linear displacement sensor.
- Encoders (use in measuring and analysis of electromechanical variables).



UNIT EXPERIENCE

▶ PROJECTS EXECUTED

- FIAEC project, Evaluation of electromobility prototypes for their integration into national industrial activity (2020 - 2023).
- Fondecyt Initiation project N° 11170862: "ONLINE ESTIMATION OF ROCK PROPERTIES AND BIT WEAR MONITORING FOR MINING DRILLING RIGS USING DRIVE AND PROCESS SIGNALS" (2018 - 2020).
- Internal project INDIN N° 06/2017: "Torque Observer for Energy Efficiency Analysis in Blower Drivers for Mining Foundries" (2017 - 2018).

▶ RESEARCH (2014 - 2019)

- Guillermo Ramírez, M. Aníbal Valenzuela, Steve Pittman, Robert Lorenz, "Modeling and Evaluation of Paper Machine Coater Sections Part 2: 2-Coater Section and Control Loops Bandwidths", IEEE Transactions on Industry Applications, 2019, vol. 55, pages: 1427 – 1437.
- Guillermo Ramírez, M. Aníbal Valenzuela, Steve Pittman, Robert Lorenz, "Modeling and Evaluation of Paper Machine Coater Sections Part 1: 1-Coater Section and Tension Setpoints", IEEE Transactions on Industry Applications, 2019, vol. 55, pages: 2155 – 2164.
- Guillermo Ramírez, M. Aníbal Valenzuela, Robert Lorenz, "Expert System for the Detection of Condensate Accumulation Inside Dryer Cylinders During Section Starting", IEEE Transactions on Industry Applications, 2015, vol. 51, pp: 1427 – 1437.
- Guillermo Ramírez, M. Aníbal Valenzuela "Observer-Based Estimation of Modulus of Elasticity for Papermaking Process", IEEE Transactions on Industry Applications, 2014, vol. 50, pp: 1678 – 1686.
- Guillermo Ramírez, M. Aníbal Valenzuela "Generalized Correlations for the Estimation of Condensate Power in Flooded Cylinders", IEEE Transactions on Industry Applications, 2014, vol. 50, pp: 1577 – 1589.



LABORATORY OF NATURAL RESOURCES AND BIOENERGY CHEMISTRY

DESCRIPTION

Created in 2019 to carry out basic and applied scientific research in the area of Bioresources technology, Bioenergy, and Biorefinery. It gives first preference to academic collaborations and is available to establish agreements for formal services.

DEPARTMENT

Science Faculty.

AREA OF KNOWLEDGE

- Bioenergy.
- Biorefinery.
- Biopolymers.

TECHNOLOGICAL OFFERING

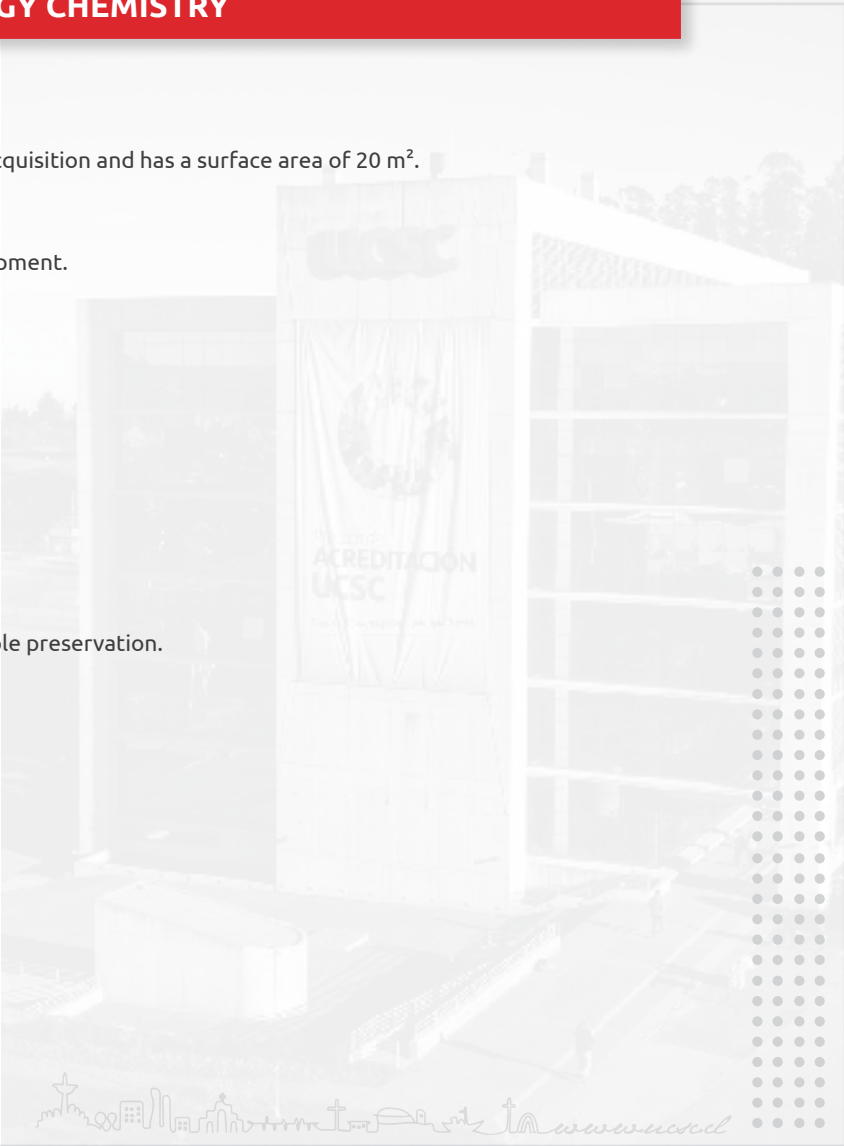
- Has the capability to carry out basic and applied scientific research in the areas of Bioresources Technology and Bioenergy. It has installed capabilities and two R+D projects at a research level.
- Has the potential to offer services in the characterization of biomass with energy potential and pellet analysis.

