RegioneLombardia
IL CONSIGLIO

XI LEGISLATURE ACTS: 2018/XI.2.4.1.20

SESSION OF 24 NOVEMBER 2020 RESOLUTION N. XI/1445

Presidency of the Vice President BRIANZA Secretary: councilor VIOLI

Councilors in office:

ALBERTI Ferdinand
ALPARONE Marco
ALTITONANTE Fabio
RINGS Roberto
ASTUTE Samuel
MUSTACHE Patrizia
BARUCCO Gabriele
BASAGLIA COSENTINO Giacomo
STICKS Massimiliano
BECCALOSSI Viviana
BOCCI Paola
BORGHETTI Carlo
BRIANZA Francesca Attilia
BUSSOLATI Pietro
CAPPELLARI Alessandra
CARRETTA Niccolò
CARZERI Claudia
CENCI Roberto
CERUTI Francesca
COLOMBO Marco
COMAZZI Gianluca
CORBETTA Alexander
DE ROSA Massimo
OF THE ANGELS Mark
DEL GOBBO Luca
BY MARCO Nicola
EPIS Federica
ERBA Raffaele
STOP Alessandro
FIASCONARO Andrea
Attilio FOUNTAIN
FORATTINI Antonella
FORMENTI Antonello
STRONG Monica
FRANK Paolo
FUMAGALLI Marco Maria
GALIZZI Alex
GHIROLDI Francesco Paolo
GIRELLI Gian Antonio
JUDGES Simon
INVERNIZZI Ruggero
LENA Federico
LUCENTE Franco
MALANCHINI Giovanni Francesco
MAMMI' Consulate
MARIANI Marco Maria
MASSARDI Floriano
MAZZALI Barbara
MAZZOLENI Monica
MONTI Andrea
MONTI Emanuele
WALLS Roberto
ORSENIGO Angelo Clemente
PALMERI Manfredi
PALUMBO Angelo
PACE Riccardo
PEDRAZZI Simona
PIAZZA Mauro
PICCIRILLO Luigi
PILONS Matteo
PIZZUL Fabio
BRIDGES Pietro Luigi
PRAVETONI Selene
RIZZI Alan Christian
ROMANS Federico
ROMEO Paola
ROUGH Maria
SCANDELLA Jacopo
DARKEN Silvia
SENNA Gianmarco
SPELZINI Gigliola
ROAD Elizabeth
FOREIGN Raffaele
Simone Tironi
TREZZANI Curzio
TURBA Fabrizio
USERS Michele
VERNI Simone
VILLANI Giuseppe
VIOLI Dario

Councilors on leave: ERBA, FONTANA and LUCENTE.

Councilors absent: ASTUTE, FERMI, MALANCHINI and MONTI E.

There are therefore no. 73 Councillors

Not participating in the vote: BRIANZA and PICCIRILLO.

The Secretary of the Council Assembly assists: SILVANA MAGNABOSCO

SUBJECT: ACT OF GUIDELINES FOR THE DEFINITION OF THE REGIONAL PROGRAM ENERGY, ENVIRONMENT AND CLIMATE, PURSUANT TO ART. 30 OF LR 26/2003.

INITIATIVE: REGIONAL COUNCIL

REFERENT COMMISSION: VI ACT CODE: PDA/38

THE REGIONAL COUNCIL OF LOMBARDY

HAVING REGARD to the Resolution adopted by the United Nations General Assembly on 25 September 2015 “Transforming our world: the 2030 Agenda for Sustainable Development” and containing a program of action for people, planet and prosperity and which has defined 17 *Sustainable Development Goals (SDGs),* including SDG 7 Affordable and Clean Energy and SDG 13 Climate Action;

ALSO SEEN -

Communication COM(2016)860 final from the Commission to the European Parliament, at Council, the European Economic and Social Committee, the Committee of the Regions and the Bank European Investment Fund “Clean energy for all Europeans”, with which the Commission Europea has defined its own energy strategy, setting itself the objective of maximizing energy savings and achieving world leadership in the field of renewable energy, and proposing the implementation of a package of rules for the implementation of this strategy; - EU Directive 2018/410 of the European Parliament and of the Council of 14 March 2018 which amends Directive 2003/87/EU to support more cost-effective emissions reduction and promote investments in favor of low carbon emissions; - EU Directive 2018/844 of the European Parliament and of the Council of 30 May 2018 which amends Directive 2010/31/EU on energy performance in buildings and the Directive 2012/27/EU on energy efficiency;

- Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of renewable sources, which defined the European 2030 objective for the diffusion of renewable energy sources; - Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive 2012/27/EU on energy efficiency, with which the European Commission defined the European energy efficiency objective at 2030, and issued measures aimed at achieving it; Regulation 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the *Governance* of the Energy Union and Climate Action, which establishes that each member state must present an integrated ten-year plan for energy and climate climate, which takes into account the five dimensions of energy: "decarbonisation", "energy efficiency", "energy security", "internal energy market", "research, innovation and competitiveness"; Legislative Decree 13 August 2010, n. 155 (Implementation of Directive 2008/50/EC relating to ambient air quality and cleaner air in Europe); - the regional law of 12 December 2003, n. 26 (Regulation of local services of general economic interest. Rules on waste management, energy, use of the subsoil and water resources);

- the regional law of 11 December 2006, n. 24 (“Regulations regarding prevention and reduction emissions into the atmosphere to protect health and the environment);

CONSIDERING THAT -

Italy joined the United Nations 2030 Agenda for sustainable development in 2015; - in January 2020, in implementation of article 3 of the aforementioned Regulation 2018/1999, the Integrated National Energy and Climate Plan was sent to the European Commission (PNIEC) prepared by the Ministries of Economic Development, the Environment and the Protection of Territory and Sea and Infrastructure and Transport;

CONSIDERING also that the Lombardy Region

- is committed to defining the Regional Strategy for sustainable development in line with the guidelines and objectives identified by the European Commission and deriving from international obligations;

- joined the international organization *"The Climate group"* by signing the *"Compact of States and Regions",* on the occasion of the *"UN Climate Summit"* in New York on 23 September 2014 (Regional Council Resolution X/2861 of 5 December 2014), committing to reduce its greenhouse gas emissions by 2020 , 2030, 2050 – respectively 20%, 40% and 80% compared to 2005;
- has activated, since 2018, the Regional Observatory for the circular economy and energy transaction with functions of guidance and sharing of general strategies and, through the Technical secretariat, provides technical-scientific support for the development of regional strategies and the coordination of thematic tables;

HAVING NOTED

THAT - Article 9, paragraph 11, of Legislative Decree 155/2010 provides that in the drafting of all sectoral, regional and local planning and programming documents, consistency with the provisions contained in the national planning for the reduction of gas emissions responsible for the greenhouse effect; - Article 2, paragraph
7, of Regional Law 24/2006 provides that the objectives of the air quality programming are coordinated with those of the Regional Environmental Energy Program (PEAR) referred to in Article 30, paragraph 1, of the Regional Law 26/2003;

GIVEN that, pursuant to Article 30, paragraph 1, of Regional Law 26/2003:
- the regional energy planning is constituted by the act of guidelines, approved by the Regional Council on the proposal of the Regional Council, and by the Regional Environmental Energy Program (PEAR) approved by the Regional Council;
- with PEAR, regional energy needs and lines of action are determined, also in reference:
  1. to the reduction of gas emissions responsible for climate variations, deriving from energetic processes; 2. the development of energy production from renewable and similar sources; 3. the containment of energy consumption in the productive, residential and tertiary sectors; 4. improving efficiency in the various segments of the energy supply chain;

GIVEN the resolution of the Regional Council X/3706 of 12 June 2015, as integrated with the subsequent resolution of the Regional Council energy matters and reduction of climate-changing emissions for a five-year period which ends in 2020;

TAKING INTO ACCOUNT the widespread and matured institutional awareness, on the one hand, of the effects and the need for timely intervention for mitigation and adaptation to climate change, and, on the other, of the indispensable role of the energy transition in tackling the phenomenon, which have imposed a significant evolution of strategies, rules and objectives at higher levels;

HAVING NOTED the opportunity to proceed with the definition of a new regional planning that takes into account the innovative elements and objectives introduced by the European standards and the Plan Integrated National Institute for Energy and Climate;

CONSIDERING the importance of the role that the Regional Administrations are called upon to play for the definition of national objectives at a territorial level;

CONSIDERED sharing the need to align new regional energy planning with climate and environmental strategies, according to a medium-term perspective to 2030 and a long-term vision to 2050, in coherence with European and national programmatic documents;

CONSIDERED as appropriate the proposal to adapt the name of the Program in order to explain the interaction with climate issues also in relation and coherence with the State's activity on the matter;

CONSIDERING the results of the first PEAR monitoring report which gives an account of the first two years of implementation of the current Programme;

DATE EVIDENCE of the support activities for the construction of the act of guidelines for the definition of the Regional Energy, Environment and Climate Program carried out within the Observatory Regional for the Circular Economy and Energy Transition and, in particular, within the thematic tables energy efficiency and renewable energy sources;

