

MANITOBA ANALYTICS

Manitoba Bioproducts Industry Overview



Executive summary

Manitoba is committed to a sustainable bioproducts¹ industry. Blessed with a clean, natural environment and vast biological resources, the province produces millions of tonnes of biomass from agriculture and forestry, and enjoys strong research-industry partnerships. Currently a variety of bioproducts is produced in Manitoba, including biofuels, hemp fibers and renewable epoxies and resins.

The majority of processing has been focussed on biofuels and bioenergy areas with the production of ethanol and processed biomass for space and water heating. This is largely because these two sectors have received numerous provincial and federal incentives, and regulatory requirements have been established to stimulate growth.

Manitoba Agriculture and Resource Development created a bioproducts strategy to ensure the province capitalizes on opportunities in the bioproducts industry, while sustaining the need for food, feed and medicines. The strategy focuses on sustainable biomass production and supply, biochemicals, biofuels, bioenergy and biomaterials.

In 2020, Manitoba's bioproducts industry revenues were at \$626 million.² In 2019, the Manitoba bioproducts industry contributed \$464 million to the total gross domestic product (GDP), being \$273 million direct, \$123 million indirect and \$68 million induced GDP, respectively.

Bioproducts Industry sectors

Industry sectors	Definitions
Biochemicals	chemicals produced from biomass
Biofuel	any solid, liquid or gaseous material derived from biomass and used to obtain energy
Ethanol	ethyl alcohol derived from biomass such as grain or lignocellulose
Biodiesel	an ester-based oxygenated fuel that is derived from vegetable oils, animal fats or other biomass materials
Biogas	a mixture of gases produced through the break down of biomass by microorganisms in the absence of oxygen
Bioenergy	renewable energy produced by the release of stored chemical energy contained in biofuels
Bioheat	thermal energy generated by direct or indirect combustion of biofuels, particularly biomass, solid fuels and biogas
Biomaterials	processed or engineered materials partly or fully made from components derived from biomass
Biofibre	any hair-like materials obtained from a vegetable or animal source, or from a synthetic biomaterial
Bioplastics	plastics produced from renewable biomass such as that of a plant or microbial source
Biocomposites	a compound of biofibres and petroleum-based plastics or bioplastics for structural or non-structural applications

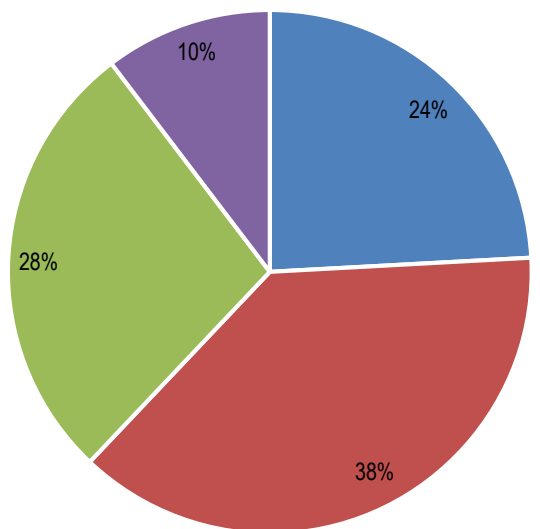
¹ Commercial or industrial products other than food, feed, and medicines made with biomass.

² Bioscience Association of Manitoba – Industry Profile Study 2021

Number of processors and locations³

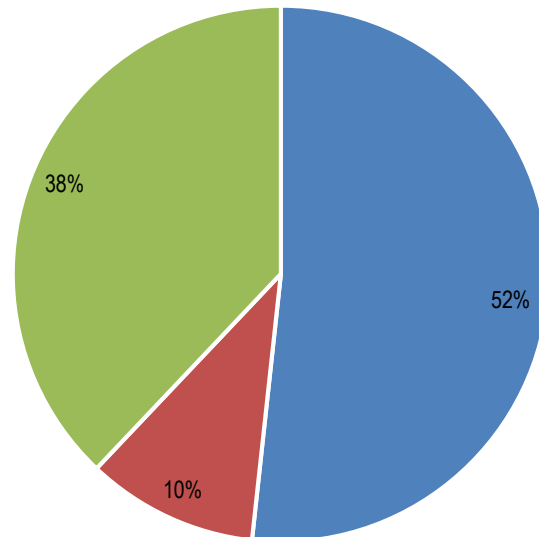
In Manitoba, 29 companies either manufacture bioproducts or provide solutions. Most of the organizations in this industry (52 per cent) belong to the biofuels sector (15), while 38 per cent (11) and 10 per cent (three) are in the biomaterials and the biochemical sectors, respectively.. There is no company currently in the bioenergy sector, as bioenergy is only produced for internal use and not for sale to third parties. The majority of processors are located in the southern region. By location, seven are located in Winnipeg, three in the Interlake, eight in the Prairie Mountain region and 11 in the Southern region respectively.