▶ INFRASTRUCTURE

The Laboratory is a new acquisition and has a surface area of 20 m².

▶ EQUIPMENT

- Basic laboratory equipment.
- Volumetric material.
- Calorimeter.
- Grindability tester.
- Durability meter.
- Muffle.
- Drying heater.
- Thermostatized bath.
- pH meter.
- 2 heating plaques.
- Analytical scale.
- Precision scale.
- Vacuum pump.
- Refrigerator for sample preservation.



UNIT EXPERIENCE

▶ PROJECTS EXECUTED

- FONDEF ID20I10331. Second generation biopropane production through an integrated biotechnological/thermochemical process (2020 - 2022).
- Call for postdoctoral positions UCSC (2020 - 2021).
- R+D Project. Use of eucalyptus bark generated in the wood processing industry in the Biobío region for compost generation and technosoil as an amendment for urban soils (2020 - 2021).
- Government Grant Biobío Regional Government FIC2018. Generation of bioenergy for heating from sustainable forest management in the Biobío region (2019 - 2021).
- Millenium Nuclei on Catalytic Processes towards Sustainable Chemistry (CSC) (2018 - 2020).
- FONDECYT Post doctorate 3180648. Bio-precipitation of heavy metals in wastewaters through Microbial Induced Calcite Precipitation (MICP) (2018 - 2020).



MICROGRID LABORATORY

DESCRIPTION

Created in 2017 and operating since 2019 to carry out teaching and applied scientific research in the area of renewable energies. It includes a scale system of photovoltaic and wind-powered electric energy generation with storage capacity and energy back-up, and with monitoring technologies for energy management. It allows the evaluation of on-grid, off-grid, and hybrid networks.

DEPARTMENT

Engineering Faculty.

AREAS OF KNOWLEDGE

- Renewable Energies:
 - Integration of renewable energies into electric power systems.
 - Photovoltaic solar energy.
 - Wind energy.
 - Solar tracking systems.

TECHNICAL OFFERING

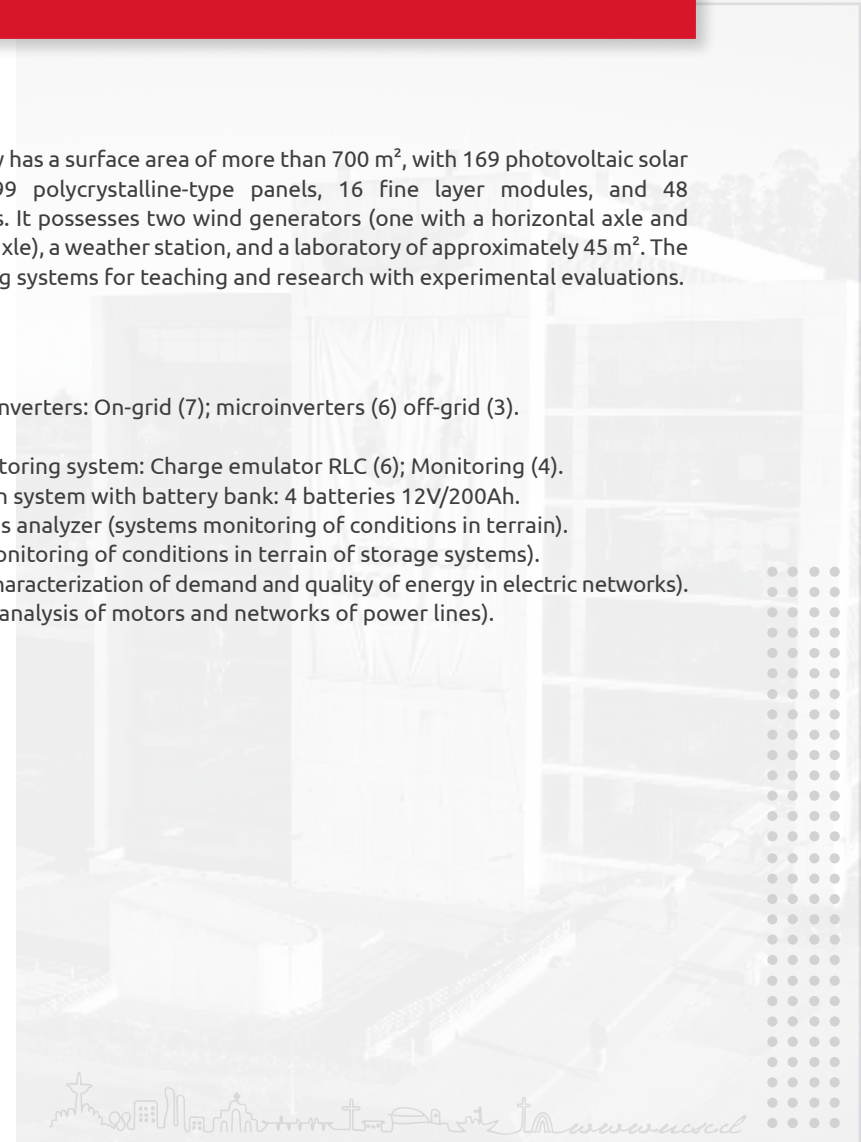
- Studies and consulting in renewable energies:
 - Studies of electrical demand for the integration of renewable energies.
 - Technical-economic feasibility studies.
- Training in electric power systems with renewable energies.

▶ INFRASTRUCTURE

The microgrid Laboratory has a surface area of more than 700 m², with 169 photovoltaic solar panels, composed of 99 polycrystalline-type panels, 16 fine layer modules, and 48 monocrystalline modules. It possesses two wind generators (one with a horizontal axle and the other with a vertical axle), a weather station, and a laboratory of approximately 45 m². The laboratory has monitoring systems for teaching and research with experimental evaluations.

