

2030  
QUÉBEC GREEN  
HYDROGEN AND  
BIOENERGY STRATEGY



# DECARBONIZE INNOVATE SHINE

This publication was produced by the Secteur de l'innovation et de la transition énergétiques of the ministère de l'Énergie et des Ressources naturelles, with the cooperation of several government departments and external partners.

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# PREMIER'S MESSAGE



François Legault  
Premier of Québec

Québec is a proud, audacious and resourceful nation. Over 50 years ago, we deployed treasures of engineering and perseverance to build the first of a series of major hydroelectric dams to see the light in Northern Québec. We still rank among the world's biggest producers and distributors of renewable electricity, thanks to our ability to be farsighted and mobilize the necessary knowhow to meet our needs. We have the ability to move from dream to reality.

Given the new challenges facing us in fighting climate change, we're initiating a new phase to make the most of Québec's resources. The Plan for a Green Economy launched an initiative for direct electrification of our economy: the Québec Green Hydrogen and Bioenergy Strategy will lift the barriers to indirect electrification and optimal valorization of our resources.

These green hydrogen and bioenergy sectors are not new. We have everything it takes to develop them further in order to achieve carbon neutrality on our roads and waterways, in our cities, towns and villages, all the way to the factory chimneys and the deepest mines!

Reducing our dependence on fossil fuels, securing our supplies by increasing our energy autonomy, creating green prosperity, improving our balance of trade, enhancing our companies' competitiveness and invigorating the economic vitality of the regions: that's what we intend to achieve with green hydrogen and bioenergy.

Once again, we can excel in our creativity, knowhow and expertise to contribute to decarbonization of the economy.



# MESSAGE FROM THE MINISTER OF ENERGY AND NATURAL RESOURCES



**Jonatan Julien**  
Minister of Energy and Natural Resources

The energy transition and the achievement of carbon neutrality by 2050 are an immense planetwide initiative. No transformational challenge of this type has probably ever been issued to humanity. In fact, in addition to the challenge of the transition, its tight deadlines are coming closer.

While the 2030 and 2050 horizons may still seem far away, vigorous actions are necessary immediately to achieve our objectives of reducing greenhouse gas emissions and reducing fossil fuel consumption.

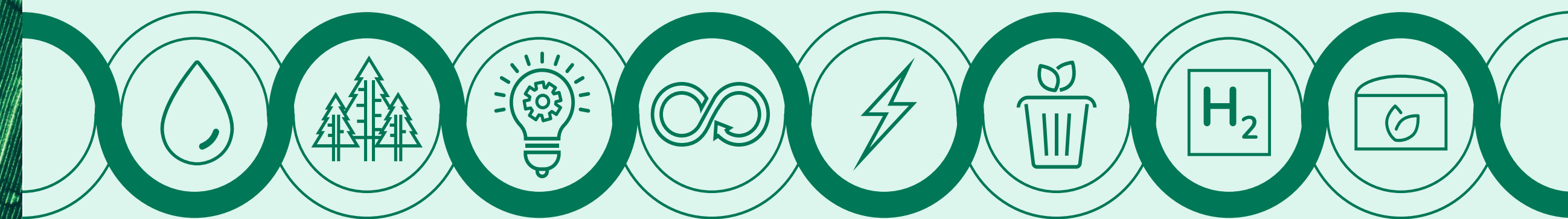
Gradually replacing the share held by fossil fuels in our energy balance is no small matter, but solutions exist. And we all have what it takes to change the situation: the deliberate use of raw materials and resources, the expertise to be mobilized to the benefit of collective initiatives, not to mention the technical and social creativity to deploy new business models. Quebecers have repeatedly worked as a team to convert ideas into successes. Our government is determined to use the full potential

of our talents, our renewable energy and our natural resources to obtain the maximum economic, social and environmental impacts.

The green hydrogen and bioenergy sectors offer us a privileged opportunity to develop green, local and sustainable economies in the four corners of Québec. We can thus accelerate the pace of our energy transition. The 2030 Québec Green Hydrogen and Bioenergy Strategy demonstrates our firm intention to go ahead with the decarbonization of our society, in collaboration with the local and Indigenous communities. And we will achieve this initiative together, collectively and proudly!



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# INTRODUCTION

## A CONTEXT CONDUCTIVE TO ACTION

To fight climate change, Québec has committed to reducing its greenhouse gas (GHG) emissions 37.5% relative to the 1990 level by 2030. In addition, the Gouvernement du Québec is targeting a 40% reduction in the consumption of oil products by 2030<sup>1</sup> and carbon neutrality by 2050.

While nearly 70% of GHG emissions come from energy sources, almost exclusively of fossil origin (petroleum, natural gas and coal), we must work together more than ever to achieve a successful energy transition: use resources more efficiently while replacing fossil fuels with different forms of low carbon energy.

In the coming decades, green hydrogen, also called renewable hydrogen, and bioenergy will play a growing and complementary role to electricity in the decarbonization of the most GHG emitting sectors.

It is in this context that the [2030 Plan for a Green Economy \(2030 PGE\)](#), published in November 2020, announced the development of the first strategy on green hydrogen and bioenergy.

Plan pour une  
économie  
verte 

<sup>1</sup> 2030 Plan for a Green Economy. This target seeks a reduction compared to the 2013 level.

# AMBITIOUS UNDERTAKINGS AND MAJOR GAINS

Québec has undeniable advantages to develop production of these essential sectors of the energy transition in its territory, particularly diversified sources of residual biomass and renewable electricity.

The Gouvernement du Québec is committed to a concrete approach toward the decarbonization of the economy. To do this, it intends to deploy a business environment that will favour green hydrogen and bioenergy production developed sustainably, with the ambition that these types of energy are consumed on a priority basis in Québec to generate direct impacts here. By the 2030 horizon, deployment of the green hydrogen and bioenergy sectors could generate:



**4 million tonnes**

A potential reduction of over 4 million tonnes of carbon dioxide equivalent (Mt CO<sub>2</sub> eq) per year, or more than 13% of the reductions required to reach the Québec GHG emissions reduction target in 2030.<sup>2</sup>



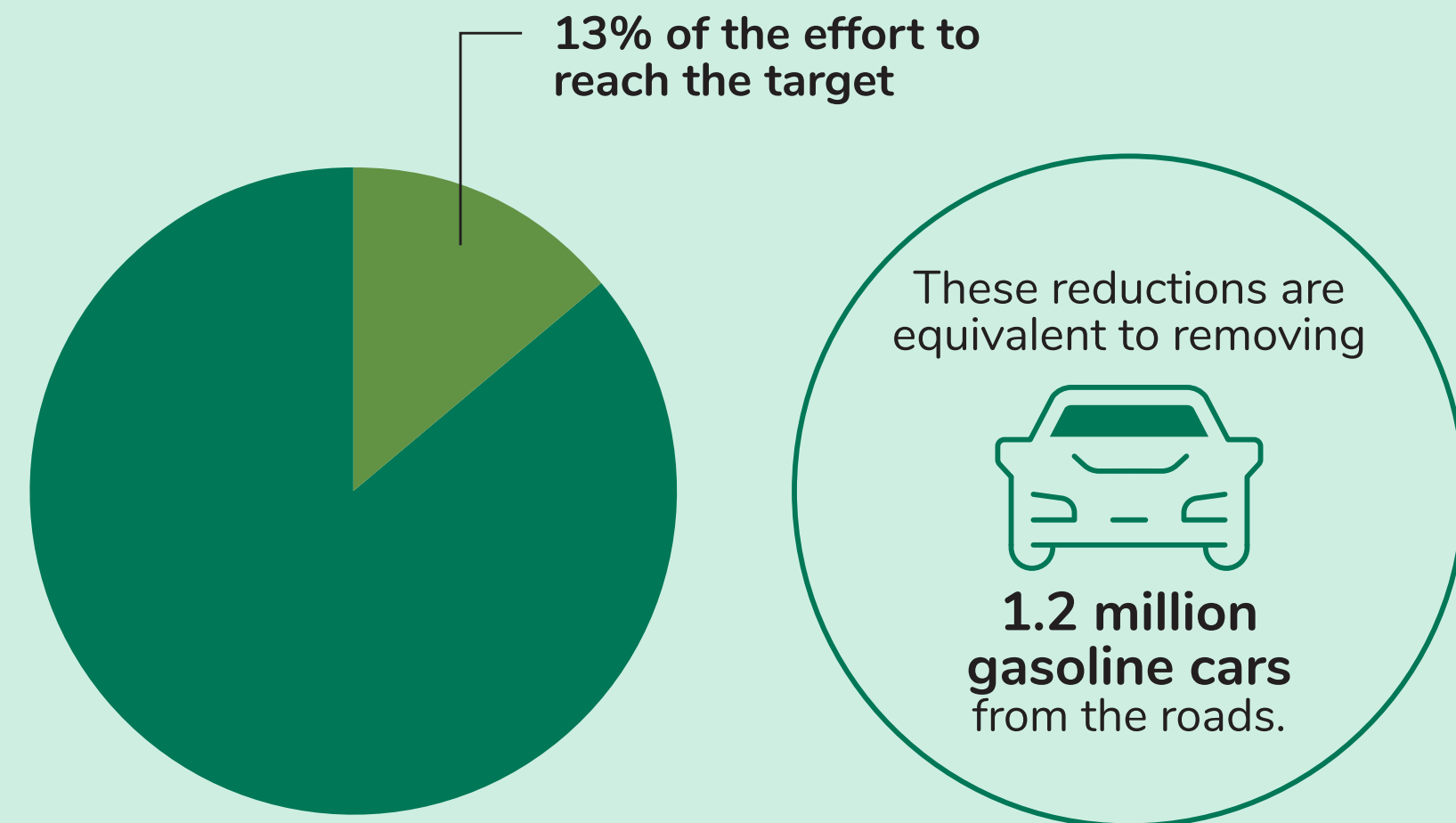
**1 billion litres**

A potential annual reduction of consumption of oil products of nearly 1 billion litres, 16% of the reduction target for consumption of oil products in 2030.<sup>3</sup>

<sup>2</sup> The reductions required to meet the GHG emissions reduction target of 37.5% relative to the 1990 level by 2030 are estimated at 31 Mt. 2022-2027 Implementation Plan of the 2030 PGE. This estimate is based on a growth potential of production in Québec, on the assumption that this production would be consumed in Québec.

<sup>3</sup> The reductions required by the 2030 horizon to reach the petroleum product consumption target of 40% relative to 2013 are estimated at 6.0 billion litres.

## Potential contribution to the GHG reduction target



The Gouvernement du Québec also confirms the objective of increasing bioenergy production 50% by 2030.<sup>4</sup> To favour consumption of bioenergy produced in Québec, the Government is adopting ambitious regulatory targets.



**10% renewable source gas<sup>5</sup> that will have to be injected into the natural gas network by the 2030 horizon.**



**Increase the use of low carbon intensity fuels intended for transportation to reach a proportion of 15% in gasoline and 10% in diesel fuel by the 2030 horizon.<sup>6</sup>**

Moreover, the Gouvernement du Québec is seeking to eliminate the use of coal as an energy source by 2030.

Québec's ambition to concretize green hydrogen and bioenergy projects will lead to public and private investments that could reach nearly \$10 billion over the next few years.

<sup>4</sup> 2030 Plan for a Green Economy. This target seeks a reduction relative to the 2013 level. It corresponds to the addition of about 70 PJ.

<sup>5</sup> The adoption, on September 30, 2021, of the Act to amend the Act respecting energy efficiency and energy conservation standards for certain electrical or hydrocarbon-fuelled appliances allowed amendment of the Act respecting the Régie de l'énergie to introduce the notion of "renewable source gas", which particularly includes renewable source hydrogen and other renewable sources gases, including renewable natural gas.

<sup>6</sup> The adoption, on December 15, 2021, of the order concerning the Regulation respecting the integration of low carbon intensity fuel content into gasoline and diesel fuel.



# 1. WHY FOCUS ON GREEN HYDROGEN AND BIOENERGY?



Fossil fuels such as coal, natural gas or oil, by their extraction or use, release large quantities of greenhouse gas and thus contribute to climate change. This is why the energy transition is essential to meet the GHG emissions reduction targets.

The reduction in energy consumption, achieved by energy sobriety and efficiency approaches, as well as direct electrification, are at the core of the solutions. However, they are not enough to replace all fossil fuels due to certain technical or economic obstacles.

Other avenues prove necessary, including deployment of the green hydrogen and bioenergy sectors, which have fewer *climate impacts than fossil fuels* and for which Québec has many advantages.

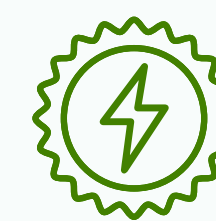


# 1.1 INCOMPARABLE POTENTIAL

Québec has been active for several decades in the hydrogen and bioenergy fields, although there is currently little optimization of these sectors. It has major advantages to develop them further, particularly:



Renewable electricity, competitive electrical rates among the most stable in North America



Recognized expertise in the energy field



A reliable and robust electric power distribution grid



Favourable policies for achievement of projects



Substantial and diversified residual biomass availability



A firm intention of the Gouvernement du Québec to reduce GHG emissions, continue the energy transition and increase energy autonomy



Fast-growing local and global demand

# GREEN HYDROGEN

Green hydrogen, also called renewable hydrogen, is produced from renewable source electricity or biomass, and therefore has low carbon intensity as opposed to grey hydrogen, obtained from fossil fuels. Québec intends to favour this type of carbon-free hydrogen.