GIVEN the Regional Development Program of the XI Legislature, approved by the Regional Council on 10 July 2018 with resolution Air quality and pollution reduction indicates the approval of the Climate Plan among the objectives to be achieved

Energy, in implementation of the European Commission's "Clean Energy for All" package Europeans" and in line with the objectives of reducing climate-altering gas emissions signed within the *Compact of States and Regions;*

CONSIDERED, in line with the guidelines of the Regional Development Plan, to base the development of the plan on four main macro-objectives: 1. reduction of consumption by increasing efficiency in the end use sectors; 2. development of local renewable sources and promotion of self-consumption; 3. growth of the production system, development and financing of research and innovation service of decarbonisation and the *clean economy;* 4. adaptive and resilient response of the Lombardy system to climate change;

NOTING that pursuant to article 1, paragraph 8, of regional law 26/2003 the Plan will be subject to Strategic Environmental Assessment;

HAVING SEEN the proposal for the "Act of guidelines for the definition of the Regional Energy Programme Environment and Climate (PREAC)" referred to in Annex A, an integral part of this act, prepared by the regional offices;

HAVING NOTED that, within the scope of the investigation under its jurisdiction, the VI council commission "Environment and Civil Protection" carried out a series of hearings with interested parties in order to acquire further elements of evaluation;

HAVING HEARD the report of the VI council commission "Environment and Civil Protection";

with a roll call which gives the following result:

Councilors present:	n. 73
Not participating in the vote: n. 2	
Voting councilors:	n. 71
Votes in favor:	n. 43
Votes against:	n. 11
Abstentions:	n. 17

RESOLUTION

1. to approve Annex A “Guidelines for the definition of the Regional Energy, Environment and Climate Programme, pursuant to art. 30 of Regional Law 26/2003" which constitutes an integral and substantial part of this resolution.

THE VICE PRESIDENT
(signed Francesca Attilia Brianza)

THE SECRETARY COUNCILOR (signed
Dario Violi)

THE SECRETARY
OF THE COUNCIL ASSEMBLY (signed
Silvana Magnabosco)

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ANNEX A

Guidelines for the definition of the Regional Energy, Environment and Climate Programme, referred to in art. 30 of regional law 26/2003

ADDRESSES FOR THE DEFINITION OF

REGIONAL ENERGY, ENVIRONMENT AND CLIMATE PROGRAM

(PREAC)

Summary

PREMISE

ADMINISTRATIVE FRAMEWORK

The Italian Constitution, in article 117, places the matter of *"national energy production, transport and distribution"* in the concurrent competences between the State and the Regions.

Within the principles established by national law, among the functions assigned to the Regions is the formulation of regional energy policy objectives.

Pursuant to article 30 of LR 26/2003 *"regional planning is constituted by the act of guidelines, approved by the Regional Council upon proposal of the Regional Council, and by the regional environmental energy program (PEAR)",* and with which they are achieved the objectives identified in the guidelines.

The Lombardy Region adopted the current PEAR in 2015, responding to the regulatory mandates and national objectives attributed to the Regions operational at the time.

Over the past five years, the widespread international awareness on the one hand of the effects and the need for timely intervention to mitigate and adapt to climate change, and on the other of the indispensable role of the energy transition in tackling the phenomenon, has led to a significant evolution of strategies, rules and objectives at higher levels.

Regional planning, therefore, requires a profound alignment of energy objectives with climate and environmental strategies and a medium-term prospective approach to 2030 and a long-term vision to 2050.

In order, therefore, to highlight the integration between the strategic objectives and the incisive penetration of climate issues, it is considered appropriate to give a new name to the document which will outline the new medium and long-term policies, coinciding with the Regional Energy, Environment and Climate Program (PREAC).

In order to align the regional regulatory framework on energy with the new needs that have emerged, pending the extension of the Program, a proposal for the revision of LR26/2003 will be put forward which updates the name and duration of the program, in line with the new objectives and in coherence with the relevant community and national instruments.

Pursuant to article 1 paragraph 8 of Regional Law 26/2003, PREAC is subject to Strategic Environmental Assessment.

STRATEGIC FRAMEWORK

The world is in a phase of mature awareness of the need to face one of the decisive challenges of our time, climate change, a challenge that embraces a multiplicity of areas, ranging from sustainable development to the protection of the well-being and health of citizens, up to to the definition of a new global economic model that minimizes the impact of its negative externalities on the environment. A profound transformation.

On this virtuous and challenging path, which requires a complete review of existing economic, productive and social models and which is still suffering from the wounds of a significant global recessive crisis in 2008, the coronavirus pandemic has struck, causing a health emergency condition. still in progress.