▶ EQUIPMENT

- 169 solar panels.
- Inverters and microinverters: On-grid (7); microinverters (6) off-grid (3).
- 2 wind generators.
- Emulation and monitoring system: Charge emulator RLC (6); Monitoring (4).
- Energy accumulation system with battery bank: 4 batteries 12V/200Ah.
- Photovoltaic systems analyzer (systems monitoring of conditions in terrain).
- Battery analyzer (monitoring of conditions in terrain of storage systems).
- Network analyzer (characterization of demand and quality of energy in electric networks).
- Insulation analyzer (analysis of motors and networks of power lines).



UNIT EXPERIENCE

► PROJECTS EXECUTED

- “Construction of Green Hydrogen plant for industrial applications in the Biobío region”, Código BIP 40029803-0. Gobierno Regional del Biobío (2021 - 2023).
- Technological contract SACYR – Hub APTA – UCSC/2020. Technical-economic feasibility study for the implementation of photovoltaic systems in the Chacalluta Airport - Arica (2020 - 2021).
- Technological contract ECOSEA – UCSC. Design of a system of autonomous energy, including renewable energies (2021).
- “Generation of bioenergy for heating from sustainable forest management” FIC Biobío Pellets. Design and implementation of energization system through a hybrid network for a geosolar drier (2019 - 2021).
- FIAEC Project, Evaluation of electromobility prototypes for integration into national industry (2019 - 2021).

► RESEARCH (2019 - 2022)

- Felipe Rebolledo, Patricio Mendoza-Araya, Gonzalo Carvajal, Guillermo Ramírez, “Performance evaluation of different solar modules and mounting structures on an on-grid photovoltaic system in south-central Chile”, Energy for Sustainable Development, Volume 68, 2022, Pages 65-75, ISSN 0973-0826.
- Jorge Torres C., Hans Cabrera M., Anibal S. Morales and Guillermo Ramírez A., “Performance Evaluation of an On-Grid PV Installation in the Rural Foothill of Central Chile – Case Study”, 2019 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON), June 13 – 27, 2019.
- Hans Cabrera M., Britam Gómez A., Jorge Torres C., Anibal S. Morales and Guillermo Ramírez A., “Integration of Industrial Power Quality Analyzer and Open Source Hardware and Software Solution for Microgrids Monitoring”, 2019 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON), June 13 – 27, 2019.



ELECTROMOBILITY LABORATORY

DESCRIPTION

Deals with different lines of industrial electromobility for the Biobío region, supplying data and operating information for industrial equipment in the region, in terms of its real and nominal performance in the surrounding environmental conditions.

DEPARTMENT

UCSC Energy Center.

AREAS OF KNOWLEDGE

- Energy.
- Engineering.
- Electrical engineering.
- Electronic engineering.
- Mechanical engineering.

INFRASTRUCTURE

- Laboratory: 40 m².
- Outdoor workspace: 30 m².

▶ TECHNOLOGICAL OFFERING

- Consulting for the evaluation of performance linked to electromobility in nominal operation in industry:
 - Monitoring of equipment performance.
 - Operational performance considering working environment.
 - Lifting and analysis of data to encourage the industrial sector in the use of totally electric equipment, through environmentally friendly technologies, with equal or better performance than conventional equipment.
 - Reporting of adequate equipment operation in real working environments.
 - Improvement capabilities for electromobility equipment improving its performance (Green Hydrogen application, super capacitors, among others).
- Evaluation of surroundings and reductions in noise level generated the machines operating.
- Industrial market evaluation in electromobility applications.
- Carrying out market studies of available industrial equipment for the different applications required by industry.

▶ EQUIPMENT

- 1 totally electric pick-up truck, with a cargo capacity of 500 kg.
- 1 totally electric truck with a cargo capacity of 2.000 kg.
- 1 totally electric forklift with a lifting capacity of 5.000 kg.
- 1 approved electric charger Enel X brand – installed (in the process of certification).
- Generic measurement instruments (oscilloscope, current sensors, voltage sensors, differentials, inductance capacity, capacitance).
- Capacity to form or integrate electronic power systems: semiconductors Semikron and Imperex brands.
- H bridge Imperex brand.
- Others: evaluators of battery performance, geo-localization equipment, emulator of bidirectional batteries, control platform Interix brand, and MicroLabBox dSPACE.

UNIT EXPERIENCE

► PROJECTS EXECUTED

- Dr. Ricardo Lizana Fuentes, “Predictive Control of Active Front End Rectifiers”, FONDECYT Project no. 11090253, Research Assistant, 2010.
- Dr. Guillermo Ramírez Arias, Fondecyt Initiation project N° 11170862: “ONLINE ESTIMATION OF ROCK PROPERTIES AND BIT WEAR MONITORING FOR MINING DRILLING RIGS USING DRIVE AND PROCESS SIGNALS”. Principal researcher (2018 - 2020).
- Dr. Guillermo Ramírez Arias, CORFO project code 17PTECNA-102694 “PTEC-HAMA Technological program in the area of Sensorization and Additive Manufacturing with an enabling axis in the development of critical ground-breaking technological solutions that allow national industry to advance towards Advanced Manufacturing”. Collaborating researcher (2019 - 2023).
- Dr. Guillermo Ramírez Arias, Public interest innovation project CORFO code 18IIP-BB-99513: “Diagnostic and historization platform of thermic comfort, energy consumption, and air quality in public hospitals”. Professional expert in charge of energy modelling of electrical systems (2019).
- Dr. Guillermo Ramírez Arias, project Fund for Regional Competitiveness FIC-R Biobío – code BIP 40011065: “Generation of Bioenergy for heating from Sustainable Forest Management” Researcher in charge of drying biomass from ERNC (2019 - 2020).
- Dr. Guillermo Ramírez Arias, project 413131-BIP 07/IE-28 “MicroRed UCSC”, Academic in charge (2017 - 2019). Design and implementation of 44kW a self-generation plant of photovoltaic solar and wind-powered electric energy on the San Andrés campus of UCSC. The set up includes three solar tracking systems (one horizontal axis, one inclined axis, one with two axes), three technologies of photovoltaic modules (polycrystalline, monocrystalline and fine layer), on-grid microinverters, on-grid string inverters, off-grid inverters, back-up system for batteries and diesel generation, emulation equipment for RLC charges, system for monitoring and online register.
- Dr. Guillermo Ramírez Arias, internal project INDIN N° 06/2017: “Torque Observer for Energy Efficiency Analysis in Blower Drivers for Mining Foundries”. Principal Researcher (2017 - 2018).
- Dr. Guillermo Ramírez Arias, Project 15CABB-069 CIFES Regional Fund Sensibilization and Co-funding of Investment Projects in ERNC for Self-supply for “MiPymes” of the Biobío region, Director (2015 - 2016).