Green hydrogen currently only accounts for a small percentage of global hydrogen production, less than 2%<sup>7</sup>. The largest share of the market remains occupied by hydrogen from fossil sources, often referred to as “grey hydrogen”. In Québec, as elsewhere, in 2022, the production of green hydrogen was still marginal.<sup>8</sup>

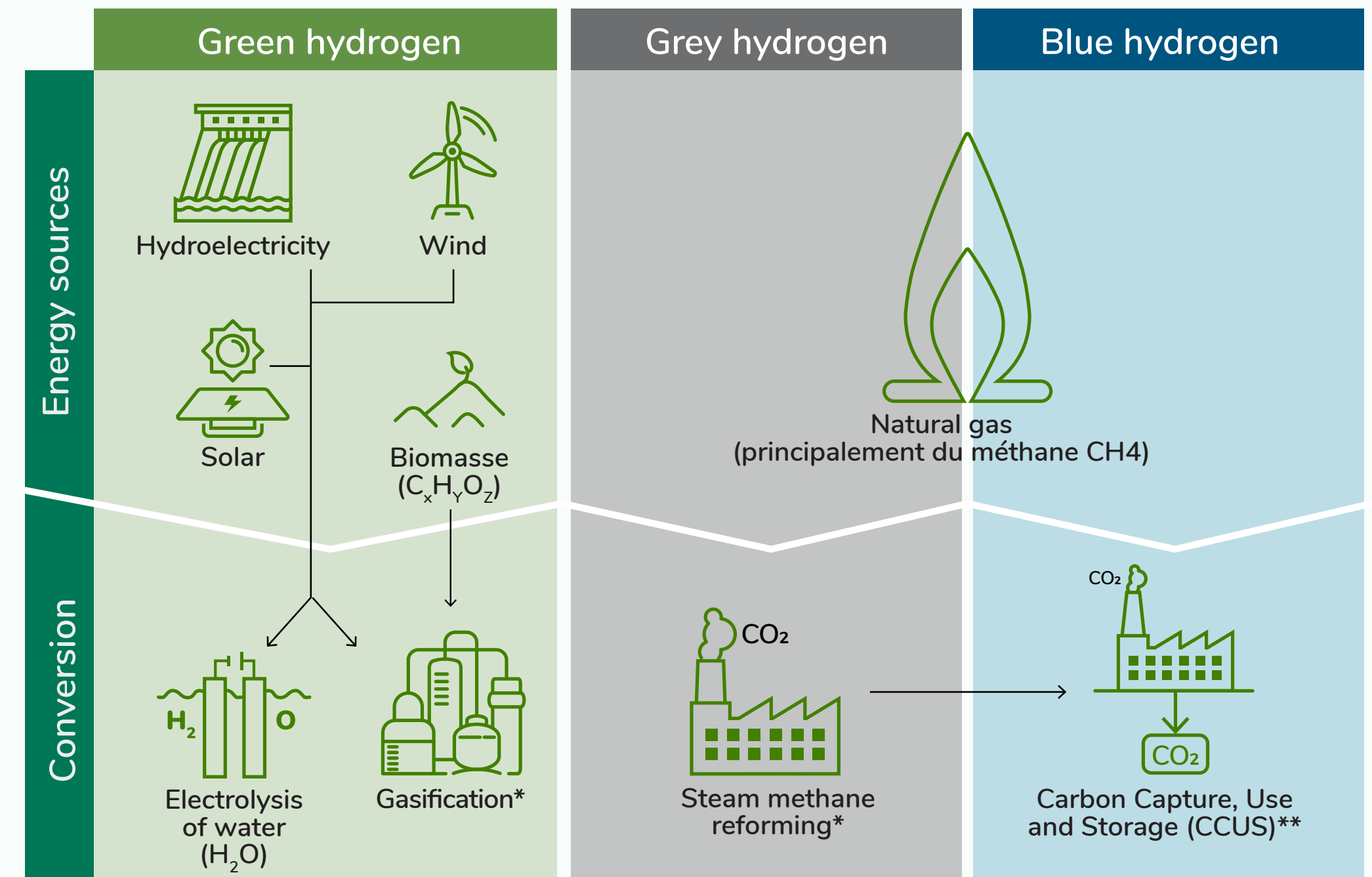
The share of hydrogen from fossil sources is set to decrease over the coming decades because of its incompatibility with the objectives of carbon neutrality and reducing GHG emissions. In this context of energy transition, the development of green hydrogen, which has low carbon intensity, constitutes an opportunity making it possible to:



Replace hydrogen of fossil origin currently consumed in sectors such as petroleum refining or other industrial processes with green hydrogen



Replace other sources of fossil energy in applications where hydrogen is currently unused or little used, as in heavy and intensive transport



\* Most common processes. There could be other processes.

\*\* Carbon capture, use and storage (CCUS) technologies do not guarantee the recovery of all CO<sub>2</sub> emissions produced by steam methane reforming.

<sup>7</sup> POLYTECHNIQUE MONTRÉAL (2020), Study on the technico-economic potential of the development of Québec’s hydrogen sector and its potential for the energy transition.

<sup>8</sup> Air Liquide has been producing green hydrogen since 2021 at its new Bécancour plant. Also, other chemical manufacturers make hydrogen as a by-product of electrolysis.





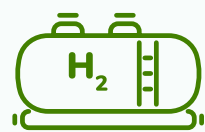
# 1.1 INCOMPARABLE POTENTIAL

A major and sustained investment is necessary so that the hydrogen sector imposes its presence and replaces traditional hydrogen production methods. It is therefore crucial to deploy efforts immediately to structure a Québec sector that is robust, innovative and competitive. Thus, they may play a significant role by the 2030-2050 horizon in the transition to carbon neutrality.

In addition to the opportunities to substitute fossil fuels in current uses, such as industrial processes and green chemistry, several emerging uses are being developed for green hydrogen in the coming years, for example:



In certain land, air or sea mobility applications with the development of **fuel cells** or synthetic fuels produced from renewable energy

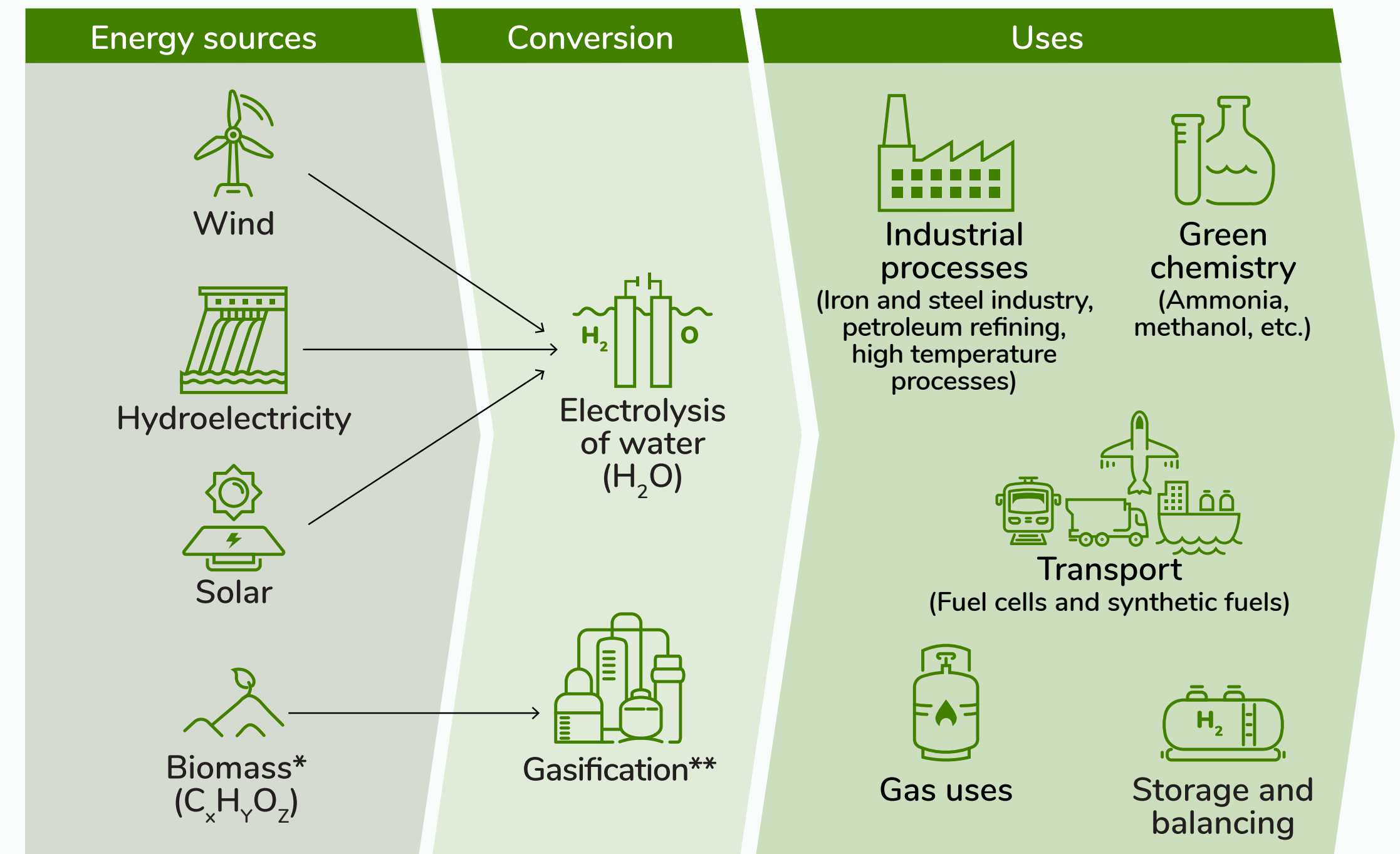


In energy uses such as storage



In gas applications

## Potential applications of hydrogen in Québec



\* In the context of this strategy, hydrogen from residual biomass is considered green if it is produced from a transformation process with low carbon emissions.

\*\* The most common process. There could be other processes.



## Current profile and development issues of the hydrogen sector in Québec

In 2020, *Study on the technico-economic potential of the development of Québec's hydrogen sector and its potential for the energy transition* by Polytechnique Montréal, produced on behalf of Transition énergétique Québec and the Ministère de l'Énergie et des Ressources naturelles (MERN), made the following findings:

1. Green hydrogen will be advantaged where electric power production is based on renewable energy.
2. The industrial logic of deployment should concentrate on installation of large capacities for captive applications, e.g. big industrial users and trucking fleets.
3. Lowering of the production costs will dictate the speed of deployment.
4. Certification of the green character of hydrogen and harmonization of the regulations with those of the United States are important.
5. Mixed public and private funding is the path to prefer for support programs.
6. The availability of expertise and skilled labour is a priority.

The suggested government interventions are divided into four components:

- Institution of a coherent and incentive policy, legal and regulatory framework to help reduce the risks inherent in private investment.
- Deployment of financial incentives (subsidies, tax reduction, regulation, facilitation of demonstration projects) to favour investment.
- Raising public awareness of the importance of hydrogen in the energy transition and implementation of measures to encourage its use.
- Development of competencies (university education, research programs, innovation platforms) in the most promising application sectors.

# BIOENERGY

Québec has been active for several decades in the field of bioenergy, whereas in 2019, bioenergy represented approximately 8% of Québec’s primary energy supply.<sup>9</sup>

Bioenergy is used to produce heat and electricity and to power thermal engines used in transport. They are renewable energy sources produced by living organisms or their by-products, namely biomass. In Québec, the residual biomass deposits exploited for bioenergy are divided into three main families:

## Forest



**Residual forest biomass and timber without buyers\*.**

\* For the purposes of the Strategy, timber without buyers, such as hardwood pulpwood, small stems or low-quality timber, is considered residual biomass when no other market exists for this timber and it would have been abandoned on the cutovers if not for bioenergy outlets.

## Agricultural



**Crop residues, animal excreta (manure, slurry, etc.).**

## Municipal, commercial and industrial



**Residues from the residential, municipal, commercial and industrial sectors (from food processing, paper and cardboard from sorting centres, timber for construction, renovation and demolition, from the pulp and paper industry, biogas produced in landfills, etc.).**

<sup>9</sup> HEC MONTRÉAL (2022), *The state of energy in Québec*, Chair in Energy Sector Management.

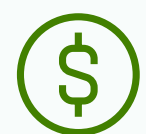


In addition, green hydrogen and various residual biomass deposits can be used together, in particular for the production of synthetic fuels to maximize residual biomass yield.

Unlike fossil fuels requiring millions of years for their formation, bioenergy is renewable when produced sustainably. It is about prioritizing the right energy in the right place, by enhancing the raw material with appropriate technology.

### Multisectoral benefits associated with sustainably developed bioenergy

Developed sustainably, bioenergy can bring multisectoral benefits:



**Economic:** value chains must favour the use of raw materials at a price that ensures a certain viability and that do not compete with other uses. They seek industrial symbiosis, quality job creation throughout Québec (direct, indirect and induced) and reinvigoration of traditional industrial sectors.



**Social:** value chains promote the use of raw materials, which is not opposed to the objectives of food autonomy. They contribute to a synergy between local and Indigenous communities, municipalities and their territory, thus strengthening autonomy and cohesion of the social and regional fabric.



**Environmental:** the use of raw materials must not be to the detriment of the quality of ecosystems, for example soil fertility and biodiversity. It must follow sustainable agricultural and forestry practices while delivering benefits, such as improving the productivity of forests and their capacity to **absorb and capture carbon** through tree growth and wood products. Thus, the replacement of fossil fuels by bioenergy favours the reduction of GHG emissions in addition to improving waste management.