Distribution of the Industry by Region



■ Winnipeg ■ Southern ■ Prairie Mountain ■ Interlake

Distribution by sector



■ Biofuels ■ Biochemicals ■ Biomaterials

Within the 29 companies, seven companies commercialize their products and services only in Manitoba, seven sell to other provinces, while fifteen also export to the U.S. Among those exporting to the U.S., six also export to the rest of the world.

Biomass

There is over 5 million tonnes of biomass available in Manitoba every year, resulting from agriculture, forestry residue, industrial and municipal wastes, and marginal lands and roadside ditches⁴. Some of this biomass is used as livestock bedding, compost and energy. Other biomass is just wasted.⁵ In addition to the above, an estimated one million gross tonnes of biomass residue and cattail can be found within 100 kilometres of Winnipeg or Brandon, presenting a growth opportunity for these low-carbon fuel sources in Manitoba.⁶

³ Manitoba Agriculture and Resource Development – Bioproduct directory – March 2021

⁴ Manitoba Bioeconomy Atlas, International Institute of Sustainable Development

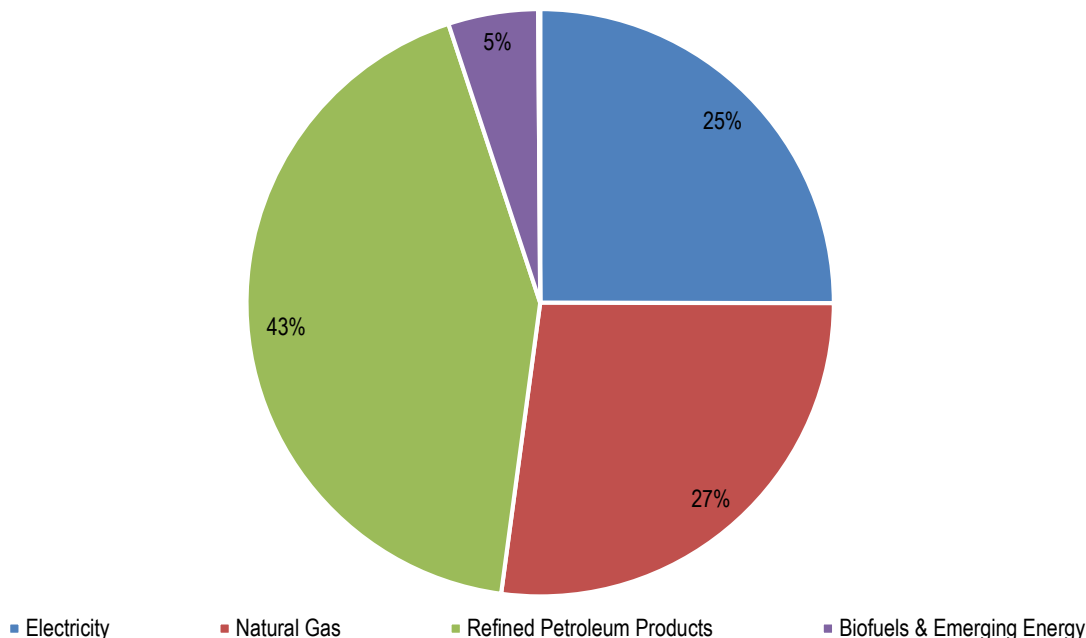
⁵ Richard Grosshans on February 26, 2018 – International Institute for Sustainable Development

⁶ International Institute of Sustainable Development

Biofuels

In Manitoba, biofuels represented five per cent (15 PJ) of the total energy demand in Manitoba, which totaled 302 PJ in 2020. In 2022, biofuels are projected to have a slight increase in demand to 16 PJ.⁷