- Dr. Aníbal Morales Montecinos, Project Researcher, National Fund for Regional Development FNDP, GORE Biobío, “Construction green hydrogen plant for industrial applications in the Biobío region” (2021 - 2022).
- Dr. Aníbal Morales Montecinos, Alternate Director, UCSC Research Equipment Acquisition Program, “Evaluation of Electromobility prototypes for their integration into national industry” 2019.
- Dr. Aníbal Morales Montecinos, Director UCSC, CORFO 2018 18PTECMA-102694 (5 years), “PTEC-HAMA: Technological Program in the Area of Sensorization and Additive Manufacturing as an Enabling Axis in the Development of Critical Ground-breaking Technological Solutions that Allow National Industry to Advance towards Advanced Manufacturing”, UdeC-UCSC-INACAP, Chile.
- Dr. Aníbal Morales Montecinos, principal Researcher (PI) FONDECYT INITIATION GRANT 2017 – 11170388 (3 years), “Modeling, Simulation and Pareto Multi-objective Optimization of Piezoelectric Energy Harvesting Systems for Idler Condition based Monitoring Sensors in Overland Belt Conveyor Applications”, UCSC, Chile.
- Internal project CIBAS N° 511317: “Evaluation of the performance of electric vehicles for sustainable industrial production” Co-Researcher (2020 - 2022).

► RESEARCH LINES

- HVDC transmission lines based on Multilevel Modular Converters (MMC).
- Multilevel converter control.
- Industrial electric drivers.
- Renewable energies.
- Energy Harvesting, Energy Efficiency, Electrical Safety, and Technology for the Mining Industry.
- Copper Electrowinning and Electrorefining.
- Power electronics, Power converters, and High-current rectifiers.
- Multiphysics Modeling FEM and DEM.



GEOSOLAR DRYING LABORATORY

DESCRIPTION

Drying unit from the integration of renewable energies as a strategy of economic and environmental sustainability.

DEPARTMENT

UCSC Energy Center.

AREAS OF KNOWLEDGE

- Geotechnic.
- Engineering:
 - Mechanical.
 - Electrical.
 - Chemical/Environmental.
- Automatization.

TECHNOLOGICAL OFFERING

- Drying tests with different types of biomass:
- Active air solar technology.
 - Geothermic photovoltaic technology.

INFRASTRUCTURE

- Machine room with 12 m² surface area.
- Drying chamber with 12 m² surface area and 2 m height.

▶ EQUIPAMIENTO

- 3 intercambiadores de calor instalados en el subsuelo: intercambiador horizontal, un intercambiador slinky horizontal y un intercambiador slinky vertical.
- 1 sistema de intercambiadores solares térmicos (aire-solar), compuesto por un intercambiador marca Grammer y un diseño propio.
- 1 estanque acumulador de agua.
- Cámara de secado.
- 1 bomba de calor.
- 1 tanque de expansión.
- Paneles de instrumentación.
- 1 Sistema de circulación de agua (tuberías, válvulas y bombas de recirculación).
- 1 sistema de baterías e inversores y paneles fotovoltaicos.
- ▶ Sistema de adquisición y registro de datos.

PROYECTOS EJECUTADOS

- “Generación de bioenergía para combustión a partir del manejo forestal sustentable en la región del Biobío” (directora alterna).
- ▶ Fondo de Innovación para la Competitividad Regional del Biobío 2018, (2019 - 2021).

LINEAS DE INVESTIGACIÓN

- Integración de ERNC para el secado industrial.
- Producción de químicos intermediarios y/o combustibles alternativos al petróleo (estudio de sistemas catalíticos), modelamiento matemático de sistemas energéticos, eficiencia energética en sistemas de producción.



ADVANCED MANUFACTURING LABORATORY

DESCRIPTION

The Advanced Manufacturing Laboratory was created in 2021. It is a UCSC initiative that is part of the Strategic Technological Program PTEC-HAMA Enablers in Advanced Manufacturing supported by CORFO, led by UdeC and co-run by UCSC and Inacap. This technological program in the area of sensorization and additive manufacturing seeks to be an enabling axis in the development of critical ground-breaking technological solutions to allow the national industry to advance towards advanced manufacturing. PTEC-HAMA is a base station of a multidisciplinary team of professionals who work together to develop methodologies, create products, optimize technologies, and strengthen capabilities that increase the generation of high-performance products for attractor industrial sectors.

UCSC Advanced Manufacturing participates in PTEC-HAMA contributing to create a collaboration platform that allows the validation, scaling, and commercialization of technological solutions that deal with the challenge of advancing from traditional manufacturing towards an advanced one.

The available infrastructure, technological capabilities, and advanced human capital allows the development of embedded sensors for operation in industrial environments; intelligent and autonomous embedded electronic systems including energization and advanced communication techniques; laying out of data communication systems for the implementation of cyberphysics systems; and design of technological and artificial intelligence tools to generate dynamic recommendations for decision making in industrial processes. Additionally, the available capabilities allow the designing and implementing of personalized parts of complex forms from a process of additive manufacturing, improving response times, considering multiple materialities for low productive volumes, and integrating different sensorization solutions.