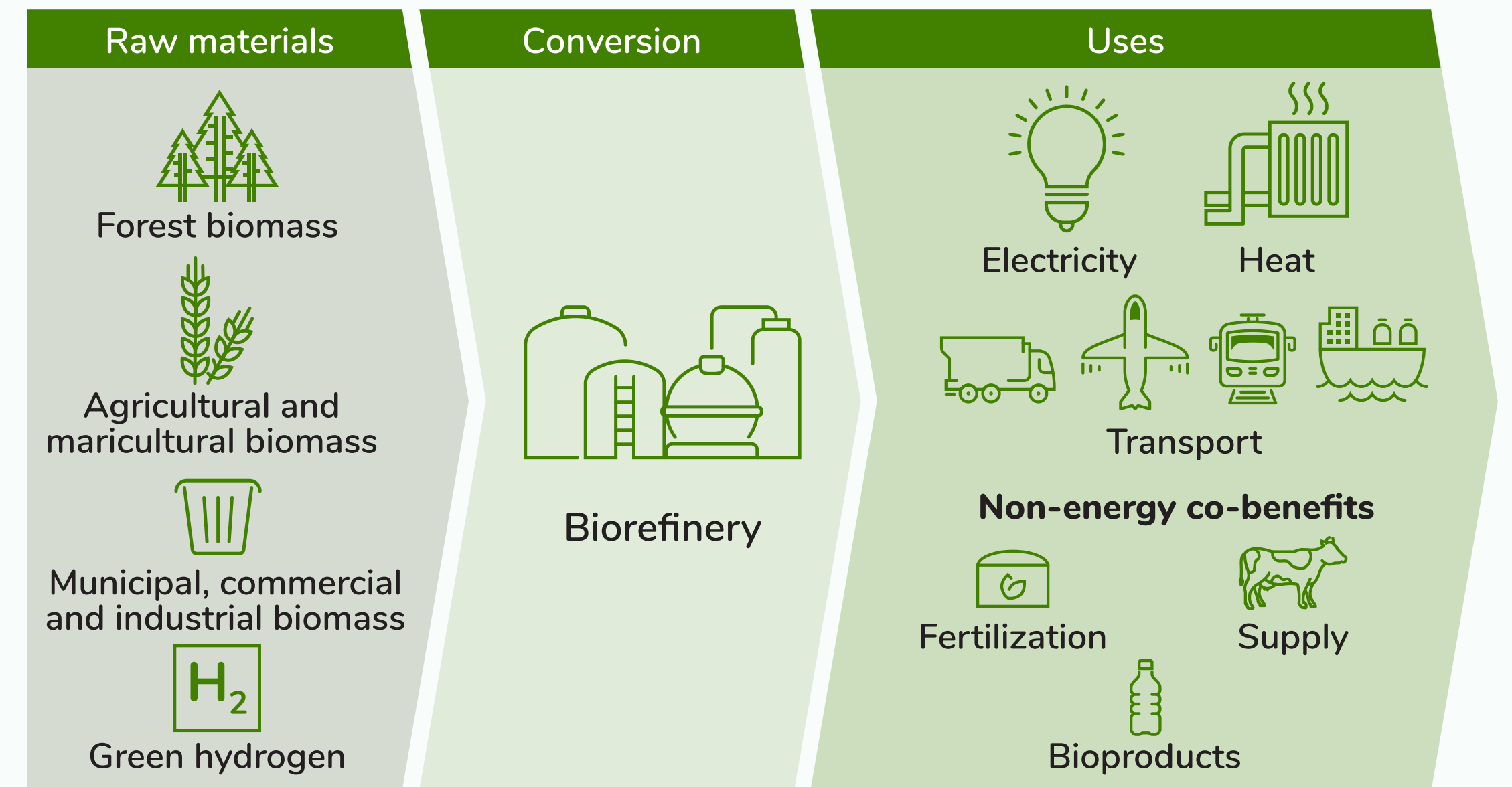




Bioenergy is of particular interest because of its great versatility in the use and replacement of fossil fuels, especially since the supply and distribution infrastructure already in place can be used without major transformation. In this context, it must nonetheless be ensured that “carbon lock-in” is not created, i.e. a context that could be favourable to the prolonged use of fossil fuels. All types of solid, liquid and gaseous fossil fuels, like coal, fuel oil, propane and natural gas, can be replaced with any form of bioenergy. It is even possible to produce electricity. Several technologies are mature and already contribute to the energy transition, while others must be improved, researched and developed.



### Potential applications of bioenergy in Québec





## Inventory of biomass available to produce bioenergy and current production profile in Québec

The MERN mandated WSP Canada Inc. to draw up [an inventory of the biomass available to produce bioenergy and profile the current production in Québec](#). The work pertains to the municipal, commercial and industrial forest, agricultural, commercial and industrial residual materials sector. For each type of biomass targeted, the study presents the technical availability potential, i.e. the maximum quantity of raw materials that can be developed for energy purposes from a general and regional point of view.

The technical availability potential calculated in the context of this study is 19.2 million metric tonnes dry matter (MDMT) or the energy equivalent of 326 petajoules (PJ).<sup>1</sup> In comparison, Québec's total consumption was 1925 PJ of energy in 2019, more than half from fossil sources.



The forest sector has the greatest bioenergy production potential with a total of 13.5 MTDM or the energy equivalent of 254 PJ.



The biomass derived from urban residual materials is in second place, with 3 MTDM or the energy equivalent of 49 PJ.



Agricultural biomass ranks third and totals 2.7 MTDM or the energy equivalent of 23 PJ.

(1) 1 PJ corresponds to the energy contained in 27 million litres of gasoline or 278 GWh, which corresponds to energy consumption of about 10,000 Québec households.

Moreover, the study shows that the equivalent of 63 PJ\* of forest, agricultural and residual biomass is already transformed into various types of bioenergy marketable in Québec:



firewood (17 PJ)



ecological pellets and logs (15 PJ)



biofuels (11 PJ)



cogeneration (13 PJ)



renewable natural gas (8 PJ)

Producers who consume the energy they produce are not included in this study.

Considering that the technical potential of 326 PJ includes 168 PJ (8.8 MTDM) of joint products of transformation of timber recovered and valorized by the pulp and paper industry, particle board and ecological pellets and logs for the equivalent of 15 PJ and that 63 PJ of biomass is already transformed into various types of marketable bioenergy, it can be deduced that the additional technical potential of bioenergy in Québec could reach 110 PJ, a sufficient quantity to achieve the Strategy's objectives.<sup>2</sup>

\* Given that the figures have been rounded, their sum may not correspond to the total indicated.

(2) The target of the 2030 PGE to increase bioenergy production 50% by 2030 corresponds to an annual increase of about 70 PJ.



## Complementarity and synergy of sectors

While bioenergy already generates environmental and socioeconomic gains and it is appropriate to increase its share of the Québec energy portfolio, the green hydrogen sector instead will be called on to play a significant role after 2030.

Strong complementarity exists between sectors in the uses to be decarbonized, for example, to replace fossil fuels in the industrial and transportation sectors.

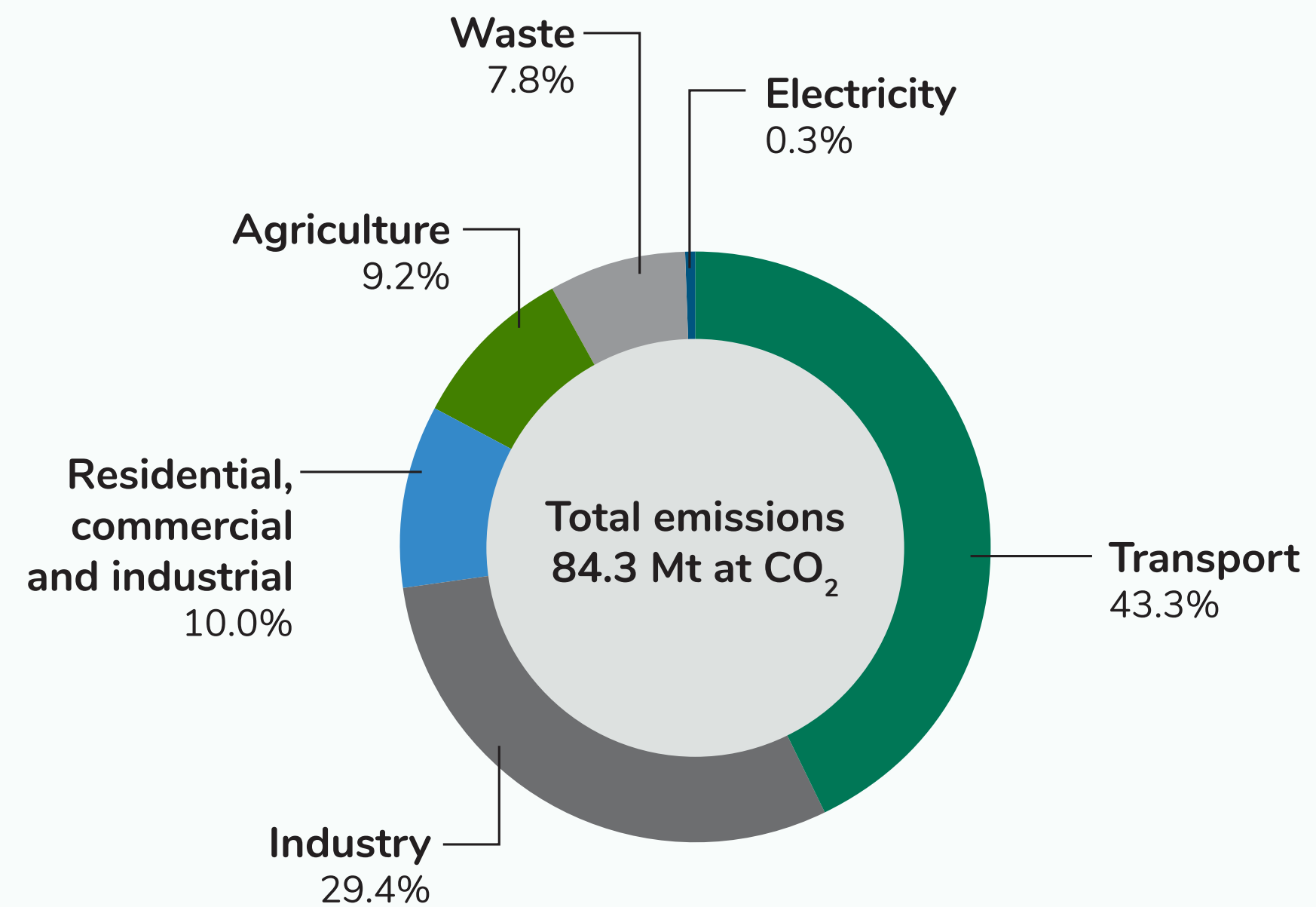
Synergies already exist between the two sectors, particularly in production of biofuels from green hydrogen or in the context of production of green hydrogen with biomass.



# 1.2 ACCELERATE THE ENERGY TRANSITION AND REDUCE GHG EMISSIONS

To accelerate the energy transition, Québec must resort to various means to replace fossil fuels in the sectors emitting the most GHGs, more particularly in the sectors of transport, industry and construction. In most of these sectors, green hydrogen and bioenergy may also contribute actively with available technologies.

GHG emissions by sector of activity in Québec in 2019



Ministère de l'Environnement et de la Lutte contre les changements climatiques, Tables of annual greenhouse gas emissions in Québec from 1990 to 2019.



## A MAJOR INPUT BY 2030

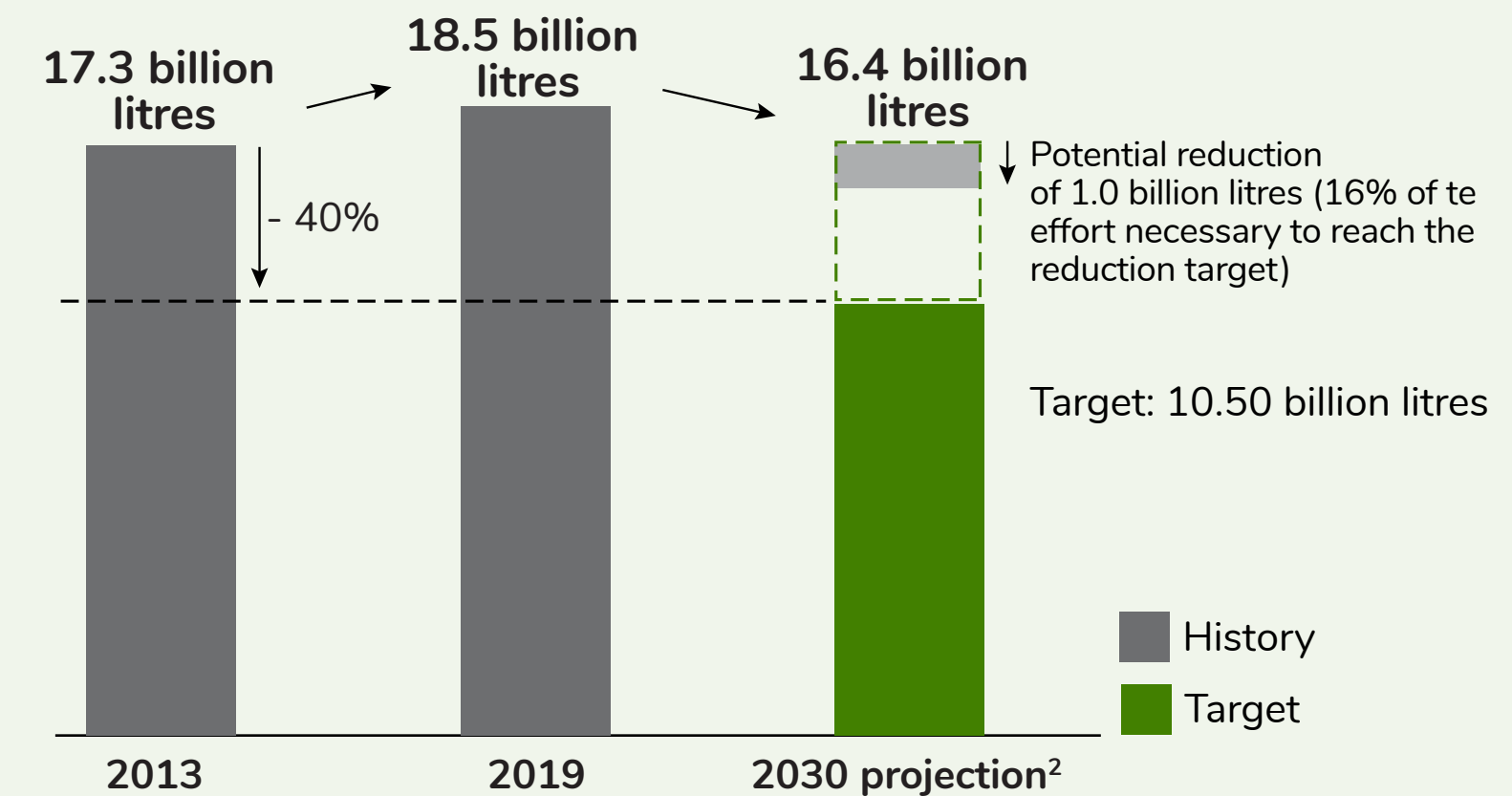
The achievement of the target set for 2030 corresponds to an emission level of 54 Mt CO<sub>2</sub> eq in 2030. Québec GHG emissions could amount to 85 Mt CO<sub>2</sub> eq without pursuing the current efforts or implementing new measures. The reduction effort is therefore estimated at 31 Mt CO<sub>2</sub> eq in 2030. (2022-2027 Implementation Plan of the 2030 PGE).