There is a rush to quantify the expected effects on the economy in terms of GDP contraction, an indicator that no longer seems adequate and which will see many commissions of experts accelerate ongoing studies on the search for new indicators of well-being and sustainability of development.

The health emergency due to the spread of the coronavirus is a sort of "crash test" to verify the stability of European, national and partly also local policies on energy and climate.

The question is whether this crisis will be able to stimulate the change of the current development model in the direction indicated by the UN 2030 Agenda, or whether the urgency of addressing the economic damage that the crisis will produce will have to emerge over all other needs , pursuing job creation, but neglecting environmental aspects or potential inequalities that classic economic solutions can cause.

The health emergency has aspects that intersect with environmental and climate issues; certain and reliable answers on cause-effect relationships will arrive in compliance with the times of science, but in any case, once again the correlation between environment - climate change - health takes on an important role, also in a preventive dimension.

Certainly the lockdown has had significant short-term effects on air quality, climate-changing emissions, habitat and biodiversity, noise pollution: an exceptional laboratory for studying human impact. Even in the more strictly energy sector, as RSE points out in a recent dossier, there have been specific conditions of low energy demand, sustained production from renewable sources - in particular from sun and wind - minimal production from coal associated with very low gas prices which simulated a decarbonisation situation, close to the 2030 electricity system designed by the National Integrated Energy and Climate Plan.

Analyzing the possible dynamics in the transport, energy and industrial sectors highlights the considerable potential of a relaunch of environmentally and socially sustainable solutions, but also the risk of a strong slowdown in transformations.

The combination of the slowdown in the energy transition and the risk of a rebound in climate-altering gas emissions upon full recovery of the economy opens up scenarios of increased risks associated with the climate crisis which are not feasible and which essentially ignore the aspects of fragility highlighted by global health emergency.

The analysis of the effects of the economic crises of previous decades on emissions always shows how the subsequent recovery phase is characterized by a new growth in emissions, often greater than the pre-crisis one. It is therefore to be expected that if policies strongly oriented towards green and low carbon criteria are not introduced, 2021 could be characterized by a growth in greenhouse gas emissions in clear contrast with the prospects of the Green New Deal.

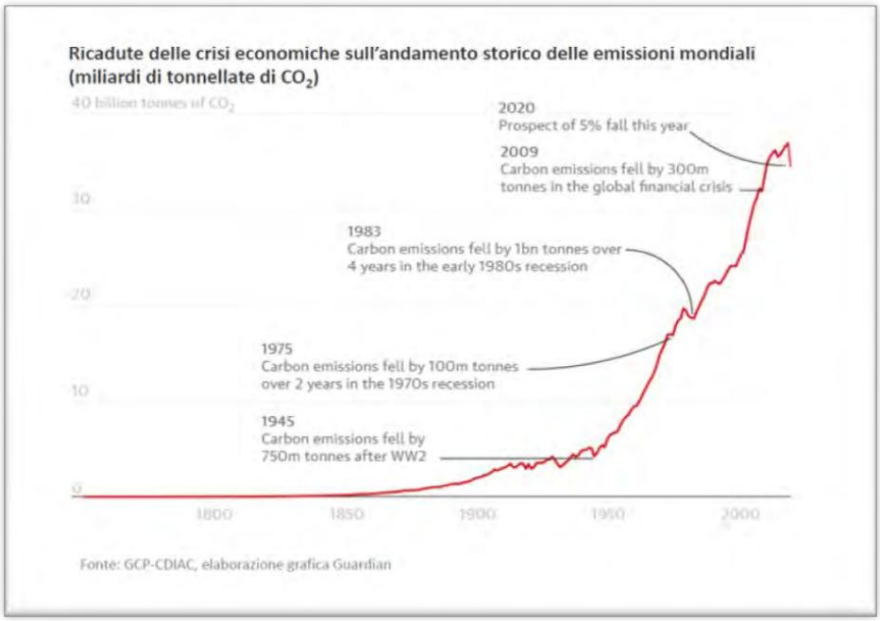

Fig.1: CO2 trend in relation to global economic crises

We certainly cannot ignore the new forces and emerging fragilities that post-evolution
Covid brings with it but today, perhaps and even more than before, long-term policies require an approach of disruptive innovation understood as completely modifying the logic up to that present moment, introducing new behaviors and interactions and therefore revolutionizing current logics; new and different ways, compared to the past, of doing, thinking or interpreting what we do
surrounds.

Therefore, the perspective of the Regional Development Program does not change, which sees the Lombardy Region projected towards the future, linked to the vocation of its territories, strong in its identity, capable of combining solidarity and competition. A competitive, attractive, supportive, safe and fast Lombardy. A Region that collaborates constructively with all the forces active in the Lombardy region, capable of listening to the needs expressed by the territory and making them its own.