DEPARTMENT

- ▶ Engineering Faculty - DIE.

AREAS OF KNOWLEDGE

- ▶ • Sensorization and cyberphysics systems.
- Industrial internet of things (IIoT).
- Additive manufacturing, 3D printing.
- Artificial intelligence, Machine learning, Computer Vision.
- Cloud computing, On Premise, Edge devices.

INFRASTRUCTURE

- ▶ • The laboratory has 35 m² surface area located in the UCSC Energy Center.

TECHNOLOGICAL OFFERING

- ▶ Currently the laboratory can:
 - Support the development of R+D projects.
 - Provide technical assistance services and consulting in digital transformation.
 - Support in design and execution of industrial pilot testing.
 - Provide technological vigilance and competitive intelligence services.
 - Develop Data Science + Artificial Intelligence + Machine Learning projects.
 - Develop IoT + Cloud computing sensor platforms.
 - Develop applied Computer Vision projects.
 - Provide training services in Industry 4.0 technologies.



► EQUIPMENT

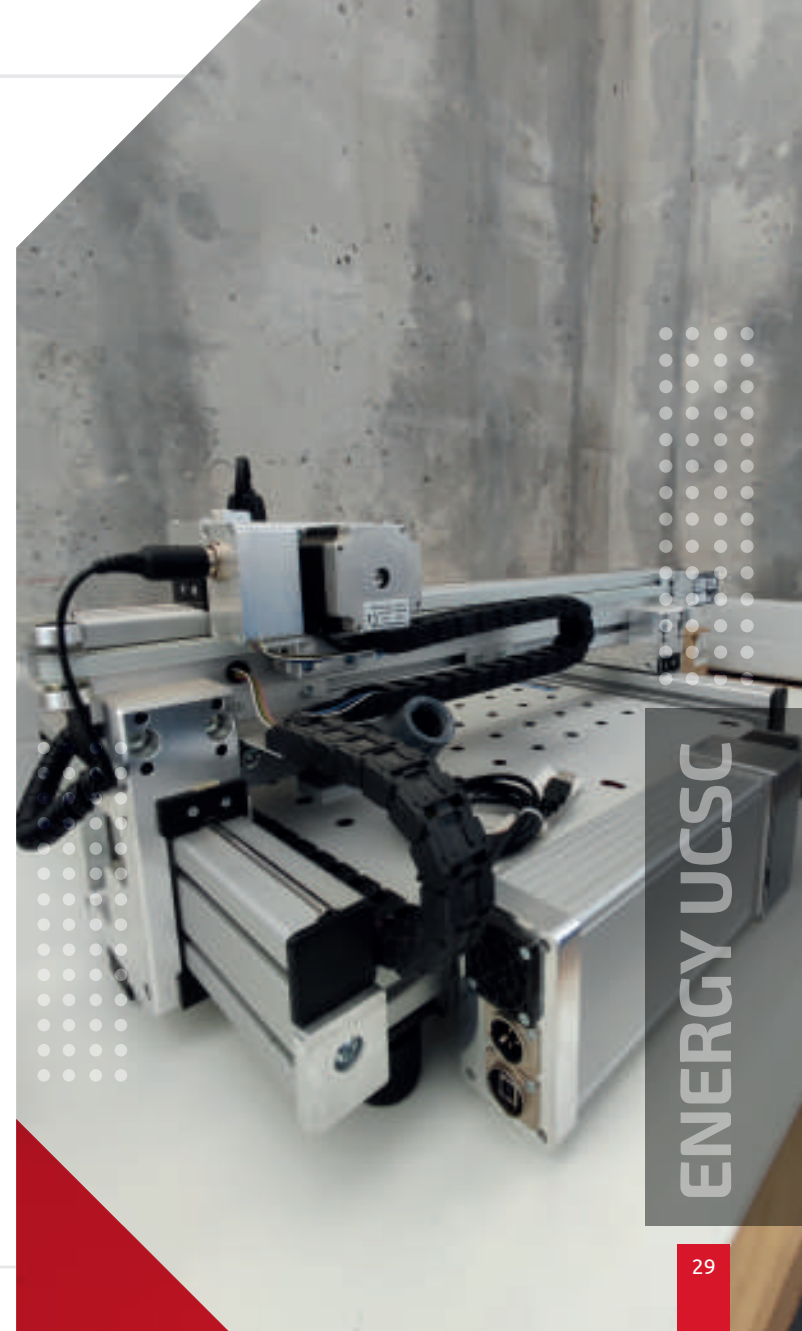
Among other technologies, the laboratory currently has:

- CNC drill and router with numerical control Bungard model CCD/2/ECO (with ISOCAM 5.0 software).
- Ultimaker S5 professional 3D printer (industrial-grade parts).
- Formlabs Form2 3D rein printer with FormCure and FormWash kit.
- ERSА I-CON VARIO4 professional soldering station with MOTIC LED60T lighting ring.
- ERSА I-CON NANO IC1200A soldering station with QUICK 850DESD 320 W hot air station.
- Stereo microscope MOTIC SFC11B, (6) Multimeter TrueRMS with integrated thermic chamber Fluke 279FC/IFLEX.
- Digital Oscilloscope TEKTRONIX MDO3012 100MHz 2.5 GS/s.
- Meter/Analyzer of standard industrial vibrations PCE Instruments PCE-VM25.
- MiniShaker The ModalShop K20078E1 vibration generating equipment.
- Energy quality recorder and analyzer Hioki PQ3100 + Accessories 300A.
- Energy quality recorder and analyzer Hioki PQ3100 + Accessories 3000^a.
- Portable standard industrial oscilloscope Fluke Scopemeter 190-504-UN-S 500MHz 2.5GS/s.