End-use demand by fuel in Manitoba



Source: Canada Energy Regulator - Canada's Energy Future 2020

The chart above shows the end-use demand by fuel type in Manitoba in 2020. Refined petroleum accounts for 129 PJ (43 per cent) of demand, followed by natural gas at 82 PJ (27 per cent), electricity at 75.5 PJ (25 per cent), biofuels at 15 PJ (five per cent), and others at a negligible 0.33 PJ. Others include coal, coke and coke oven gas, which has seen substantial reduction in its use because of Manitoba's decision to be the first jurisdiction in North America to ban coal and petroleum coke for space heating. All coal users were required to have a plan in place by 2014 and to have transitioned away from coal to another fuel source by the middle of 2017. In August 2018, the last coal-fired generating unit in Manitoba (Unit 5 at the Brandon Generating Station) ceased operation. It is currently being used as a synchronous condenser, a unit that does not create electricity of its own, but rather regulates grid voltage and helps stabilize the grid.

Aligned with the Manitoba Bioproducts Strategy, progress has been made with the implementation and testing of a renewable liquid biofuel obtained from woody biomass via a pyrolysis process⁸. The viscous and somewhat acidic fuel has a large fraction of water. Its energy content is approximately half that of diesel fuel on a volumetric basis. Near Grosse Isle, Manitoba, approximately 1,200 litres of pyrolysis oil was combusted in a 390-kilowatt-thermal hot water boiler, fitted with a pyrolysis oil burner to showcase the oil as an alternative fuel for the community district heating system. The results show there is a good potential for replacing fossil fuels with pyrolysis oil in both small and large-scale commercial and industrial boilers.

The Manitoba Climate and Green Plan and federal government's policies are triggering an increase in use and development of biofuels. Effective Jan. 1, 2021, the amount of ethanol required in gasoline in Manitoba increased to 9.25 per cent from 8.5 per cent, and it will further increase to 10 per cent on Jan. 1, 2022. The biodiesel requirement increased to 3.5 per cent from two per cent on Jan. 1, 2021, and it will rise again to five per cent on Jan. 1, 2022. Currently, Manitoba has one of the fifteen ethanol refineries in Canada. The plant, located in Minnedosa, has the capacity to produce from corn a total of 39 million gallons of ethanol per year. For second-generation biofuels⁹, Manitoba is well positioned to provide canola feedstock for enhanced biodiesel production. Canola consistently ranks as the

⁷ Canada Energy Regulator

⁸ Thermal decomposition of materials at elevated temperatures in an inert atmosphere

⁹ Non-edible feedstock sourced from agriculture and forestry wastes

best biofuel feedstock when calculating net carbon emissions. This opportunity needs further analysis, based on feedstock concentration and distance range, to find the best location and processing capacity for a potential biodiesel plant.

The Federal Government is investing \$1.5 billion over five years through the Clean Fuels Fund. The fund offers new opportunities to fuel Canada's transition to clean energy. The Clean Fuels Fund aims to help Canadian companies produce clean fuels, create an estimated 36,000 new jobs by 2030, and enable the reduction of greenhouse gas emissions. This is clearly an opportunity to restore the biodiesel industry in Manitoba, which does not exist on a commercial basis since a fire in 2012 depleted a biodiesel production plant in Winnipeg.

To meet Canada's new 2030 and 2050 net-zero goals, renewable natural gas is expected to play a critical role in hard-to-decarbonize sectors such as industry and medium- and heavy-duty freight. Biogas is a clean-tech solution that offers innovation to the agricultural, municipal and waste management sectors. Biogas technologies can develop in a small footprint, and function compatibly with existing operations. The Canadian 2020 Biogas Market Report calculates that Canada is tapping only 13 per cent of its easily accessible biogas potential, meaning that biogas output could grow another eight times. A recent study commissioned by Natural Resources Canada calculates that 155 petajoules of biogas energy from renewable natural gas is realistically available in Canada. The study estimates there is an additional 654 PJ of potentially renewable natural gas that is less commercially feasible because of competing feedstock demands, logistical constraints and economic viability. Canada now has 279 biogas projects, from coast to coast, that are capturing methane from agricultural and community waste and turning it into 196 megawatts (MW) of clean electricity and six PJ of Renewable Natural Gas (RNG). That is the equivalent of roughly 300 million square metres of solar panels or more than nine large hydro dams.¹⁰



Manitoba farm capturing biogas.
Source: Manitoba Agriculture and Resource Development website

As part of the federal government's commitment to reduce carbon emissions by 40 to 45 per cent below 2005 levels by 2030, the Federal Minister of Agriculture and Agri-Food recently announced funding for the Canadian Biogas Association to accelerate sustainable agricultural development. There are already 61 farms and agri-food businesses across Canada successfully capturing biogas and turning it into a valuable clean energy resource¹¹. Biomass technologies, such as anaerobic digestors, are being implemented across Canada and the United States.