The 2022-2027 Implementation Plan of the 2030 Plan for a Green Economy provides that all of the actions deployed in Québec to fight climate change would result in reductions of 15,9 Mt CO<sub>2</sub> eq in Québec territory, 51% of the effort required by the 2030 horizon to achieve the GHG emissions reduction target of 37.5% relative to 1990.

Overall, by the 2030 horizon, it is estimated that the growth of the green hydrogen and bioenergy sectors could generate potential annual GHG emissions reductions in Québec of around 4 Mt CO<sub>2</sub> eq. This represents the equivalent of removing 1.2 million gasoline vehicles from the roads.

By the 2030 horizon, the initiatives arising from the implementation of the Strategy would allow an anticipated reduction of consumption of oil products equivalent to nearly 1 billion litres of oil products, or about 16% of the reductions required to achieve the target of a 40% reduction of consumption of oil products. Added to these last initiatives are several other measures deployed by the Government in support of the efforts of the energy transition, such as transportation electrification or energy efficiency.

Estimated efforts to reach the 2030 target for reduction of consumption of oil products<sup>1</sup> (in billion of litres)



1. Oil products include crude oil, motor gasoline, diesel fuel, jet fuel, light oil and heavy fuel oil.  
 2. Energy consumption projection scenario (MERN, 2021).



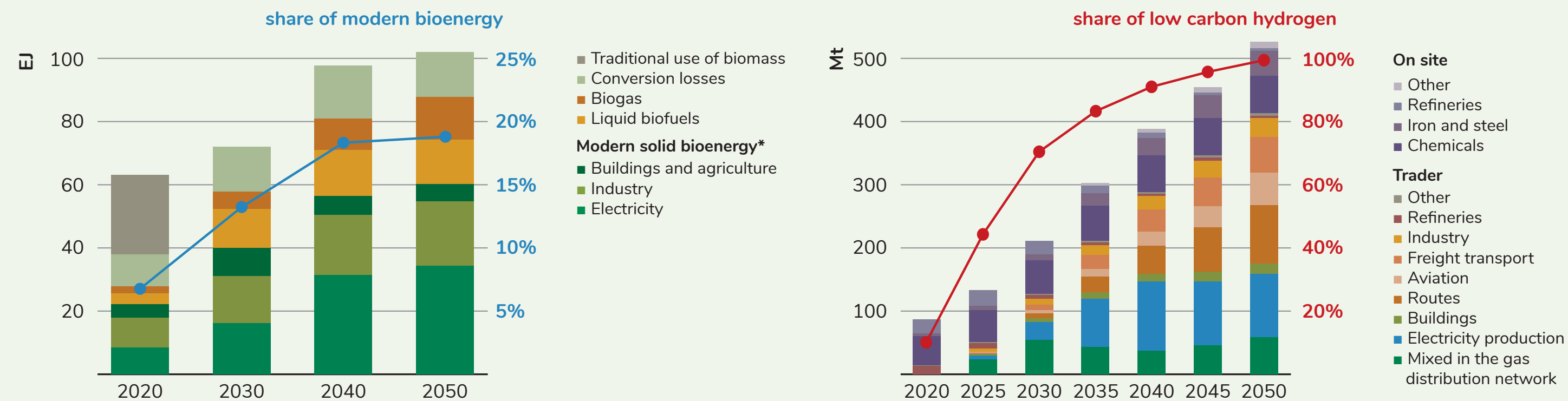
## AND EVEN MORE BY 2050

Thus, in achieving the objective of carbon neutrality, fossil fuels will be replaced with a set of solutions, including energy sobriety and efficiency, direct electrification, bioenergy and green hydrogen.

In its report *Net Zero by 2050: In A Roadmap for the Global Energy Sector*, published in May 2021, the International Energy Agency (IEA) proposes a roadmap to achieve carbon neutrality in the energy sector on a global scale by 2050 and to limit the global temperature rise to 1.5°C. According to its estimates, the IEA suggests that global demand for hydrogen should increase fivefold by mid-century to meet carbon neutrality targets.<sup>10</sup> Regarding bioenergy, it estimates that their production should provide nearly 20% of global energy needs in 2050 if global carbon neutrality is targeted.

This report demonstrates the importance that the development of the green hydrogen and bioenergy sectors may take worldwide, in addition to energy efficiency and electrification, to achieve carbon neutrality in 2050.

Anticipated growth in demand for hydrogen and bioenergy to achieve carbon neutrality in the global energy sector by 2050



<sup>10</sup> In 2020, global hydrogen production was 90 Mt and could exceed 500 Mt in 2050.



## Carbon capture, use and storage (CCUS) technologies, potential to consider by 2050

○ INITIATIVE TO COME

In its report, *Energy Technology Perspectives 2020*, the IEA explains that Carbon Capture, Use and Storage (CCUS) technologies will play a major role in achieving carbon neutrality by 2050. Capture may also apply to greenhouse gas emissions of large industrial emitters and waste landfill sites. Once captured, CO<sub>2</sub> can be used directly or transformed to make other products. For example, it can be combined with green hydrogen to make synthetic fuels or transformed into various chemicals or construction materials, such as cement. It is also possible to combine bioenergy (e.g. combustion of residual forest biomass) with carbon capture and storage (BECCS) to generate negative emissions (net reduction of GHG concentrations in the atmosphere). The maturity of carbon sequestration and valorization technologies varies enormously, making it necessary to pursue work relating to the acquisition of knowledge and the accomplishment of innovative projects in this field.

In this regard, An Act mainly to end petroleum exploration and production and the public financing of those activities, adopted on April 12, 2022, provides that the Minister of Energy and Natural Resources may, after consulting with the Minister of the Environment and the Fight Against Climate Change, authorize the implementation of pilot projects or the acquisition of knowledge, particularly regarding CO<sub>2</sub> sequestration potential, geothermal potential or any other activity that fosters the energy transition or carbon neutrality or that helps achieve the objectives of the fight against climate change. These pilot projects will be accomplished from hydrocarbon wells before their permanent closure. In an innovation context, the accomplishment of pilot projects allowing acquisition of knowledge will be essential to validate certain models supporting the solutions that will be specific to the Québec context.





## 1.3 CREATE WEALTH AND DEVELOP GLOBAL REACH

# ECONOMIC BENEFITS TO BUILD A GREENER, MORE RESILIENT AND MORE PROSPEROUS ECONOMY

The Strategy's initiatives will contribute to Québec's enrichment, particularly by the replacement of imported energy with energy produced in its territory, but also by excelling internationally with its products and knowhow and through Québec's positioning as a leading North American actor in the development of these sectors. At the same time, Québec will confirm its leadership in the green economy and its contribution to the global effort to achieve carbon neutrality by the 2050 horizon.

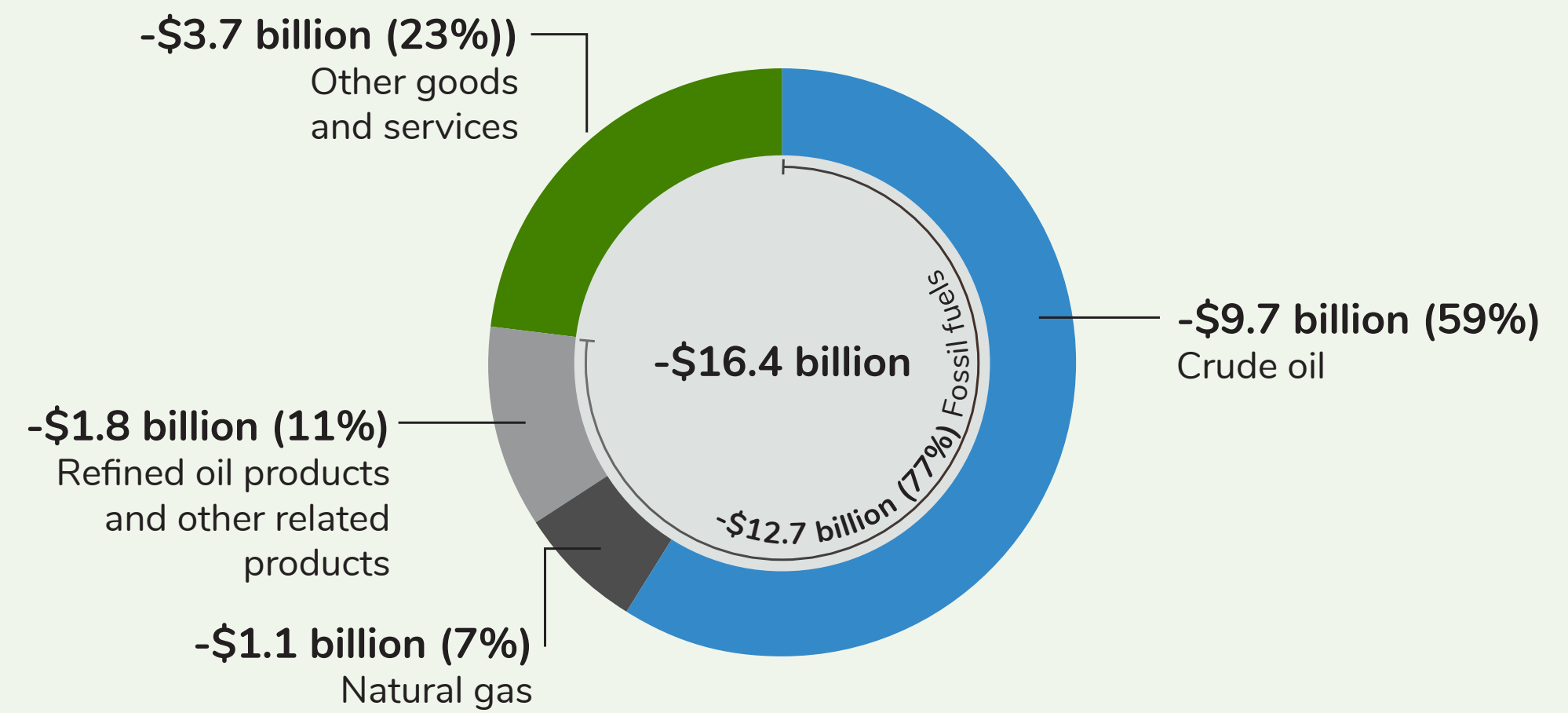
In addition to reducing GHG emissions and increasing Québec's energy autonomy, the use of the green hydrogen and bioenergy will help diversify and secure Québec's energy supplies, improve its trade balance and generate jobs in future-oriented fields. Energy resilience and security, which can be obtained by the development of greater energy production in Québec, will make it possible to avoid flights of capital out of the province.



## Influence of fossil fuel consumption on the balance of trade

With substantial imports and oil products consumed in the province, Québec has a trade deficit, meaning that Québec capital is transferred out of the province to ensure this energy intake.

The reduction of consumption of these hydrocarbons thus would have a positive effect not only on the environment, but also on the province's economy.



Calculations of the Ministère des Finances du Québec based on Statistics Canada data (2018).  
The data takes into account international and interprovincial imports and exports.



Québec, which enjoys renewable electricity production capacities at competitive cost and advantageous residual biomass availability, is favourably positioned to develop competitive sectors.

This is why, in the past few years, green hydrogen and bioenergy production projects offering an exceptional showcase for Québec expertise in this matter have been confirmed in Québec.

**The world's biggest proton exchanger membrane electrolyzer is in Québec**

In January 2021, the French company Air Liquide completed the construction in Bécancour of the world's biggest proton exchange membrane electrolyzer. With 20 MW of power, this electrolyzer has a production capacity of 8.2 tonnes of green hydrogen per day. Compared to production from natural gas, this new production unit will allow avoidance of nearly 27,000 t CO<sub>2</sub> eq of emissions per year, or annual emissions of nearly 8000 gasoline cars.



Over the next few years, in order to achieve Québec's ambitions, investments in the Québec economy of up to \$10 billion could result from the accomplishment of green hydrogen and bioenergy production projects. These projects will favour an increase in long-term production capacity and will consolidate the economy in these sectors.

Because increased pressure on electric power supplies is to be anticipated,<sup>11</sup> it is necessary to develop an appropriate approach to sustainable valorization of Québec's wealth, while optimizing the impacts for all Quebecers. In this context, the Government will first support the production projects that will give priority to meeting a local demand for consumption in two ways:

- The creation of regional energy ecosystems associating green hydrogen or bioenergy production and consumption locally will stimulate regional development of the sectors while reducing the risks and cost. The mutual commitment of the different actors will allow consolidation of the most structuring projects by capitalizing on the competitive particularities of the different regions of Québec.
- The legal and regulatory frameworks applicable to the export projects for bioenergy, green hydrogen or their by-products could be adapted to encourage local use and ensure maximization of the socioeconomic impacts of exploitation of Québec natural resources. Among them, wealth-creating projects leading to export of value-added products, such as green steel, will be favoured. The same is true for export projects with low needs for resources and energy.



The deployment of green hydrogen and bioenergy sectors will also help create and maintain quality jobs and transform current jobs into well paid jobs. For many people, jobs will be created mainly in the regions, near potential resource deposits.

<sup>11</sup> The 2020-2029 Hydro-Québec Supply Plan and its updates allow recognition of the anticipated evolution of electricity needs in Québec.





### Green hydrogen: an environmental and economic choice

While currently green hydrogen costs two to five times more than grey hydrogen, mainly because of the investment costs and the cost of the renewable electricity required for the water electrolysis process, [several organizations specializing in the field of energy foresee a rapid reduction in the costs linked to the production of green hydrogen.](#) For example, Polytechnique Montréal, in its [technico-economic potential study](#) deposited in 2020, presented modelling of the anticipated green hydrogen costs.