UNIT EXPERIENCE

► PROJECTS EXECUTED

- National Fund for Regional Development FNDR, GORE Biobío, “Construction green hydrogen plant for industrial applications in the Biobío region” (2021 - 2022).
- UCSC Research Equipment Acquisition Program, “Evaluation of Electromobility prototypes for their integration into National industry” (2019).
- Coexecutor CORFO 2018 18PTECMA-102694 (5 years), “PTEC-HAMA: Technological Program in the Area of Sensorization and Additive Manufacturing as an Enabling Axis in the Development of Critical Ground-breaking Technological Solutions that Allow National Industry to Advance towards Advanced Manufacturing”, UdeC-UCSC-INACAP, Chile (2018).
- FONDECYT INITIATION GRANT 2017 – 11170388 (3 years), “Modeling, Simulation and Pareto Multi-objective Optimization of Piezoelectric Energy Harvesting Systems for Idler Condition based Monitoring Sensors in Overland Belt Conveyor Applications”, UCSC, Chile (2017).



MAJOR EQUIPMENT LABORATORY

DESCRIPTION

Created in 2021 to carry out basic and applied scientific research in the area of bioresource technologies; Biopolymers, Bioenergy y Biorefinery. Its infrastructure, technological capabilities and human capital allow it to study and optimize methods for the quantitative and qualitative identification of biopropane, jet fuel, synthesis gas, biochar, and hydrocarbons from economically important and/or residual biomass. The research seeks to respond to current needs of the national energy matrix.

DEPARTMENT

Science Faculty.

AREAS OF KNOWLEDGE

- Bioenergy.
- Biorefinery with a focus on the complete use of the biomass.
- Biogeochemical processes, particularly of the soil.
- Fire ecology and the pyrogenic carbon cycle.
- Application of stable isotopes, hydro pyrolysis, and organic matter fractionation techniques.

INFRASTRUCTURE

- The Laboratory is a new acquisition and has 34 m² of surface area.

▶ TECHNOLOGICAL OFFERING

Currently the Laboratory can:

- Support the development of R+D projects.
- Determination and quantification of biopropane through gas chromatograph with thermic conductivity detector (GC/TCD).
- Qualitative and quantitative determination by gas chromatography with flame ionization detector (GC/FID).
- Characterization and composition of biomaterials (i.e., mass) through thermogravimetric analysis (TGA) and differential scanning Calorimetry (DSC).
- Determination of the concentration and stable isotopic composition of light elements (C,N,H,O) in samples in solid, liquid, and gaseous states.