Instead, the methods and paths with which we intend to achieve the objectives must be revolutionized: hence the birth of a **new Lombard paradigm** which, borrowing the verb **"propagate" from the emergency,** presents an innovative perspective for energy planning. climate.

It focuses on the characteristic factors of the Lombardy region, seen as the epicenter of a propagation of stimuli for change towards decarbonisation and sustainability, starting from the bottom, from specific and local initiatives, from the contribution of individual subjects, which spreads rapidly and intensely as a dilation by contagion.

The new Lombard paradigm of energy and climate transition wants to interpret the transition from the idea of decreasing and minimizing the use of fossil fuels and the consumption of natural resources, drivers of the current PEAR, to the idea of increasing the driving factors of the new sustainable economy in Lombardy . Decarbonization and sustainability can be the means and end of the evolutionary transformation of territories, but the relaunch must have its own intrinsic vocations as its indispensable fuel: local communities, businesses and innovation.

The task that the Lombardy Region intends to undertake, of building an energy-climate strategy for the transition towards a low carbon emission economy, is expressed in **a long-term program of *decarbonisation and circularity* of the entire economic system, functional both to a robust mitigating action to combat climate drift, and a new vision of the use of resources, material and energy, in terms of renewability and compatibility with human health and the quality of the environment.**

For effective climate mitigation, within the framework of the Paris objective of a temperature increase below 2 °C, it is necessary to achieve a substantial elimination of the net fluxes of greenhouse gases between the Earth system and its atmosphere by 2050. The Lombardy Region confirms and relaunches the commitments undertaken in the international context of reducing carbon dioxide (CO2) emissions.

40% **CO2 EMISSION REDUCTION BY 2030 AND NET CARBON NEUTRALITY BY 2050**

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Policies to combat climate change intersect inextricably with energy policies, referring to the way of producing, accumulating, distributing and consuming energy at different territorial levels; the energy system, in fact and also in the regional territorial reality, is decisive in the production of climate-altering gas emissions.

An energy program capable of fulfilling this objective, for a dynamic and productive region like Lombardy, must contribute to building a new development model adhering to territorial peculiarities and responding to multiple emerging needs for a better quality of life.

While on the one hand it is necessary to plan an intense and gradual transition from fossil fuels to available, sustainable, suitable and safe renewable sources for the territorial context, on the other hand it is necessary to intervene as a priority **on the reduction and rationalization of energy consumption** through a marked increase in efficiency in construction, production processes and transport.

Energy efficiency comes first and requires it to be equated with an energy source in its own right; energy efficiency and demand management must be able to compete on an equal footing with generation capacity.

Looking at the efficiency measures of the entire energy system, it is appropriate to evaluate the efficiency margins in its entirety by promoting the efficiency of individual energy consumption processes but also by evaluating the possibilities of recovering waste or excess heat between different sectors. In this context, district heating and cooling networks, as well as various storage technologies allow the rational use of energy and the exploitation of energy sources that would otherwise be dispersed.

It will be appropriate to look at buildings in particular **also as "energy reserves".** Intervening on them is expensive but has a set of very important co-benefits as it rapidly contributes to the reactivation of the construction sector in chronic crisis, assists the relaunch of the financial system towards local sectors, promotes an allocation of public resources towards models of virtuous economic and social development, guarantees a real response of economic savings on the bill

for end users, it has the effect of strengthening the assets of public and private properties, pursues the achievement of environmental protection objectives and has a direct correlation with the well-being and quality of life of the people who live in the environments subject to improvement.

BETWEEN 28 AND 32% REDUCTION IN ENERGY CONSUMPTION IN ALL SECTORS COMPARED TO 2005 LEVELS

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The development of renewable energy must be **territorialized** and subject to **strong decentralized expansion.**

A penetration model, therefore, consistent with the territories based on the availability of the resource, the network structure, the consumption model and the best environmental integration; however integrated and connected into the existing system, capable of responding to advanced needs for security, quality and continuity of service. For this reason, we will have to look at optimizing the distribution of energy demand by encouraging **self-consumption and the creation of energy communities** and supporting investments and the **diffusion of storage systems,** which are essential to guarantee the necessary flexibility required by intermittent energy sources.

The fundamental pillar of regional hydroelectric production for the entire country suffers from limited expansion capacity and growing seasonal variability; the objective will therefore be the maintenance and strengthening of the asset.