Compared to hydrogen produced from fossil fuel, for which the production cost is influenced by carbon pricing, which is bound to increase progressively up to 2030 and beyond, the competitiveness of green hydrogen depends primarily on the evolution of the price of electrolyzers and the cost of electricity. These economic considerations supported by the inevitable medium-term evolution of the carbon pricing are added to the environmental imperatives to support the Government's intention.

## 2. HOW TO ACHIEVE THIS? BLAZING THE TRAIL FOR OPTIMAL DEVELOPMENT



Following consultations conducted with different actors in the academic, social and economic communities and Indigenous nations and after targeting the issues and the solutions, the Gouvernement du Québec has adopted a vision, guiding principles and action priorities that will guide the development of a green hydrogen and bioenergy economy.

## CHALLENGES TO MEET

The green hydrogen and bioenergy sectors present common challenges. They call for a global and concerted action, particularly to:



Ensure optimum use of Québec's natural and energy resources



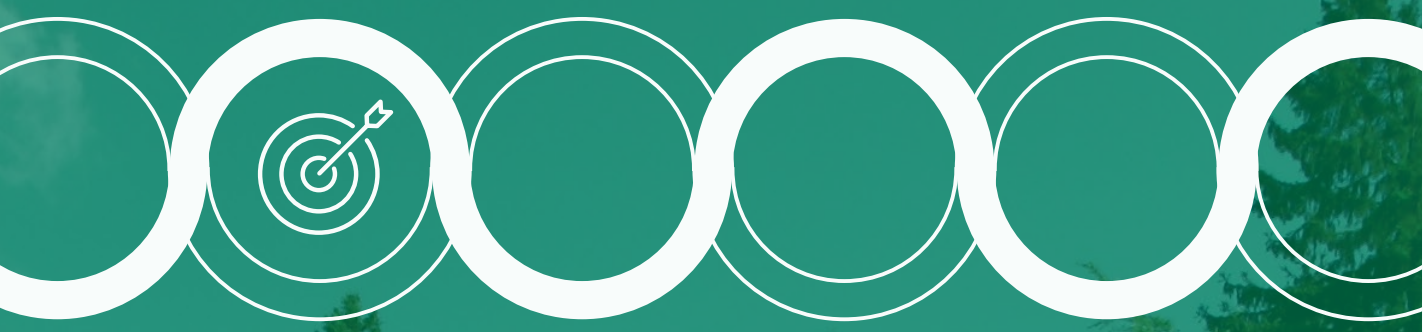
Close the current price differences and thus promote their competitiveness in relation to the cost of fossil fuels



Increase networking among industry, government and research actors



Accelerate development and the technology transfer to the industrial environment



## 2.1 A FIRST GREEN HYDROGEN AND BIOENERGY STRATEGY

The very first 2030 Green Hydrogen and Bioenergy Strategy puts favourable conditions in place to meet current challenges and remove obstacles to the development of the green hydrogen and bioenergy sectors.

Developed in a coherent and structured manner, these sectors will constitute a key solution for the energy transition and the socioeconomic vitality of the regions.

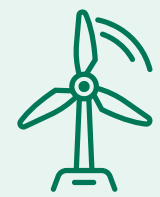
### VISION

The government vision is clear: in the pursuit of its energy transition and on the strength of its natural resources, Québec intends to increase the role of green hydrogen and bioenergy in its energy portfolio in the pursuit of decarbonizing and strengthening its economy.



# FIVE GUIDING PRINCIPLES

The 2030 Québec Green Hydrogen and Bioenergy Strategy will be structured around five guiding principles:



Act in complementarity with energy sobriety and efficiency and direct electrification of the economy by using green hydrogen and bioenergy, depending on the sector, so as to contribute to the achievement of the GHG emission reduction target for 2030 and the objective of carbon neutrality in 2050



Ensure sustainable valorization of natural resources and residual materials by including the principles of the circular economy and lifecycle assessment at the core of green hydrogen and bioenergy projects



Involve the local, regional and Indigenous communities in the deployment of the green hydrogen and bioenergy sectors, respecting best practices in terms of sustainable development and social acceptability



Maximize the socioeconomic impacts of these sectors in Québec by attracting investment and exporting our knowhow abroad



Contribute to Québec's energy autonomy and security by substituting renewable energy produced in the territory for imported fossil fuels while diversifying energy supply sources





## 2.2 ACTION PRIORITIES FOR ORDERLY DEVELOPMENT OF THE SECTORS

The Government now intends to give directions to the economic partners to see to the sustainability of resources and maximize the economic, social and environmental benefits for Québec.

In choosing the projects to prioritize for the production and use of green hydrogen and bioenergy in Québec, the Gouvernement du Québec will consider the following criteria, in particular:

- The project's relevance to direct electrification, supported by an uncompromising vision in order to prioritize uses via an informed approach
- The contribution of the energy transition and reduction of GHG emission in Québec, which may arise from these projects, and the time in which these effects will materialize
- The level of investment required and the projected economic impacts, particularly in the regions
- The structuring effect of the project on the value chain, such as: stimulation of demand in current or new niches, development of Québec expertise and innovation, consolidation of a local manufacturing base, or creation of technological complementarity
- Technical feasibility (maturity of technologies and the necessary infrastructures), market volume, long-term potential of use, and the duration for which State financial support will be required



# INTERVENTION PRIORITIES FOR HYDROGEN

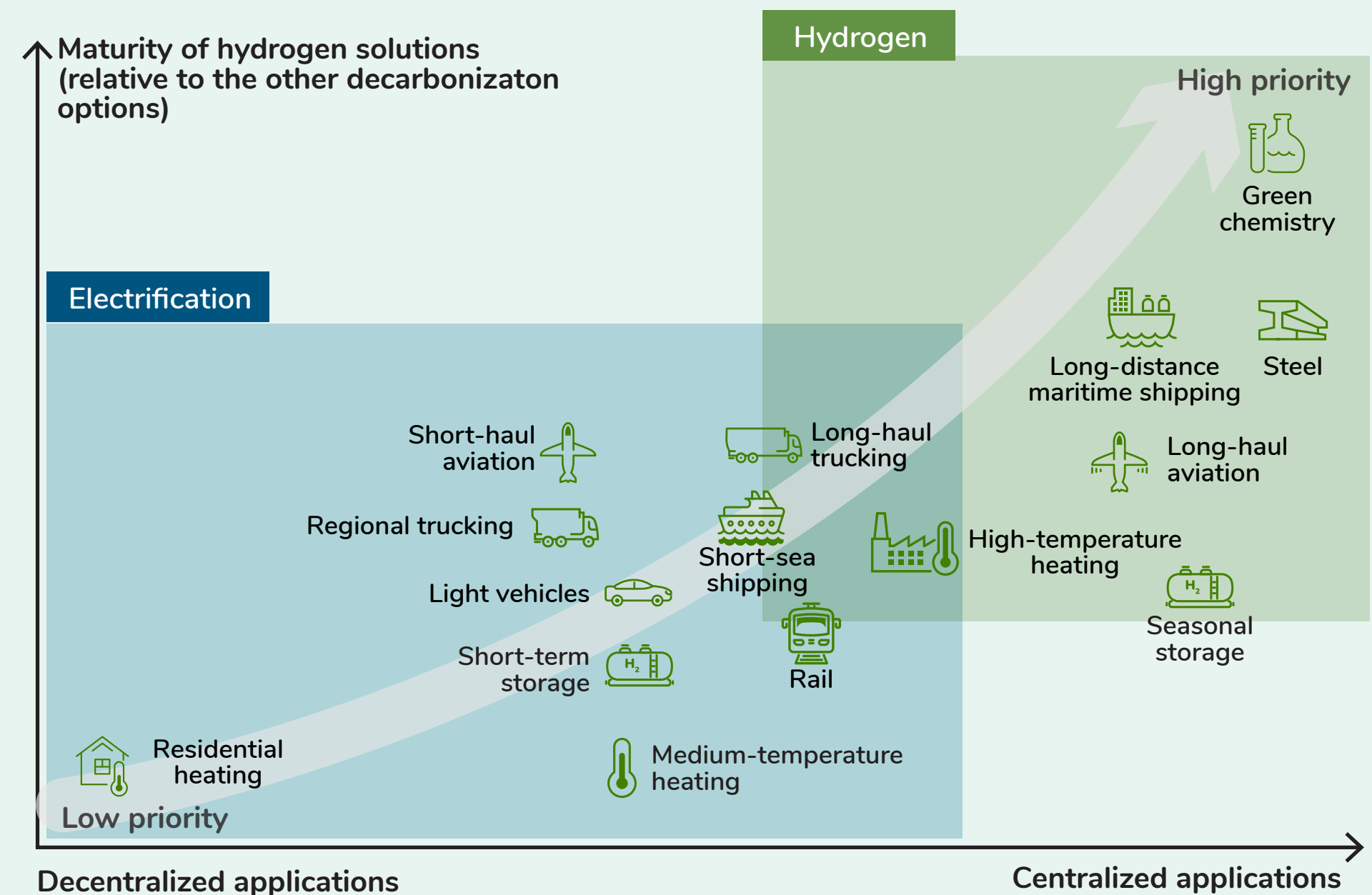
It is currently possible to agree on certain uses of green hydrogen that comply with the above-mentioned criteria. Demonstration projects can also be envisioned in other segments of the economy, where technological maturity is not assured. This is particularly the case for synthetic fuels, which could be used in the aviation sector.

## Prioritizing uses in an informed development approach

Decarbonization of Québec must depend on a multitude of technological solutions. Each technology has advantages and disadvantages. To support the emergence of a sector like hydrogen, it is appropriate to capitalize first on the uses in which few or no options are available, while deploying the necessary efforts to ensure the evolution of the uses for which this sector could play a complementary role to direct electrification, in particular.

It is with this strategic concern that the relevance of the projects will be assessed to avoid overdimensioning the infrastructure and, above all, to address the priority needs that will evolve over time, in consideration of the progress of the various technologies.

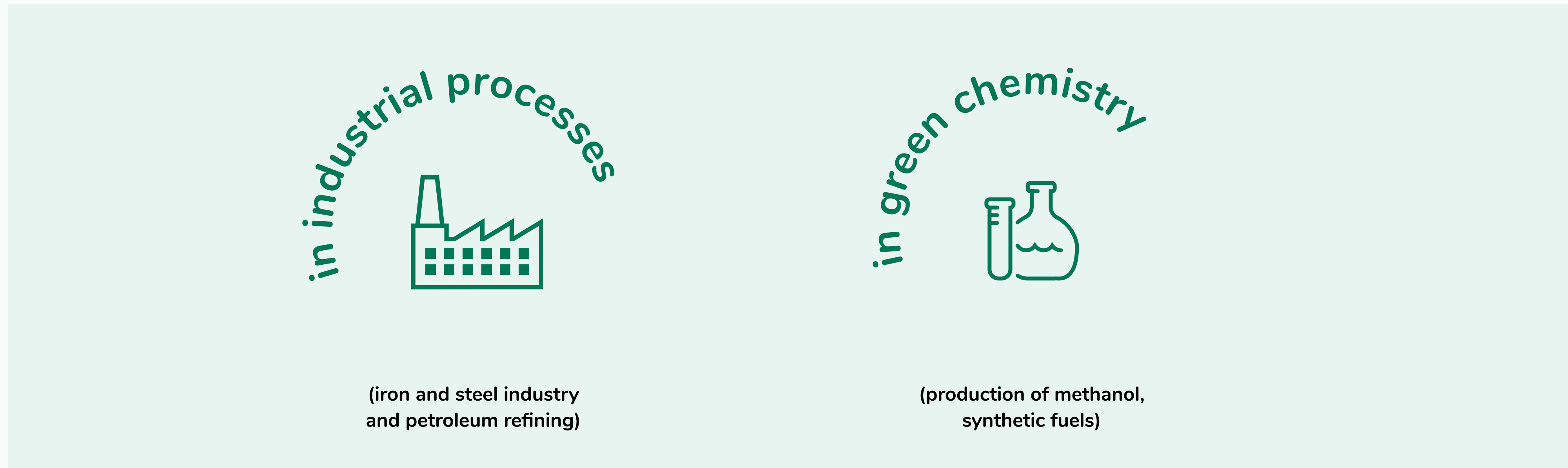
The scientific literature suggests several interpretations of the priority uses for green hydrogen. These uses must be considered, in particular, according to their current maturity, compared to other decarbonization solutions including direct electrification, and based on the specific context, both of the territory concerned and the global trends.



Source inspired by [Geopolitics of the Energy Transformation - The Hydrogen Factor](#), produced by the IRENA.

# SUPPORTING CONSUMPTION IN PRIORITY USES

Concretely, it is planned to support green hydrogen consumption in substitution for the grey hydrogen currently used in Québec, for example:





## CAPITALIZING ON LOCAL CONSUMPTION AND REGIONAL ENERGY ECOSYSTEMS

The Gouvernement du Québec will support the development of production infrastructures for green hydrogen consumed on the site, or in a regional energy ecosystem, while encouraging the purchase of green hydrogen. It will also see to governing the orderly injection of renewable source gas, including green hydrogen, into the gas network.

## FOLLOWING THE TRENDS OF A BURGEONING SECTOR

Moreover, support will be provided to different high-potential initiatives, which could quickly achieve the required commercial maturity level, such as:



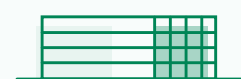
Renewable source synthetic fuels



Energy storage and balancing of networks for management of winter peak periods, particularly as a complement to the [wind energy segment](#)



Replacement of fossil fuels in autonomous networks



Production of renewable source gas by [methanation](#)



Phases of deployment of the green hydrogen sector

Short term Up to 2025	Medium term 2026-2030	Long term Beyond 2030
<ul style="list-style-type: none"> <li>• Support consumption in priority uses</li> <li>• Create regional energy ecosystems</li> <li>• Increase expertise and pursue the evaluation of the orders of merit of uses</li> <li>• Favour the development of normative tools and guarantee of origin systems</li> <li>• Support the production projects, primarily those concerning local needs</li> <li>• Validate the opportunity, then define the criteria and the conditions favourable to eventual support of export projects</li> <li>• Support the accomplishment of pilot projects and studies relating to uses of interest in development</li> </ul>	<ul style="list-style-type: none"> <li>• Supporting consumption in priority uses</li> <li>• Support deployment in the sectors that show promising interest</li> <li>• Deploy an appropriate operational framework for large-scale production projects</li> <li>• Support the accomplishment of pilot projects and innovation in the emerging sectors</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidate consumption in priority uses</li> <li>• Deploy large-scale projects</li> <li>• Support infrastructure construction</li> </ul>



# HYDRO-QUÉBEC, PARTNER IN DEPLOYMENT OF THE GREEN HYDROGEN SECTOR

The development of the green hydrogen sector is consistent with an energy transition logic, and, in this context, Hydro-Québec wishes to develop the advantages of its clean, reliable and available electricity to position Québec among the leaders in the green hydrogen field.