One example in Manitoba is the complete mix anaerobic digester and biogas system installed on a farm near Winkler. The farm is a 200 head dairy farm seeking better manure management practices. In the

complete mix system, manure digestion takes place in the mesophilic temperature regime (35°C to 40°C) in a continuously mixed concrete tank reactor. Sulphuric acid is removed from the biogas using a microbial process that stays on a wood structure within the digester. The lower sulphuric acid content biogas is consumed in either a biogas engine (a 75 kW natural gas engine), or a 200 KW dual-fuel propane and biogas boiler. Digested manure is treated using a solid and liquid separator system, with the solid fraction of the fiber recycled to the dairy barn as a substitute for straw bedding.

Very few Canadian landfills recover methane emissions for energy purposes. However, some Canadian municipalities (e.g. Edmonton, Nanaimo, and Vancouver/Burnaby) actively produce energy from waste, either from landfills or from large-scale anaerobic digesters. In Winnipeg, the methane gas released from the Brady Road Resource Management Facility is being reduced by capturing and burning the gas. The system is undergoing upgrades at a cost of \$3.2 million to expand the gas collection by 20 per cent more and to use the captured gas as an energy source. The methane gas collection system is required under The Climate Change Emissions Reduction Act of Manitoba.

The proposed Federal Clean Fuel Standard¹² seeks to increase the use of lower-carbon fuel, including renewable natural gas, and applies to the transportation, building and industry sectors. For Manitoba, it would mean removing barriers to allow biogas injection into the natural gas grid as a renewable green source. .

¹⁰ Canada Biogas Association

¹¹ Jennifer Green, Executive Director of the Canadian Biogas Association

¹² published in Canada Gazette, Part I, on Dec. 18, 2020

Bioenergy

Biomass can be directly burned to generate electricity. It can also be co-fired with other fuels to reduce overall greenhouse gas emissions, as biomass is generally considered carbon neutral. This is because the carbon dioxide (CO₂) released from either burning or decomposing biomass approximately equals the CO₂ that trees or plants take in from the atmosphere during their lives.



Biomass Power Plants in Canada (Source: Canada Energy Regulator)

As of 2014, Canada had approximately 70 biomass generating power plants with a total installed capacity of 2,408 MW. Most of these facilities rely on wood, wood by-products and landfill gas. Manitoba has one plant in The Pas with a capacity of 22.8 MW¹³. The contribution of forest biomass to Canada's energy supply has increased from three to four per cent in the 1970s to five to six per cent today.¹⁴

Biomass power plants have the advantage of generating power on demand, in contrast to other renewables that generate intermittently. However, fuel availability and transportation costs are major factors affecting the financial viability of biomass plants. In addition, biomass has a lower energy density than coal or petroleum, which means that more biomass is needed to generate one unit of electricity. Therefore, biomass plants are more

economical when located close to fuel supplies. An example is sawmills, which typically convert about 45 per cent of each log into lumber. The remaining sawmill waste (wood chips, shavings and sawdust), may be used as feedstock in a biomass plant. However, the waste could also be consumed by the pulp and paper industry or sometimes converted into wood pellets or fibreboards. This competition limits the amount of wood biomass that is available for electricity generation.

B.C. Hydro estimates that the cost of producing electricity from wood waste in that province varies between \$107 and \$134 per megawatt hour (MW.h), while the cost of producing electricity from standing timber is \$208 per MW.h.

The federal government has provided financial support for the installation of other systems. The Bioenergy Optimization Program Demonstration Project received \$2.8 million from the Clean Energy Fund to install a system in Hadashville, Manitoba. The system was capable of generating a net 100 kilowatts of electricity and 120 kW of thermal energy. The longest period of continuous generation achieved was 22 hours. 18,155 kWh of electricity was generated to offset Pineland's demand.