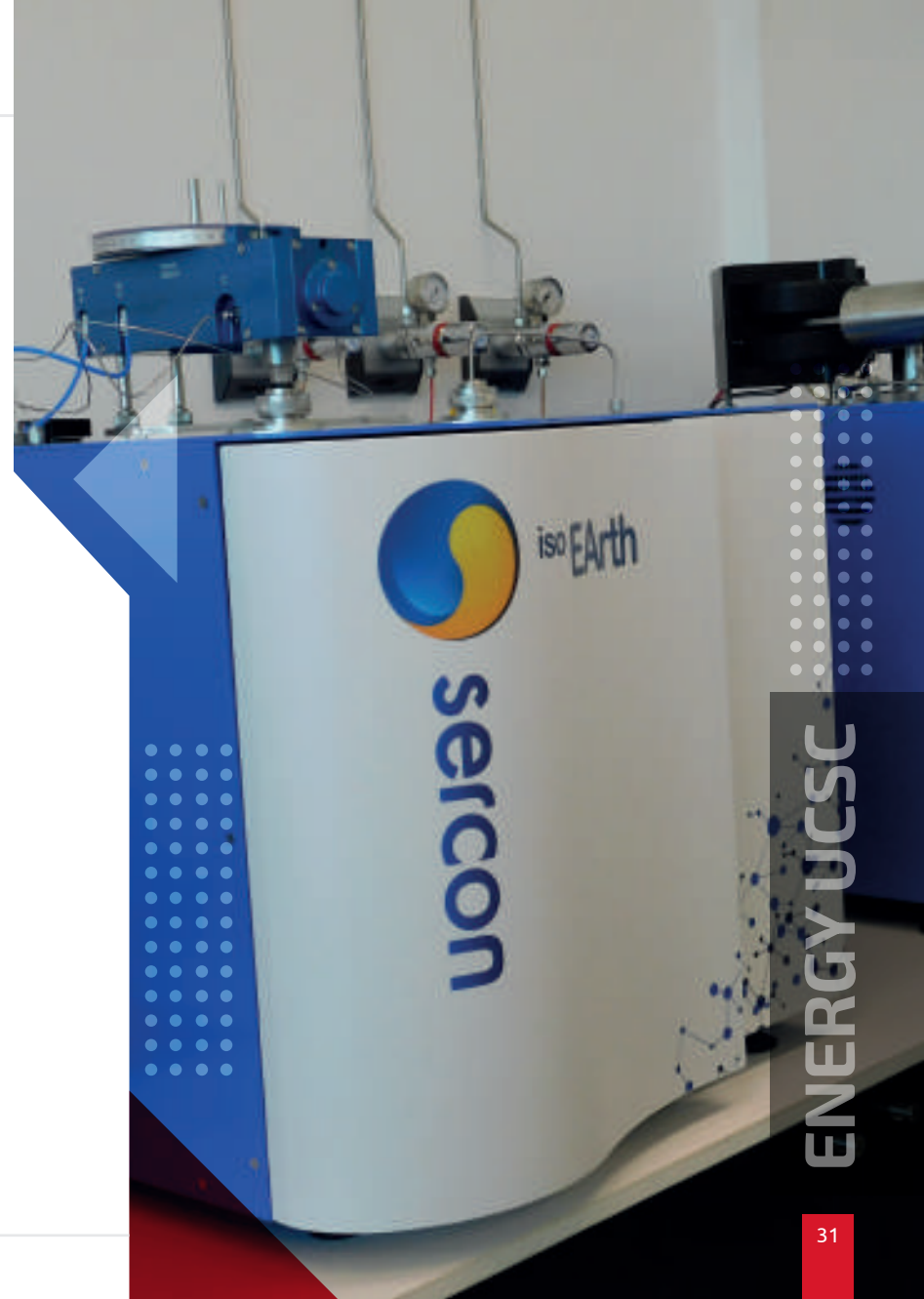
▶ EQUIPMENT

- GC – TCD, gas chromatograph with thermic conductivity detector. Used to identify and quantify gasses like CO₂, propane, butane; related with bioenergy and biorefinery of recycled oil for obtaining propane.
- GC – Fid (detector with flame ionization), gas chromatograph. Used to quantify compounds with high molecular weight and to characterize long or short chain fatty acids. Used to characterize plants, detect levels and concentrations of essential fatty acids (DHA in fisheries to make the most of nutritional contributions), and in organisms. Used to characterize the profile of fatty acids for energy use (oils, biological organisms [fish and plants], or matrixes [soil sediments]).
- TGA – Thermogravimetric analyzer. Used for lignocellulosic biomass, polymers, agricultural residues, and algae. The aim is to detect if the type of sample analyzed has the potential to be used as a bioresource.
- It is possible to determine the humidity, volatile compounds, fixed carbon and ashes, and differential thermogravimetric analysis, as well as identifying macromolecules (lipids, proteins, and carbohydrates).
- IRMS HS2022 Spectrometer, Equipment to measure isotopes. It has a Tesla coil and is used for oxygen, carbon, and nitrogen analysis.
- Iso Earth elemental analyzer elemental, in conjunction with the HS2022.
- Iso Earth in conjunction with the HT-EA.

UNIT EXPERIENCE

▶ PROJECTS EXECUTED

- “Biorefinery of urban greening waste for the production of solid biofuels and chemical building blocks, based on a hydrothermal carbonization process” FONDECYT 1211209 (2021 - 2025).
- “Production of Biopropane from pellets using a thermochemical process and nano-catalysts” R+D Project 2022.
- Pyrogenic carbon sequestration in Australian soils. Discovery Project. Australian Research Council. DP Grant 210100881 (2021 - 2023).
- “Production of second generation biopropane through an integrated biotechnological / thermochemical process” FONDEF ID20110331 (2020 - 2022).
- “ES-CL”> Use of eucalypt bark generated in the wood processing industry in the Biobío region for the generation of compost and technosoil as an amendment for urban soils. R+D Project (2020 - 2021).



PILOT LABORATORY OF RESEARCH IN BIORESOURCES AND BIOENERGY

DESCRIPTION

Implemented in 2021 to carry out basic and applied scientific research in the area of bioresources and bioenergy (solid fuels).

DEPARTMENT

Science Faculty.

INFRASTRUCTURE

- Bioenergy and combustion pilot laboratory of 50 m².

TECHNOLOGICAL OFFERING

- Production and characterization of pellet from a base of different biomasses, such as agricultural residues, forestry residues, etc., at a pilot and laboratory scale.

▶ EQUIPMENT

- Conventional pellet heater with outflow to capture emissions for the identification of gasses.
- Pellet thermoheater (mix of boiler – hot water – and conventional heater) with outflow to capture emissions for the identification of gasses.
- Pellet boiler with outflow to capture emissions for the identification of gasses.
- Pellet making machines that work under ISO 17225 certification standards.
- Chipper for branches, trunks, leaves, any type of forestry residue, and plants.
- Semi-industrial hammer mill to reduce biomass with particles smaller than 10 mm (100 kg/h).
- Pilot scale pelletizer with a capacity of 400kg/h (Munch brand).
- Sieves: fine-grain analysis by sieves of different granulometries.
- Durability meter: Analysis of mechanical durability of the pellet (measurement of resistance and durability of the pellet to mechanical movement) to simulate its useful lifespan.
- Manual press: simulates pellet manufacture at laboratory scale. A determined pressure is used to make pellets to the same density. This is very useful to measure calorific power.
- Cylinder to measure apparent density of pellets. Developed to meet ISO 17225 measurement requirements.
- Hardgrove grindability tester, capable of measuring the energy necessary to reduce a biomass in size to a specific particle (extrude pellets of a certain formulation).



BIOMASS THERMAL PROCESSING LABORATORY

DESCRIPTION

Launched in 2021 to carry out fundamental and applied scientific research in the area of Bioenergy and Biorefinery Technology. It provides biomass and pellet characterization services and obtaining value-added products based on agricultural, industrial, commercial (in the case of oil) and urban (in the case of pruning) waste to companies and industry.

DEPARTMENT

Science Faculty.

AREAS OF KNOWLEDGE

- Thermochemical processes for the production of biofuels such as biopropane, jet fuel, synthesis gas, biochar and hydrocarbons.
- Biorefinery for the generation of high-value products "building blocks".

INFRASTRUCTURE

- The laboratory has 20 m² surface area located in the UCSC Energy Center.

▶ TECHNOLOGICAL OFFERING

Currently the laboratory allows:

- Obtaining biopropane and bio-oil from carboxylates through a pyrolysis process.
- Obtaining biochar and building blocks from biomass, through hydrothermal carbonization reactions.

▶ EQUIPMENT

- Calorimeter, which is used to quantify the calorific value of different materials, for example: lignocellulosic biomass (tree species, agricultural waste, industrial waste, oils and among others).
- Reactor with temperature, gas inlet and pressure control (volume 1 liter) hydrothermal carbonization of lignocellulose biomass, urban pruning waste and agricultural waste. It has been used to obtain coal based on materials and the liquid stream with block molecules of high added value.
- Pyrolyzer.
- pH meter.
- Vacuum pump.
- Sieves.
- Conductimeter.
- Glass material.
- Bulk scale.