Hydro-Québec will act as a strategic partner by meeting the energy demand associated with the segment's development, complementary to the needs of other segments in development (particularly greenhouse production, data centres, batteries, electricity export and electrification of the economy).

Thus, the Gouvernement du Québec will develop a frame of reference to ensure that the projects that will be implemented in the green hydrogen field are aligned with Québec's decarbonization objectives and the guiding principles stated.



© Photo Hydro-Québec



## INTERVENTION PRIORITIES FOR BIOENERGY

Whether with purchasing programs for Hydro-Québec electricity produced by cogeneration, numerous financial assistance programs for innovation projects or production or use of bioenergy, the Gouvernement du Québec has supported the bioenergy energy sector for several years.



The actions regarding the development of the various bioenergy sectors will be multiplied to take advantage of these bases, consolidate the structure of these markets and develop high-potential sectors with less maturity. To do this, it is first appropriate to prefer local production and consumption while supporting the structured deployment of bioenergy produced from sustainably exploited residual raw materials.





### Carbon intensity and the real environmental impacts of bioenergy are taken into account to ensure the sustainability of supplies

The environmental impact of bioenergy production varies according to the raw materials used, the conversion processes used and the energy sources replaced. To support production of bioenergy generating real reduction of GHG emissions, the Government intends to favour sustainable use of renewable raw materials by integrating criteria, such as carbon intensity, throughout the product **lifecycle** and the environmental gains into its analysis tools.



### Creating a local market

The Gouvernement du Québec will work in concert with its partners to create a dynamic and predictable market for the bioenergy sector.

For this purpose, it will improve its program offering and adapt different economic and regulatory mechanisms to favour demand in its territory. This local demand will be supported, in particular, by State exemplarity in renewable energy consumption, including bioenergy.

#### State exemplarity

The Government has adopted ambitious State exemplarity targets for the 2030 and 2040 horizons. Apart from the adoption of energy efficiency objectives, incentive measures or resorting to renewable energy with the aim of reducing GHG emissions of new and existing State buildings are **applied**. They particularly target the conversion of heating systems using oil and other fossil fuels to systems mainly using renewable energy. Recourse to bioenergy proves to be an additional opportunity to meet renewable energy needs.



### Capitalizing on mature sectors first...

In the short term, priority will be given to bioenergy production projects that allow immediate valorization of residual biomass available thanks to mature technologies, such as heating with residual forest biomass, biogas capture, production of certain biofuels, and preparation of organic materials. The development of the bioenergy sector for targeted applications represents the bases on which Québec can lay the foundation for its development.

Thus, by 2026, the Gouvernement du Québec will pursue efforts so that these mature bioenergy sectors can continue their deployment in the market. To achieve this, special efforts must be made to establish the bases of an efficient residual biomass supply chain to support the overall development of the bioenergy sector.

### Structuring supply chains

Because the supply of raw materials is a central factor for every bioenergy project, it is planned to target the best ways of structuring sustainable and reliable supply chains that ensure the quality of biomass at a competitive price. The biomass supply chain structuring efforts are part of an overall circular economy approach that seeks the strategic valorization of the available biomass deposits. Standards will also be adopted to facilitate commercial transactions, strengthen the safety and quality of uses and contribute to ensure the industry's viability.





### Accelerating the pace of deployment and capitalizing on emerging sectors

To accelerate the pace of deployment of the bioenergy sector, Québec will also pay attention to promising local sectors for which deployment is currently slowed by certain technical and economic challenges. For example, the use of raw cellulosic materials in biochemical and thermochemical valorization processes, which are more difficult to transform due to their composition, or residual materials available in large quantities, but for which valorization is complicated by their heterogeneous composition or harvesting costs.

In the medium term, the Gouvernement du Québec will endeavour to support the deployment of structuring projects for valorization of residual biomass through biochemical and thermochemical technologies for production of different forms of bioenergy.

Finally, a special effort will be made to develop regional energy production and consumption ecosystems that will take advantage of the synergies between the actors and the residual biomass deposits available to create the maximum socioeconomic and environment (value-added energy products and coproducts).

### Opening the way to an integrated and efficient biorefinery model

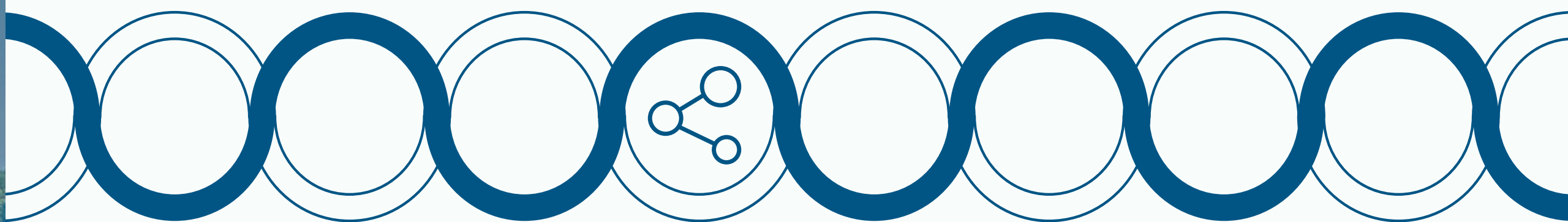
Beyond 2030, the actions taken by the Gouvernement du Québec to develop the sector will have opened the way to integrated and efficient use of biomass, particularly by implementation of biorefineries in synergy with green hydrogen production.



Phases of deployment of the bioenergy sector

Short term Up to 2025	Medium term 2026-2030	Long term Beyond 2030
<ul style="list-style-type: none"> <li>• Structure and optimize the residual biomass supply chain</li> <li>• Adapt the training programs according to the industry's special needs</li> <li>• Accelerate production of mature bioenergy sectors, primarily aimed at local needs</li> <li>• Increase and consolidate use of wood pellets for heating and processes in Québec</li> <li>• Refine the knowledge of the various biomass departments and make this information available</li> <li>• Favour local consumption</li> <li>• Support the development of biomass quality standards and guarantee of origin (traceability) systems</li> <li>• Adopt research and development of processes and business models applicable to the market's needs</li> </ul>	<ul style="list-style-type: none"> <li>• Support the deployment of the various forms of bioenergy in the most relevant sectors</li> <li>• Pursue the initiatives in view of supporting regional energy ecosystems by focusing on deployment of biochemical and thermochemical conversion processes (value-added energy products and coproducts)</li> <li>• Pursue research and development of processes and business models applicable to the market's needs</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidate bioenergy consumption in Québec</li> <li>• Accelerate deployment of large-scale biorefinery projects</li> </ul>

# 3. QUÉBEC IN ACTION TO ADVANCE FUTURE SECTORS



The development of the green hydrogen and bioenergy sectors must continue according to a harmonious, comprehensive and coherent vision. This is why it is necessary to send clear market signals and create a favourable long-term environment, direct the choices in the public and private sectors, support innovation and foster better collaboration among ecosystem actors to increase the synergy of interventions.



## A first Green Hydrogen and Bioenergy Roadmap

With the 2030 Québec Green Hydrogen and Bioenergy Strategy, the Government is releasing the first Green Hydrogen and Bioenergy Roadmap integrated into the 2026 Québec Energy Transition, Innovation and Efficiency Master Plan.

This roadmap presents the measures that will be deployed over the next five years to carry out the first initiatives of the Strategy, some of which are also presented in the Implementation Plan of the 2030 Plan for a Green Economy (PGE).

While the Strategy sets out a long-term vision and the principles and priorities that will guide the government action for the 2030 horizon and beyond, the roadmap will be updated every five years to evolve according to the Québec energy, economic and technological context.

The follow-up, evaluation and accountability of the Strategy will be in the context of the mechanisms of the Master Plan and the Implementation Plan of the PGE.



# 3.1 THREE AXES TO DECARBONIZE, INNOVATE AND SHINE

The objectives of the Strategy break down into three axes, namely the business environment, knowledge and innovation and, finally, collaboration, information and promotion measures.

Social acceptability, which is one of the essential conditions for the success of the Strategy, will translate into different actions and ways of working together, according to the needs and priorities of each community.

<b>LINE 1</b> BUSINESS ENVIRONMENT	<b>LINE 2</b> KNOWLEDGE AND INNOVATION	<b>LINE 3</b> COLLABORATION, INFORMATION AND PROMOTION
<p>Objective 1: Develop production and distribution infrastructure</p> <p>Objective 2: Increase green hydrogen and bioenergy use</p>	<p>Objective 3: Improve knowledge and its dissemination</p> <p>Objective 4: Develop innovative solutions and processes</p>	<p>Objective 5: Increase the commitment of public and private actors for the development of the green hydrogen and bioenergy sectors</p> <p>Objective 6: Encourage the support of local and Indigenous communities in the development of the sectors</p>



# AXIS 1 BUSINESS ENVIRONMENT

The Business environment axis has the purpose of creating a context allowing the development of production and distribution infrastructures and increasing the use of green hydrogen and bioenergy.

To achieve this, the State must collectively ensure the sustainable use of resources while developing flexible and predictable support and guidance mechanisms to develop both supply and demand, as well as the value chain associated with it, and to reduce the financial risks associated with the implementation of projects related to green hydrogen and bioenergy.

Non-exhaustively, several initiatives are already in progress to achieve the established objective, and the Government intends to accentuate its efforts in this field. All of the measures are presented in the Green Hydrogen and Bioenergy Roadmap of the Energy Transition, Innovation and Efficiency Master Plan.

Flagship measures	Examples of initiatives
<b>Objective 1: Develop production and distribution infrastructure</b>	
Foster the deployment of green hydrogen and bioenergy production and distribution infrastructure in prioritized market segments, particularly in the regional energy ecosystems	✓ Natural Resources and Energy Capital Fund
	✓ Financial assistance programs for biogas and renewable natural gas production
	○ Initiative to support the regional energy ecosystems
Offer tax credits for production of biofuels and pyrolytic oil	○ Overhaul of the tax credits for production of biofuels and pyrolytic oil

✓ IN PROGRESS

○ TO COME





Flagship measures	Examples of initiatives
<b>Objective 2: Increase green hydrogen and bioenergy use</b>	
Adapt the regulatory framework to require minimum renewable content (or a better maximum carbon intensity index) in fossil fuels	✓ Regulation respecting the integration of low carbon intensity fuel content into gasoline and diesel fuel
	✓ Regulation on the minimum volume of renewable natural gas
	✓ Introduction of the notion of renewable natural gas into the legislation to govern decarbonization of the gas network more comprehensively
	○ Increase of the thresholds for the minimum volume of renewable source gas to be injected into the gas network
Make regulatory and administrative changes allowing the safe and sustainable deployment of green hydrogen and bioenergy as well as harmonization of standards	✓ Funding of the update of the Canadian Hydrogen Installation Code by the Bureau de normalisation du Québec
	○ Adopt a hydrogen installation code and a hydrogen safety code
	○ Assess the possibility of extending the regulation with the aim of favouring minimum renewal content (or a maximum carbon intensity index) for all fossil fuels
Continue and accentuate deployment of technologies allowing consumption of green hydrogen and biofuels	✓ Financial assistance programs for the purchase of equipment allowing recourse to bioenergy and green hydrogen in the industrial, commercial, institutional and transportation sectors
Cover the operating costs transitionally by conversion to renewable electricity, green hydrogen or bioenergy	○ Initiative to reduce the price difference between fossil fuels or hydrogen of fossil origin and their renewable alternatives

✓ IN PROGRESS

○ TO COME



## Objective 1: Develop production and distribution infrastructure

- Foster the deployment of green hydrogen and bioenergy production and distribution infrastructure in prioritized market segments, particularly in the regional energy ecosystems

The creation of green hydrogen and bioenergy production and distribution hubs is one of the most efficient ways to reduce the risks related to investments and maximize the results. By doing this, the Government wishes to favour the development of industrial synergies and collaborations bringing together all of the actors in the chain and allowing the design and the viable and competitive deployment of hubs located both near the raw material and near the consumption sites, depending on the regional particularities.

The government support for deployment or adaptation of infrastructures, for example, for renewable natural gas, residual biomass supply, or low carbon intensity fuel distribution, will give priority to those that offer environmental and economic gains over the next few years while remaining relevant in the longer term.



## Natural Resources and Energy Capital (NREC) Fund

✓ IN PROGRESS

Endowed with \$1 billion of capitalization, the Natural Resources and Energy Capital (NREC) Fund supports the accomplishment of projects that offer expectations of profitability in addition to a potential for notable economic impacts. The eligible companies must engage in at least one of the following activities:

- Extraction or transformation of natural resources in Québec, on condition, in the case of transformation, that a portion of these resources has been extracted in Québec
- Production, storage, transportation and distribution of fuels which, as substitutes for other fuels, including fossil fuels, allow reduction of carbon intensity
- Production, storage, transportation and distribution of renewable energy or materials substituting for fossil fuels, on condition, in this case, that these materials allow reduction of GHG emissions by contributing to the supply of clean energy or hydrogen in Québec
- Development, commercialization or implementation of technologies favouring energy transition, innovation or efficiency, reducing fugitive emissions or allowing the activities mentioned in the previous paragraph
- Transformation of forest products carried out at facilities located in Québec

The investment of the NREC Fund takes the form of equity in voting and participating shares, which may be accompanied by warrants, or partnership units.



## Renewable Natural Gas Production Support Program

✓ IN PROGRESS

The MERN has established the [Renewable Natural Gas Production Support Program \(PSPGNR\)](#). This program allows the allocation of financial assistance in support of RNG production and injection into the natural gas distribution network with the aim of meeting the targets indicated in the *Regulation respecting the quantity of renewable natural gas to be delivered by a distributor*.