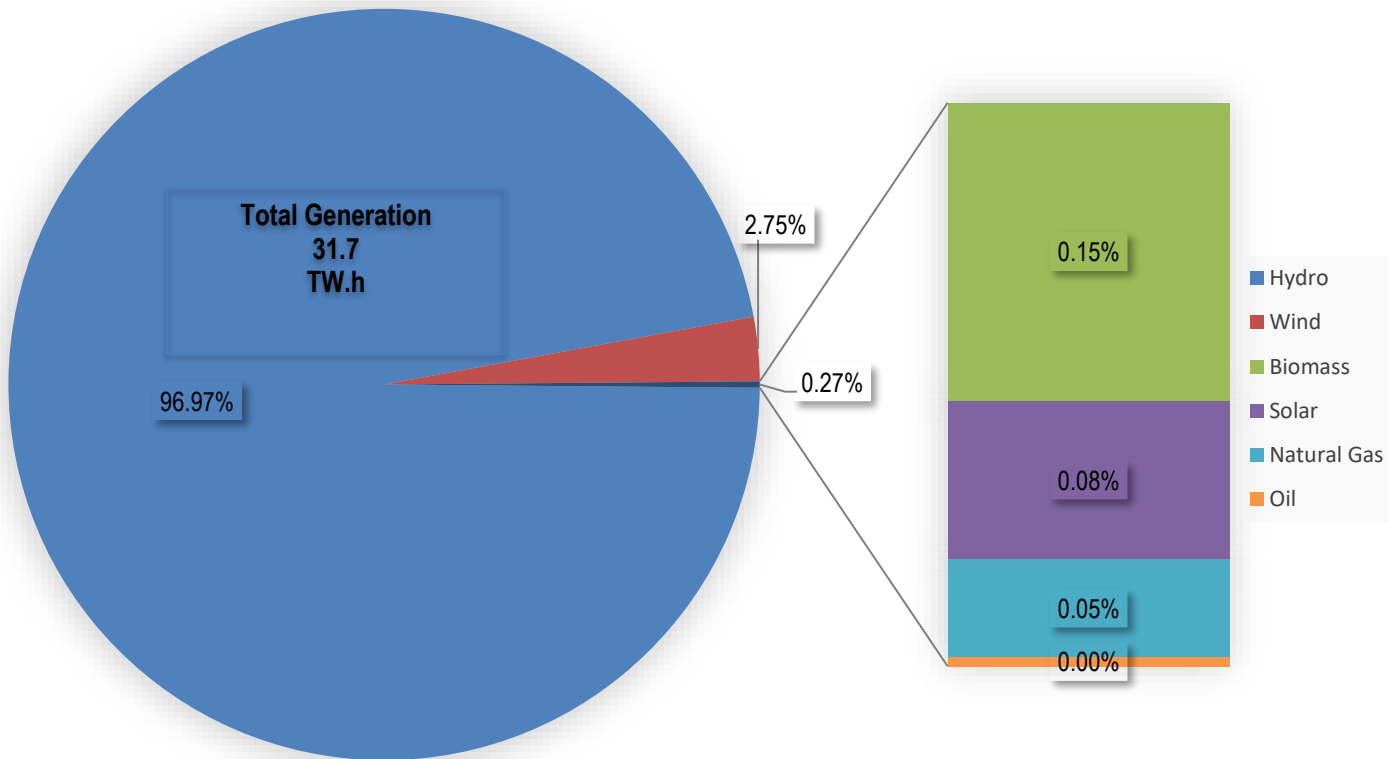
At the end of 2020, one of the biggest renewable energy installations was completed in Lac Brochet in northern Manitoba, with solar, geothermal and biomass. This installation set a precedent for energy and food independence in northern communities and is a proven example of renewable energy integration in Manitoba. In 2018, a dual-boiler 1.5 MW biomass system was installed and integrated to a new underground district energy loop. The project has replaced the combustion of 300,000 litres of diesel per year, the equivalent of one-third of the diesel used for heat. It reduced the community's Greenhouse Gas (GHG) emissions by about eighteen per cent (800 tonnes per year). The biomass system needs approximately 700 tonnes of fuel a year to operate.