UNIT EXPERIENCE

▶ PROJECTS EXECUTED

- “Biorefinery of urban greening waste for the production of solid biofuels and chemical building blocks, based on a hydrothermal carbonization process” FONDECYT 1211209 (2021 - 2025).
- “Production of Biopropane from pellets using a thermochemical process and nanocatalysts” R&D Project 2022.
- “Second generation biopropane production through an integrated biotechnological/thermochemical process” FONDEF ID20110331 (2020 - 2022).
- “ES-CL”> Use of eucalyptus bark generated in the wood processing industry in the Bío Bío region for the generation of compost and technosoil as an amendment to urban soils” R&D Project (2020 - 2021).
- “Generation of Bioenergy for combustion from sustainable forest management.” Innovation Fund for Regional Competitiveness (FIC-R) Biobío (Chile). BIP CODE 40011065 (2019 - 2021).



APPLIED CHEMICAL PROCESSES LABORATORY

DESCRIPTION

Created in 2020 with the support of the National Association for Research and Development (ANID) and the Engineering Faculty with the main objective of carrying out research in the area of nanotechnology applied to the removal of contaminants in hydrological resources. It has equipment for the chemical synthesis of nanomaterials, water quality parameter analysis (DBO, DQO, heavy metals, nutrients, pH, conductivity, turbidity, among others), and studies of nanomaterials applied to photocatalysis, and to help in other research projects in engineering.

DEPARTMENT

Engineering Faculty.

AREAS OF KNOWLEDGE

- Synthesis and characterization of nanomaterials.
- Advanced oxidation processes.
- Removal of contaminants in hydrological resources.
- Support in chemical aspects of projects of interest in engineering.
- Analysis of water quality parameters.

INFRASTRUCTURE

- The laboratory is located in the San José Obrero building and covers 55 m².

EQUIPMENT

- Refrigerator.
- Equipment to measure Biological Oxygen Demand (DBO) with incubator.
- Drying furnace.
- Stirring plates with heating and temperature sensors.
- Peristaltic pump.
- Centrifuge.
- Vacuum pump.
- Orbital stirrer/orbital incubator.
- Photocatalytic reactor with UV and visible radiation.
- Extractor fan without duct.
- Reactor to measure chemical demand for oxygen.
- Ultrasound bath.
- Photometer for water quality parameters.
- Double beam spectrophotometer with capability for diffuse reflectance studies in solids.
- Analytical scales.
- pH meter (pH, conductivity, TDS, salinity, specific ions, among others).
- Water purifier.
- Turbidity meter.
- Dissolved O₂ and CO₂ sensors.



UNIT EXPERIENCE

▶ PROJECTS EXECUTED

- “Exploring the biosynthesis of a silver silicate-based nanomaterial using waste materials and seawater for the efficient removal of contaminants in water”, ANID Initiation FONDECYT N°11230671. Principal researchers (2023 - 2025).
- Technological contract UCSC-CAP to solve the challenge “Production of greater density bricks from steelworks coproducts”. Coresearchers (2022 - 2023).
- Strengthening the Innovation Ecosystem based on R+D and Technology Transfer of UCSC” Project 68-InES. Part of working team Objective 3. Coresearchers (2021 - 2023).
- “Technological Mining Consortium of Circular Economy COTMEC” in BHP Tailings Challenge - Expand 2021. Coresearchers (2021).
- “Strengthening research and teaching in the UCSC Doctorate in Civil Engineering in the area of Hydraulics and the Environment with emphasis in the use of nanomaterials for the remediation of polluted water”, CONICYT PAI N° PAI77190082. Principal researchers (2020 - 2022).

▶ RESEARCH (2019 - 2022)

- K. Márquez, F. Jiménez-Aspee, N. Márquez, P. Salgado, D. Contreras. 2022. Use of NIR spectroscopy and multivariate regression for prediction of pentosan content in wood pulp. *European Journal of Wood and Wood Products*. DOI: 10.1007/s00107-022-01896-2.
- Henríquez, P. Salgado, M. Albornoz, V. Melín, H.D. Mansilla, L. Cornejo-Ponce, D. Contreras. 2021. Determination of equilibrium constants of iron(III)-1,2-dihydroxybenzene complexes and the relationship between calculated iron speciation and degradation of rhodamine B. *New Journal of Chemistry*. p.: 15912-15919. DOI: 10.1039/D1NJ01579F.
- V. Melín, P. Salgado, A. Thiam, A. Henríquez, H.D. Mansilla, J. Yáñez, C. Salazar. 2021. Study of degradation of amitriptyline antidepressant by different electrochemical advanced oxidation processes. *Chemosphere*. p. 1-10. DOI: 10.1016/j.chemosphere.2021.129683.
- P. Salgado, J.L. Frontela, G. Vidal. 2020. Optimization of Fenton Technology for Recalcitrant Compounds and Bacteria Inactivation. *Catalysts*, p. 1-15. DOI: 10.3390/catal10121483.
- Y. González, P. Salgado, G. Vidal. 2019. Disinfection behavior of a UV-treated wastewater system using constructed wetlands and the rate of reactivation of pathogenic microorganisms. *Water Science & Technology*. p. 1870-1879. DOI: 10.2166/wst.2020.007.
- P. Salgado, D.O. Mártire, G. Vidal. 2019. Eucalyptus extracts-mediated synthesis of metallic and metal oxide nanoparticles: current status and perspectives. *Materials Research Express*. p. 1-23. DOI: 10.1088/2053-1591/ab254c.
- P. Salgado, K. Márquez, O. Rubilar, P. Toledo, D. Contreras, G. Vidal. 2019. The effect of phenolic compounds on the green synthesis of iron nanoparticles (FexOy-NPs) with photocatalytic activity. *Applied Nanoscience*. p. 1-15. DOI: 10.1007/s13204-018-0931-5.







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