The Program has the following objectives:

- Replace natural gas of fossil origin consumed in Québec with RNG that does not contribute to climate change and thus generate a reduction of Québec GHG emissions
- Increase total renewable energy production
- Create jobs and generate private investment in the RNG sector in Québec

In November 2020, under the 2030 Plan for a Green Economy, the Government announced its intention to increase the envelope allocated to this program by \$200 million by 2026. Consistent with the government intention to increase the RNG share in the natural gas network, the program was improved to stimulate deployment of projects.



## Objective 2: Increase green hydrogen and bioenergy use

- Adapt the regulatory framework to require minimum renewable content (or a better maximum carbon intensity index) in fossil fuels.

The economic, fiscal and regulatory environment will be reviewed to encourage the adoption of green hydrogen and bioenergy in replacement of fossil fuels. It will be adapted to account for the particularities of the bioenergy and green hydrogen sectors, including the techno-economic maturity level, the regional context, the environmental impacts and the carbon cost.





## Regulations to replace fossil fuels with bioenergy

✓ IN PROGRESS

The Gouvernement du Québec has undertaken to establish regulations requiring the replacement of fossil fuels with various forms of low carbon intensity bioenergy. In addition to contributing to the reduction of GHG emissions and Québec's energy autonomy, this new regulatory framework will foster the emergence of a business environment favourable to bioenergy production.

### Regulation respecting the quantity of renewable natural gas

Taking effect in March 2019, the *Regulation respecting the quantity of renewable natural gas to be delivered by a distributor* has the goal of favouring increased use of renewable source gas by specifying the minimum quantity of renewable source gas that the natural gas distributors must deliver annually in their network, 1% in 2020, 2% starting in 2023 and 5% starting in 2025. Under the 2030 Plan for a Green Economy, the Government undertook to increase this minimum volume to 10% by the 2030 horizon to favour local consumption of renewable source gas produced here.

### Regulation respecting the integration of low carbon intensity fuel content into gasoline and diesel fuel

The *Regulation respecting the integration of low carbon intensity fuel content into gasoline and diesel fuel* prescribes the integration, starting January 1, 2023, of 10% low carbon intensity content into gasoline and 3% into diesel fuel. These proportions will increase gradually to 15% in gasoline and 10% in diesel fuel by 2030.



- Make regulatory and administrative changes allowing the safe and sustainable deployment of green hydrogen and bioenergy as well as harmonization of standards

The development of new markets for green hydrogen and bioenergy necessitates the establishment of consensus on the necessary changes, particularly to ensure the safety of practices and standardization. For example, for valorization of different types of biomass, certification of low carbon intensity products or hydrogen storage and distribution, the adoption of quality, performance and safety standards assumes a concerted action by the market actors and many departments and bodies of different governments. The case of the gas network, a set of components interconnected on the North America scale, clearly illustrates the necessary harmonization beyond Québec's borders.



#### Adopt a hydrogen installation code and a hydrogen safety code

○ TO COME

The Régie du bâtiment du Québec (RBQ) is adopting standards to ensure the safe use of gas subject to the *Building Act*. In this regard, it administers an installation code and a safety code in the gas field. It is projected that hydrogen will be a gas integrated into the RBQ regulations. Indeed, it intends to adopt [the Canadian Hydrogen Installation Code](#).





- Continue and accentuate deployment of technologies allowing consumption of green hydrogen and biofuels.

The Gouvernement du Québec will support companies and individuals wishing to convert their operations to contribute to the energy transition and GHG emissions reduction objectives while maintaining their competitiveness despite the current extra costs.

Programs such as [EcoPerformance](#) and [Bioenergy](#) are examples of programs that seek to make fossil fuel replacement solutions more competitive by reducing the capital investment costs.

The Government will act to make the use of green hydrogen and bioenergy more competitive relative to fossil fuels through existing or future measures.



#### The bioenergy program

✓ IN PROGRESS

The Bioenergy program is offered to companies, institutions and municipalities that use fossil fuels and that undertake to reduce their consumption measurably and sustainably by implementing measures for conversion to bioenergy. [Bioenergy program](#)



## The problem of extra operating expenses

○ TO COME

Currently, some energy sectors with a low carbon footprint, including green hydrogen and bioenergy, are uncompetitive relative to their fossil competitors. Beyond investments related to equipment replacement, the extra costs of certain types of renewable energy are one of the main hindrances to the energy transition. The rapid transition to the industrial scale of green hydrogen and bioenergy consumption in Québec necessitates the deployment of initiatives allowing a substantial reduction of operating expenses (OPEX).

The evolution of carbon pricing and the cap-and-trade system for greenhouse gas emission allowances (SPEDE in French) have an effect on the price of fossil fuels and, consequently, an influence on the competitiveness of green hydrogen and bioenergy. Complementing this system, the assistance measures for decarbonization of the industrial sector and the new free allocation rules for the Québec carbon market have the objective of supporting the accomplishment of greenhouse gas emissions reduction projects or GHG reduction technological innovation projects with industrial facilities subject to the SPEDE cap-and-trade system, for which amounts are reserved.

These levers, which can be combined with other complementary measures to induce a reduction of operating costs and create a business environment favourable to conversion from fossil fuels to renewable energy, will contribute to the achievement of the Strategy's objectives.

## AXIS 2 KNOWLEDGE AND INNOVATION

The deployment of the green hydrogen and bioenergy sectors depends, in particular, on the improvement and dissemination of scientific knowledge and innovation throughout the value chain. Moreover, it cannot be achieved without a skilled technical and professional workforce.

Non-exhaustively, several initiatives are already in progress to achieve the established objective, and the Government intends to accentuate its efforts in this field. All of the measures are presented in the Green Hydrogen and Bioenergy Roadmap of the Energy Transition, Innovation and Efficiency Master Plan.

Flagship measures	Examples of initiatives
<b>Objective 3: Improve knowledge and its dissemination</b>	
Increase and update knowledge by conducting studies	✓ Conduct a study on the technico-economic potential of hydrogen
	○ Characterize the various energy sectors with a lifecycle assessment approach
	○ Document the natural hydrogen potential in Québec
Implement mechanisms to update the data	✓ Draw up an inventory of the available biomass and the profile of current production in Québec
	○ Specify the captive hydrogen balance (on private sites) for hydrogen consumed in Québec

✓ IN PROGRESS

○ TO COME





Flagship measures	Examples of initiatives
Determine the best possibilities for green hydrogen and bioenergy use	<input type="radio"/> Develop decision help tools
	<input type="radio"/> Clarify the order of merit of uses
Support collaborative innovation by bringing together research and industry circles	<input checked="" type="checkbox"/> Strategic collaborative research network on intelligent energy
Support the training of a skilled workforce	<input type="radio"/> Benchmarking the offer of specialized hydrogen training
	<input type="radio"/> Specialized training in harvesting forest biomass and supply chain optimization
<b>Objective 4: Develop innovative solutions and processes</b>	
Continue funding of demonstration projects	<input checked="" type="checkbox"/> Financial assistance programs supporting technological innovative projects
Improve research funding	<input checked="" type="checkbox"/> Research Chair in Biofuels and Bioproducts
	<input type="radio"/> Research chairs and networks on hydrogen and bioenergy

IN PROGRESS

TO COME



## Objective 3: Improve knowledge and its dissemination

Increase and update knowledge by conducting studies. The rapid evolution of the energy sector commands the development, maintenance and dissemination of knowledge in the green hydrogen and bioenergy fields. This situation is just as true concerning the development of expertise in the government apparatus, companies, Québec research centres and Indigenous nations. This knowledge must be based on an exhaustive profile of the situation, resulting from constantly evolving data collection.

- **Determine the best possibilities for green hydrogen and bioenergy use**

The Government intends to conduct or support technico-economic potential assessments and studies on decarbonization technologies that, in particular, will allow maximization of the results of these sectors to meet Québec's energy and environmental targets. In this regard, methodologies and analysis and decision help tools will be perfected to allow sustainable use of resources.

### Sound use of energy produced from limited resources

Québec has impressive natural resources. Although substantial, the quantity of green hydrogen or bioenergy that can be generated from these resources is limited. In this context, it is important to minimize the energy needs that must be met by these sectors and correctly determine the sectors in which it will really be necessary to resort to them. Regarding energy production, choices will have to be made to determine the energy sectors that must be prioritized, considering the limits imposed by the ecosystems.



- **Support collaborative innovation by bringing together research and industry circles**

The Strategy will favour increased collaboration among the actors to respond better to industrial needs with all of the knowledge on decarbonization technologies developed in the research communities. Collaborative innovation will allow optimization of the energy transition and maximization of the synergies between the bioenergy and hydrogen applications.

- **Support the training of a skilled workforce**

The needs for skilled labour will develop according to the evolution of the uses of green hydrogen and bioenergy in Québec. Well-paid jobs could be maintained or created in every region of Québec, significantly improving the quality of life in the local, regional and Indigenous communities.

The expertise already present in Québec can be improved, in particular, through strategic partnerships to be established in Canada or abroad.

### Tools to develop a Québec workforce adapted to the market's needs

✓ IN PROGRESS

Launched in 1996, the Comité sectoriel de main-d'œuvre sur l'environnement, known as EnviroCompétences, has the mandate to ensure the availability of continuing education and professional competencies, support and encourage good practices in human resources management, and contribute to the knowledge of the labour market in order to meet the needs of companies in the environmental and energy sector. The legitimacy of this committee's actions comes from its direct anchoring in the reality of the labour market, as attested by the composition of its board of directors and the diversity of the participants in the various public meetings held annually.

Funded mainly by the Commission des partenaires du marché du travail, the sectoral committees are non-profit organizations that exert tremendous leverage both through technical expertise and through their proximity to companies and workers. These committees are information-rich concerted action and discussion forums that help companies improve their competitiveness and help workers develop their competencies.



## Objective 4: Develop innovative solutions and processes

- Continue funding of demonstration projects

To emerge and reach the markets, the new green hydrogen and bioenergy production and utilization technologies must successfully complete all the stages of the innovation chain, from research and development to demonstration and commercialization to marketing.

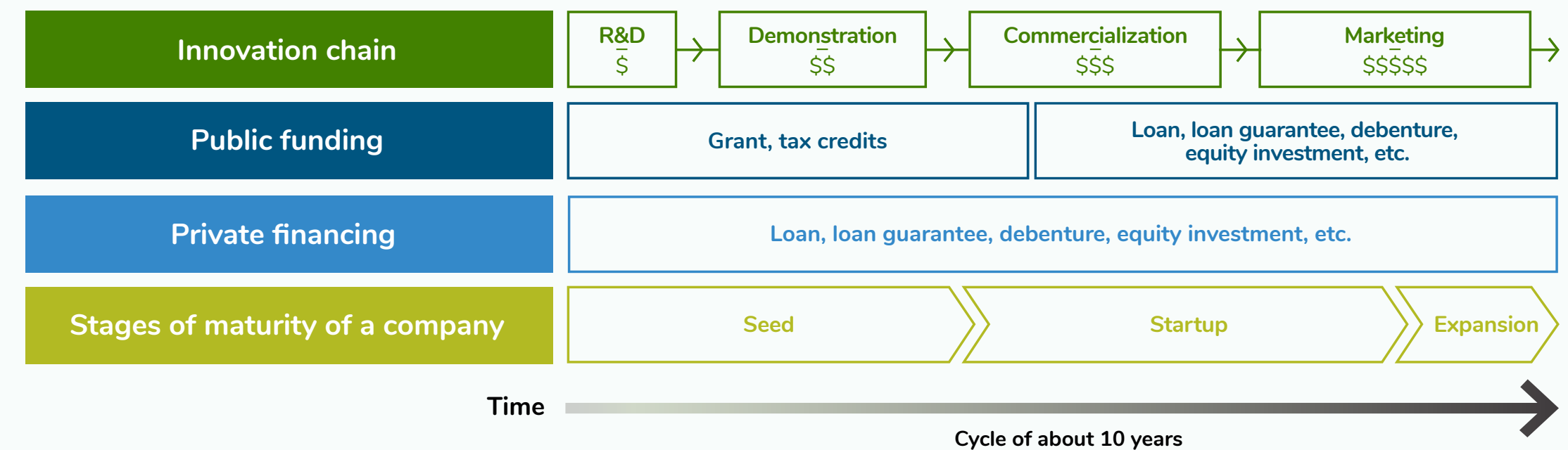
Because these two intermediate stages are particularly critical, the collaborations and partnerships between small and large companies,

the various organizations, the research community, the financial sector and the other innovation ecosystem actors have an important role to play based on their specialty and expertise.

It is planned to encourage and fund the first stages of the innovation chain, i.e. research and development, and demonstration.

### The innovation chain and its funding

The purpose of demonstration projects is to validate, generally on a smaller scale, the commercial and technical potential of new technologies. This is a key prerequisite to the search for funding to carry out projects on a commercial scale.





## Envelopes already available to support innovation

✓ IN PROGRESS

Since January 18, 2021, a \$15 million envelope reserved for innovation in the hydrogen sector is available under the Technoclimat program. This amount is added to the \$30 million envelope that had been announced on November 16, 2020 in the context of the launch of the 2030 Plan for a Green Economy to carry out bioenergy projects.

[Technoclimat program](#)

The Innovation Program (IP) managed by Investissement Québec has the objective of supporting companies, with priority to small and medium enterprises (SME), in the accomplishment of their innovation projects and commercialization of their innovations.

[Productivité innovation \(investquebec.com\)](https://investquebec.com)

The [Support Program for Organizations in Research and Innovation \(PSO in French\)](#) of the MEI has the goal of consolidating the Québec innovation system and its components, increasing the competitiveness of companies by society by innovation, and favouring the optimum or concerted use of research results for economic, social, environmental and cultural purposes. This program brings together various components to support the research and innovation organizations.