A **diversification of sources** appears necessary which focuses on residential, tertiary and industrial buildings for the propagation of photovoltaic and heat pump systems, on **degraded, underused or abandoned areas** for the implementation of larger integrative systems, and on the residual potential of **thermal sources;** with respect to the latter, it will be necessary to safeguard the regional biogas plant park, at risk following the end of the incentive period, with structural integration policies in the design of the new regional electricity system, evaluate the increase in the use of organic waste for production of biogas, aiming at the growth of biogas systems

efficient district heating and cooling and identify sustainable conditions of use of the woody biomass, both virgin and waste from the wood supply chain, with a view to correct management of the forest heritage.

The integration of renewables, combined with the reduction of consumption through efficiency in the final consumption sectors, including transport, lead to a significant contribution to energy security and self-sufficiency which, pursued with the indicated guidelines, appears evidently synergistic with the objectives of environmental sustainability.

PRODUCTION FROM RENEWABLE ENERGY SOURCES BETWEEN 31% AND 33% OF FINAL CONSUMPTION OF ENERGY

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The priority of **increasing the competitiveness of the production system** of the Lombard *green economy* , dictated with new impetus by the Regional Development Program of the current Legislature, must represent an objective of the PREAC on a par with the efficiency and renewable objectives, enhancing the

expected socio-economic and environmental co-benefits (new quality employment, valorisation of local resources and skills, retraining of the workforce, long-term sustainability, etc.).

The Region intends to contribute to the evolutionary challenge of the regional industrial fabric which, in relation to the expected scenarios, should aim at existing assets but also and above all at **new challenges** (solar for heating, low enthalpy geothermal energy, bio-fuel, energy storage, district heating and renewable district cooling), energy efficiency in the civil and industrial sector (industrialization of the construction process and *off-site technologies,* insulation technologies, solar integrated into the building, integrated energy management in the production sector), smart management of energy systems (smart grids for electricity distribution, gas/electricity/heat sector coupling, user aggregations for demand management, smart urban and industrial districts, energy communities), decarbonisation of transport, climate change defense technologies (agricultural, agronomic, zootechnical practices and sustainable forestry, CO2 capture and sequestration).

The push towards new emerging assets will be all the stronger the more it is supported by a solid system of relations between public and private in which, together, realities are identified and supported
emerging innovations.

Innovation will have to be imbued with new skills and opportunities that come from the growing **technological frontiers** of big data, artificial intelligence, circular economy, industry 4.0.

But the Lombard business fabric, in its transformation towards a low impact economy, must, in a wise and far-sighted way, take into account the decisive contribution to the transition that can come from behavioral measures and the active role of increasingly aware **consumers** and, as such, capable of orienting the market.

Orienting citizens' consumption choices towards self-production, the adoption of storage systems, participation in energy communities, the efficient management of consumption, the improvement of the energy efficiency of their homes and sustainable mobility is not only an institutional function in this and other sectors (waste, water resources, etc.), but it also represents a boost to local production and artisan realities which, in many of the sectors mentioned, qualify as leaders.

If on the one hand the new energy-environmental planning must fully integrate the opportunities offered by the operational protagonism of citizens, on the other it is necessary to look at the latter as **users** and therefore affected by conditions of widespread fragility for which, in relation to the effects of the health emergency that has occurred, a strong increase is expected, such as to lead to the extension of the conditions of **energy poverty;** for this reason, specific monitoring and intervention measures must be identified, to be shared with the private sector as an opportunity to strengthen the operational capacity of corporate social responsibility.

GROWTH OF THE PRODUCTION SYSTEM TO SERVICE DECARBONIZATION

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Finally, an integrated multisectoral strategy for mitigation and adaptation to climate change must be aimed not only at minimizing the impacts on the regional territory expected or foreseeable on the basis of different evolutionary climate scenarios, but also at increasing **resilience**

of the entire regional anthropic and natural system against the natural risks deriving from climate change and, in particular, must take into consideration the ability of the entire energy system to adapt and respond to external stresses.

Naturally, strengthening Lombardy's resilience to climate change does not only involve improving the adaptive response of its energy system, although this is essential for the safety and operation of its components.

The so-called infrastructural adaptation measures must be accompanied by **ecosystem-based measures,** i.e. actions aimed at sustainable management of the territory through interventions for the development, conservation, recovery and restoration of ecosystem services.

Resilience must be pursued with biodiversity conservation and restoration measures environmental, recovery of degraded areas and sustainable management of agricultural and forestry areas which make up important adaptation strategies, as well as important carbon sinks.

The sustainable management of agricultural systems through **new agricultural, agronomic and zootechnical practices** that mitigate emissions and allow soils and crops to respond to the effects of climate change must contribute to maintaining productivity and improving the provision of ecosystem services through sequestration of carbon, the diversification of agroecosystems and the improvement of environmental balances and therefore to reduce emissions of climate-altering gases in atmosphere.