In 2020, Manitoba generated 31.7 terawatt hours (TW.h) of electricity, which was approximately five per cent of the total Canadian generation. Manitoba had a generating capacity of almost 6,000 megawatts (MW). Biomass facilities are operated by independent producers and represented 0.15 per cent of the total generation as shown below.

¹³ Renewable Energy Power Plants, 1 MW or more - North American Cooperation on Energy Information (Government of Canada)

¹⁴ <https://www.nrcan.gc.ca/our-natural-resources/forests-forestry/forest-industry-trade/forest-bioeconomy-bioenergy-biop/bioenergy-biomass/13323>

Electricity Generation by Fuel Type in Manitoba (2020)



Source: Canada Energy Regulator

The table below shows Manitoba's electric capacity and generation from renewables in 2015 and 2020. Biomass has remained stagnant in its capacity at 0.4 per cent, and has a slim 0.15 per cent of the total generation of electricity from renewables. Hydro decreased its share in total capacity from 89 per cent to 88 per cent while the share of wind increased from 1.83 per cent to 4.25 per cent. The share of hydro in total generation decreased from 98.6 per cent to 97 per cent, while the share of wind increased from one per cent to 2.75 per cent.

Renewable Electric Capacity and Generation in Manitoba				
	Capacity in MW and %		Generation in GW.h and %	
	2010	2020	2010	2020
Hydro	5,054	5,349	33,269	30,732
	89.02%	88.20%	98.55%	96.97%
Wind	104	258	343	873
	1.83%	4.25%	1.02%	2.75%
Biomass	22	22	0	46
	0.39%	0.36%	0.00%	0.15%
All renewable sources	5,180	5,658	33,612	31,676
	91.23%	93.28%	99.57%	99.95%
All sources	5,677	6,065	33,757	31,692

Source: Canada Energy Regulator

Biomaterials

There is no end in sight to the worldwide interest in sustainable bio-based materials. Their role in a global and sustainable bioeconomy is crucial. Integrating local bio-sourced products in concrete applications has specifically been a growing interest for the federal and provincial governments and industry.

The use of cellulosic bioproducts in concrete has specifically been gaining momentum in recent years, which has led to the emergence of new products across global markets. Cellulosic bioproducts hold unique characteristics and properties that make it stand out as a major player in the bioproducts market and that make it a great addition to concrete applications¹⁵.

In Manitoba, Ecopoxy, a Winnipeg-based centre of excellence for agricultural fibre grading, carries out the automated process of decortication. The process separates natural fibres such as hemp or flax from the remaining components of the plant stem. Vehicle manufacturers are excited at the prospect of turning out parts such as body panels from constituents that would significantly reduce the carbon footprint of their industry. Trials were done to optimize the cross-linking that polymers provide to a composite material made from flax fibres. It was later tested in the body panels of a small vehicle produced in Winnipeg for the North American market. COVID-19 has delayed the introduction of these panels into the production assembly line. The urban utility vehicle's aluminum and steel passenger tub will be replaced by a flax fibre bio-composite produced by the Composites Innovation Centre.

Biochemicals

In Manitoba, there are three companies working in this sector. One specializes in bioremediation of fuel and other contaminants in soil and water.¹⁶ Bioremediation by natural populations of microorganisms represents one of the primary mechanisms by which petroleum and other hydrocarbon pollutants can be removed from the environment without using harsh chemicals.

Another company produces a non-toxic and non-corrosive dust control agent. It also produces a non-chloride-based, non-toxic, non-corrosive biodegradable soil stabilizer with applications in road construction.

The third company carries the next generation of ready-to-use biological liquid inoculant for customers to make a difference in the field of agriculture. The biochemical product contains a unique strain of *Bacillus firmus* that uses three distinct modes of action to improve phosphorus availability and increase yields in crops. This provides plant vigor and health, early maturity, longer flowering and reduces plant stress under poor environmental conditions.

Contact us

- Go to manitoba.ca/agriculture and click on Markets and Statistics
- Email us at industryintelligence@gov.mb.ca
- Follow us on Twitter @MBGovAg
- The information in this document is current as of October 2021.

¹⁵ Frédéric Lory, project leader at FPInnovations

¹⁶ Bioremediation is the use of microorganisms to detoxify or remove pollutants from the environment by utilizing their diverse metabolic properties.