The Ministère des Forêts, de la Faune et des Parcs (MFFP) supports the development of knowledge and the projects for development of bioenergy from forest biomass under the [Wood Innovation Program](#). The objective of this program is to encourage investment in the accomplishment of projects in the forest products industry, or any other industry using forest products. It includes a first component intended to stimulate innovative projects and a second component intended to support projects using lower quality timber volumes. These projects see a better valorization of wood fibre and diversification of the basket of products, particularly through bioenergy production to favour the competitiveness of the forest products industry.





- **Improve research funding**

To develop knowledge appropriately and support innovations that may be targeted by demonstration projects, research is necessary as a critical phase during which the problems can be studied in detail.

Apart from the deployment of synergies and collaborative research approaches that must be favoured, particularly to accelerate the progress of competencies and the circulation of information, the research themes are evolving and proliferating in the green hydrogen and bioenergy niches of the future.

The applied research effort in these sectors will be continued and accentuated, as these sectors are rapidly expanding.



## AXIS 3 COLLABORATION, INFORMATION AND PROMOTION

The coordination of efforts between the public and private sector actors and the Indigenous nations and public transparency will favour a smooth deployment of the green hydrogen and bioenergy sectors. They will also allow a common understanding of the economic, environmental and social issues relating to these sectors.

Non-exhaustively, several initiatives are already in progress to achieve the established objective, and the Government intends to accentuate its efforts in this field. All of the measures are presented in the Green Hydrogen and Bioenergy Roadmap of the Energy Transition, Innovation and Efficiency Master Plan.

Flagship measures	Examples of initiatives
<b>Objective 5: Increase the commitment of public and private actors in favour of the development of the green hydrogen and bioenergy sectors</b>	
Accentuate local, national and international collaborations on the green hydrogen and bioenergy sectors	✓ Strategic international partnerships, such as ADEME
Promote Québec's expertise and business opportunities in green hydrogen and bioenergy on the international scene	○ Strategy to promote the green hydrogen and bioenergy sectors on the provincial, national and international scale
Attract investments or capital to finance projects in Québec	○ Initiative to support the regional energy ecosystems

✓ IN PROGRESS

○ TO COME





Flagship measures	Examples of initiatives
<b>Objective 6: Encourage the support of local and Indigenous communities in the development of the sectors</b>	
Inform the population about the sectors and their role in the fight against climate change	<input type="radio"/> Publication of studies and popularization documents
	<input type="radio"/> Communications strategy
Promote the participation of stakeholders and Indigenous people in the development of the sectors	<input type="radio"/> Separate communications channel to foster a mutual understanding of the different components related to the energy transition, including implementation of this Strategy

✓ IN PROGRESS      ○ TO COME

## Objective 5: Increase the commitment of public and private actors for the development of the green hydrogen and bioenergy sectors

- Accentuate local, national and international collaborations on the green hydrogen and bioenergy sectors

The Québec green hydrogen and bioenergy ecosystem is dynamic. But sustained collaboration at every level — from local to international — is essential, whether to implement new business models or to diversify products and markets. This increased networking among the various actors in the energy, political and financial field will be a source of synergies conducive to the accomplishment of projects and the creation of innovative products contributing to the achievement of environmental targets.

The network of Québec representatives abroad will be involved in the achievement of such networking with foreign government and private partners, particularly regarding R&D, action of investments and establishment of best practices in the development of these sectors.



## 2022-2027 Québec Research and Innovation Strategy (QRIS)

Innovation is one of the priority economic initiatives of the Gouvernement du Québec. The foundation of this initiative is the new **2022-2027 Québec Research and Innovation Strategy (QRIS)**, which supports a vast and rich ecosystem, for the benefit of all the sectoral actions of the Government and the organizations concerned. The QRIS is a strategic and integrating tool, which targets major objectives and lays the foundations of an audacious, agile and ambitious Québec.

Québec supports an entire research and innovation ecosystem ranging from fundamental research to commercialization. This ecosystem is involved in propelling innovation for the sectoral strategies of government departments.

With the QRIS, the Government wishes, in particular, to accelerate the transition from idea to market through mobilization of the actors in research, innovation and investment, and then support sectors of the future and structuring projects. In the context of the QRIS, the government departments and bodies will unite to call on the active forces of research and innovation in the four corners of the province. Together, researchers, innovators and investors will find innovative solutions to tomorrow's challenges and will develop new ways to enrich Québec.



- Promote Québec's expertise and business opportunities in green hydrogen and bioenergy on the international scene

The Gouvernement du Québec intends to make full use of its diplomatic and economic networks and those of Canada abroad to promote Québec companies active in the green hydrogen and bioenergy fields and position Québec over time as an emerging player in the development of these sectors. Québec companies will benefit from agile coordination of representation actions on the international scene, particularly in collaboration with the Ministère des Relations internationales et de la Francophonie, the Ministère de l'Économie et de l'Innovation and Investissement Québec.



#### Programs to excel internationally

Investissement Québec International (IQI) and the Ministère de l'Économie et de l'Innovation offer financial tools to companies and Québec public research establishments seeking to develop and concretize national and international strategic partnership in the green hydrogen and bioenergy sectors. Among these tools, we should note the Innovation Program, which is addressed to companies, with priority to SMEs, and the Support Program for Organizations (PSO in French) to support the accomplishment of research and innovation projects in Québec and internationally for actors in the university, college, institutional and industrial communities of Québec. For more details, companies are invited to contact the regional directorates of IQI. The research organizations interested in the PSO should contact the MEI.



- **Attract investments or capital to finance projects in Québec**

With the Strategy, the Gouvernement du Québec intends to favour predictable and diversified financing to attract major private investments. Québec thus will set the table so that business people can seize unique opportunities relating to the emergence of these wealth-creating and environmental and social impact-generating sectors. It will also act to reduce the risks associated with the required investments.

Québec's delegates general and delegates abroad will work in concert with Investissement Québec International's prospectors for positioning in these sectors and attraction of foreign investments.

## Objective 6: Encourage the support of local and Indigenous communities in the development of value chains

- **Inform the population about the sectors and their role in the fight against climate change**

It is important for the Gouvernement du Québec to mobilize the stakeholders in the development of the green hydrogen and bioenergy sectors. The first stage is to make complete information on these sectors accessible to the public and the Indigenous nations. Moreover, the dissemination of accurate information adapted to each type of audience will allow the current and future users of hydrogen and bioenergy to make informed choices in energy matters and adopt good practices.



- **Promote the participation of stakeholders and Indigenous people in the development of the sectors**

The favourable reception of the development of the green hydrogen and bioenergy sectors not only depends on clear communication of the government vision, but on consideration of the concerns of the local and Indigenous communities. This is why it is important to favour constructive discussions on these subjects in respect for the different visions.

For example, regional concerted action authorities can play an important role in the identification, development and follow-up of projects, favouring a participatory approach. Moreover, the deployment of follow-up and evaluation measures for projects integrating sustainable development principles will allow maximization of the benefits for the environment, the local and Indigenous populations, and companies.

**Favour mobilization and participation of Indigenous people in the implementation of the Strategy**

○ TO COME

Indigenous people want to participate actively in the implementation of the Strategy and be leading actors in the energy transition under way in Québec. The Gouvernement du Québec intends to implement a fair and inclusive transition that gives Indigenous people the opportunity to contribute extensively. Thanks to a separate channel, the MERN will strengthen the dialogue with the Indigenous population to foster a mutual understanding of the different components related to the energy transition, including implementation of this Strategy. This channel seeks to consider their needs, their knowledge, the plurality of their realities and their interests to enable them to be partners in Québec's energy transition.

In the First Nations and Inuit communities, certain energy projects seeking the reduction of GHG emissions are already in progress, particularly for wind energy and biofuel production. Other initiatives could emerge under the Strategy and enable the various Indigenous communities to participate in the development of a green economy creating positive impacts for their members. Québec energy transition to carbon neutrality thus offers new prospects for collaboration and participation by the communities in the development of these sectors.

The Gouvernement du Québec has adopted ambitious targets in fighting climate change, aiming at 37.5% GHG reduction by the 2030 horizon relative to 1990. The Plan for a Green Economy opens the way to decarbonization of the Québec economy.

The renewable electricity Québec enjoys is bound to play a leading role, because it will enable Québec society to become one of the lowest-carbon economies in the world. However, this energy alone cannot meet all of the province's energy needs.

The 2030 Québec Green Hydrogen and Bioenergy Strategy present Québec's vision for these sectors. It constitutes the foundation of the development of these sectors of the future, which can ensure greater resilience and energy security through a diversified and secure energy supply. They can also free Québec from imports of fossil fuels. Reducing fossil fuel consumption to rely on renewable energy that can be produced locally will not only have a positive effect on the environment but will also allow stimulation of Québec's economic development.

While the Strategy sets out a long-term vision and the principles and priorities that will guide the government action for the 2030 horizon and beyond, the Green Hydrogen and Bioenergy Roadmap integrated into the 2026 Québec Energy Transition, Innovation and Efficiency Master Plan will be updated every five years to evolve at the same pace as the province's energy, economic and technological context. Thus, the follow-up and accountability of the Strategy will be achieved via its roadmap, in accordance with the mechanisms provided in the Master Plan and the Implementation Plan of the PGE.

Thus, in achieving the government objective of carbon neutrality, the Strategy will contribute to the effort to ensure that fossil fuels will be replaced with a set of solutions, including energy sobriety and efficiency, direct electrification, bioenergy and green hydrogen. Together, these solutions will upgrade the Québec energy context and will allow us to produce and use energy sustainably.



# APPENDIX

Appendix 1: The 2021-2026 Roadmap

Axis	2026 objective	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026
<b>LINE 1</b> BUSINESS ENVIRONMENT	<b>1. Develop production and distribution infrastructure</b>	Foster the deployment of green hydrogen and bioenergy production and distribution infrastructure in prioritized market segments, particularly in the regional energy ecosystems (PSPGMR and PTMOBC programs, valorization of residual forest biomass)				
		Offer tax credits for production of biofuels and pyrolytic oil				
			Adapt the regulatory framework to favour green hydrogen and bioenergy production  (Amend the regulations to recognize certain equipment for thermal treatment of residual materials as performing energy valorization operations)			

Appendix 1: The 2021-2026 Roadmap

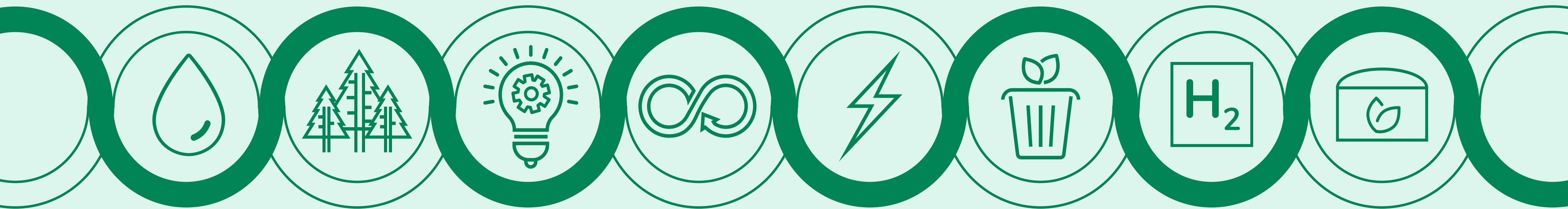
Axis	2026 objective	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	
<b>LINE 1 BUSINESS ENVIRONMENT</b>	<b>2. Increase green hydrogen and bioenergy use</b>	Adapt the regulatory framework to require minimum renewable content (or a better maximum carbon intensity index) in fossil fuels  (Set minimum low carbon intensity criteria in fossil fuels. Increase by 10% the minimum volume of renewable source gas that will have to be injected into the natural gas network by 2030)					
		Make regulatory and administrative changes allowing the safe and sustainable deployment of green hydrogen and bioenergy as well as harmonization of standards  (Adopt an installation code and a safety code for hydrogen)					
		Continue and accentuate deployment of technologies allowing consumption of green hydrogen and biofuels (EcoPerformance, Bioenergy and Écocamionnage (Eco-Trucking) programs)					
				Transitionally cover the operating costs for conversion to renewable electricity, green hydrogen or bioenergy  (Institute funding mechanisms allowing reduction of price differences relative to grey hydrogen or fossil fuels)			

Appendix 1: The 2021-2026 Roadmap

Axis	2026 objective	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	
<b>LINE 2</b> KNOWLEDGE AND INNOVATION	<b>3. Improve knowledge and its dissemination</b>	Increase and update knowledge by conducting studies (Increase knowledge of bioenergy derived from forest biomass, document the potential and the issues, analyze the scope of the different energy sector by p0urusing the approach by lifecycle assessment, etc.)					
		Implement mechanisms to update the data (Hydrogen and bioenergy production and consumption statistics)					
		Determine the best possibilities for green hydrogen and bioenergy use (Develop decision help tools to identify the sector where hydrogen and bioenergy should be preferred)					
			Support collaborative innovation by federating research and industrial circles (Fund industrial research projects in collaboration)				
			Support the training of a skilled workforce				
		Continue the test bench to introduce green hydrogen into the transportation sector (Develop the conditions necessary for testing of this sector in Québec, particularly in road transportation)					

Appendix 1: The 2021-2026 Roadmap

Axis	2026 objective	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026
<b>LINE 2</b> KNOWLEDGE AND INNOVATION	<b>4. Develop innovative solutions and processes</b>	Continue funding of demonstration projects (Technoclimat and Wood Innovation programs)				
		Improve research funding				
		Foster the establishment and emergence of companies with specialized knowledge and knowhow				
<b>LINE 3</b> COLLABORATION, INFORMATION AND PROMOTION	<b>5. Increase the commitment of public and private actors for the development of the green hydrogen and bioenergy sectors</b>	Ensure coordination and support of project proponents				
		Accentuate local, national and international collaborations on the green hydrogen and bioenergy sectors				
		Promote Québec's expertise and business opportunities in green hydrogen and bioenergy on the international scene				
		Attract investments or capital to finance projects in Québec				
	<b>6. Encourage the support of local and Indigenous communities in the development of the sectors</b>	Inform the population about the sectors and their role in the fight against climate change (Create and disseminate information tools to increase public knowledge and raise public of the benefit of the role of bioenergy and green hydrogen in the energy transition)				
Promote the participation of stakeholders and Indigenous people in the development of the sectors						



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