The important woodland and forestry heritage is also an important ally in the fight against climate change as well as in the defense of the soil, and urban forestation, understood as an exponential increase in green and tree-lined surfaces in the urban and peri-urban spaces of cities, could be today, also for Lombardy, one of the key tools to reduce the calamitous effects of climate change.

Finally, in the context of **territorial planning** and the needs of **sustainable urban regeneration,** the objectives of recovering the decommissioned building heritage and degraded, underused or disused areas must be aligned with the PREAC objectives of energy requalification of buildings, development of energy production from renewable energy sources and restoration of ecosystem functions, all with zero ecological balance of the soil.

ADAPTIVE AND RESILIENT RESPONSE OF THE LOMBARDY SYSTEM TO CLIMATE CHANGE

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This document, as a proposed Guidelines Act, represents the reference framework in which the future Regional Energy, Environment and Climate Program fits, at an international, European and Italian level.

The framework is the necessary prerequisite for the definition of the key objectives, detailed and detailed in the second part of the document, which must be pursued in the construction of the new regional policy for the energy transition towards sustainable development and against climate changes.

A. FRAMEWORK OF REFERENCE

A.1 LOMBARDY PLAYER IN A GLOBAL CLIMATE AND ENERGY POLICY

The Lombardy Region intends to play a decisive role in the transition of economic, productive and social systems towards carbon neutrality, in a playing field whose borders and rules have been overturned by the global health emergency of the Coronavirus.

The growth in the capacity for intervention and the level of leadership of subnational governments is a factor that emerges clearly from the activities comparing the decarbonisation rates of national governments with those of federal states and regions; the average rate of the latter (6.2% per year) is 3 percentage points higher than the average rate reported to the G20 governments.[1]

The new European Directives on energy also give local and regional authorities a leading role in the development, development, execution and evaluation of measures to support the energy transition so that they can adequately take into account the climatic, cultural , social and economic aspects of their territory.

Furthermore, by virtue of the Italian constitutional structure which in art. 117 places the matter of "national energy production, transport and distribution" among the competing competences between the State and the Regions, the Regions have a fundamental constitutional role for the achievement of the national energy and climate objectives.

The energy transition that the Region intends to direct on its territory must be guided by innovation, flexible in quickly adapting to changes in the scenario and capable of responding to the environmental challenges posed. It is clear how difficult the effort of a holistic evaluation is at the basis of the development of a new transition strategy and how much impact it can have on industrial activities and society as a whole since the energy supply chain (production, distribution and consumption) is pervasive for all economic activities.

The scale of the challenge requires new models of governance that are inclusive and coherent with national, European and global objectives but appropriately territorialized.

It is important, therefore, to know the state and prospects of the context in which the regional transition strategy finds place.

On the international level, the Paris Agreement on climate change, signed in 2015 between the States participating in the UNFCCC (United Nations Convention on Climate Change) of 1992, has started a new phase of climate change policy, setting the long-term goal of keeping temperature increases well below 2°C and limiting the increase to 1.5°C above pre-industrial levels. To achieve this important objective, each adhering country has undertaken to prepare its own roadmap, through the so-called "NDCs", *Nationally Determined Contributions,* i.e. the contribution of each country to the reduction of emissions.

national and adaptation to climate change.

[1] "Global States and Regions Annual Disclousure" – THE CLIMATE GRUOP, 2018

The Katowice Conference of the Parties (COP24) in December 2018 set itself the objective of making the Paris Agreement operational, through clear rules to measure the commitments undertaken by individual countries to combat climate change. These rules have merged into the *"Katowice Climate Package",* i.e. the long-awaited "Book of Rules" or *"Paris Agreement Work Programme"* with which to implement the Paris Climate Agreement, which will come into force in 2020.

During the COP25 in Madrid in 2019, the need emerged to increase the commitments to contribute to the reduction of CO2 emissions proposed by governments around the world, to avoid a significant disconnect between the policies pursued by the States and the objectives of the agreement Paris. A second point discussed in the last COP concerned the postponement of the implementation of Article 6 of the Paris Agreement, which regulates the financing of emission reductions on the carbon market between countries that pollute less and those that pollute more. The issues that remained open in 2019 will be the subject of negotiation during the next Climate Conference of the UNFCCC, the United Nations Framework Convention on Climate Change.

The COP26 scheduled for November 2020 in Glasgow has been postponed due to COVID-19 and will be hosted by the United Kingdom in collaboration with Italy, from 1 to 12 November 2021. Along with the Conference, the Italian events of the pre-COP', consisting of a series of high-level technical meetings preparatory to the Conference event which will be held on 30 September and 1,2 October and the specific event dedicated to young people Youth 4 Climate which will be held on 28, 29 and 30 September 2021, both in Milan.

In any case, the next Conference has the task of relaunching, five years later, the momentum that the international community had given to the fight against climate change with the COP in Paris.
In fact, by the end of 2020, unless there are exceptions due to the international health contingency, all countries will have to present new national plans aimed at avoiding exceeding the threshold of 2°C above the average pre-industrial terrestrial temperature, to be lowered to 1 .5°, according to scientific studies, to avoid the point of no return. However, the United Nations - with the 2019 Emission Gap Report - has shown that, if all the objectives that each country has set were achieved, there would still be large quantities of CO2 to be eliminated to avoid global warming. NDCs will therefore need to be significantly increased to be able to contain global warming.

Consequently, the COP26 challenge will also be played out on a political level of negotiation between governments, and not so much on a scientific level, as the data and evidence are now consolidated and acquired.

Furthermore , with reference to the **global dimension,** in 2015 the UN approved the 2030 Agenda for Sustainable Development, identifying 17 Goals for sustainability. Of the 17 objectives, at least 9 are connected, more or less directly, to the objectives that regional energy-climate planning pursues.

The most impactful objectives and related goals are:

Goal 7: Ensure access to affordable, reliable, sustainable and affordable energy systems for all modern

7.1 Ensure access to affordable, reliable and modern energy services by 2030

7.2 Considerably increase the share of renewable energy in total energy consumption by 2030

7.3 Double the global rate of improvement in energy efficiency by 2030

Objective 13: Promote actions, at all levels, to combat climate change

13.1 Strengthen resilience and adaptation capacity to climate and disaster risks in all countries natural

13.2 Integrate climate change measures into national policies, strategies and planning

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

In the context of the effectiveness of adaptation measures to climate change, Objectives **1** =End all forms of poverty in the world **and** 11=Make cities and human settlements inclusive and safe also have a particular relevance on issues of equity and resilience. , long-lasting and sustainable:

1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters

11.5 By 2030, significantly reduce the number of deaths and the number of people affected by disasters, including water-related disasters, and substantially reduce direct economic losses relative to global gross domestic product, with a particular focus on protection of the poor and people in vulnerable situations

11.b By 2020, significantly increase the number of cities and human settlements that adopt and implement integrated policies and plans towards inclusion, resource efficiency, climate change mitigation and adaptation, and disaster resilience , the development and implementation, in line with the “Sendai Framework”, the comprehensive management of disaster risk at all levels

On the Community front, new strategies have been adopted and tools have been developed for the next decade. On 28 November 2018, the European Union presented its long-term strategic vision (2050) for a prosperous, modern, competitive and climate-neutral economy. The strategy attributes to Europe a leading role to achieve, with the guarantee of social equity, the neutrality of the socio-economic system in terms of climate-changing emissions, focusing on investment in technological solutions, on the involvement of citizens and on the harmonization of interventions in key sectors, such as industrial policy, finance or research.

According to the strategy, joint action is needed in seven strategic areas:

1) energy efficiency;

2) diffusion of renewable energy;

3) clean, safe and connected mobility;

4) industrial competitiveness and circular economy;

5) infrastructures and interconnections;

6) bioeconomy and natural carbon sinks;

7) carbon capture and storage to reduce remaining emissions.

A year later, in December 2019, the newly installed European Commission presented **the Green New Deal to Parliament,** a new growth strategy that aims to transform Europe into a fair and prosperous society, with a modern economy, efficient in terms of resources and competitive, in which, in 2050, the objective of zero climate-changing emissions is achieved and economic growth is firmly decoupled from the intensity of resource use. The strategy establishes the need to rethink policies for the supply of renewable energy in all sectors of the economy: industry, production and consumption, large infrastructure, transport, food and agriculture, construction, taxation and social benefits and provides for increase in the European target for reducing climate-changing gas emissions for 2030, up to 50-55% compared to 1990 levels.

The **European Green Deal investment plan** was launched on 14 January 2020 , which will leverage EU financial instruments to mobilize public resources and private funds, which should translate into a revenue of at least €1,000 billion in sustainable investments in next ten years. The
The plan envisages that the EIB will become a bank for the climate, that from 2021 fossil fuel sources will no longer be financed, that mandatory minimum criteria will be established for green public procurement, that guidelines will be developed for the application of the principle of *"energy efficiency first"* in public investments, which guarantees flexibility in the legislation on state aid for investments in the energy efficiency of buildings, in renewables for self-consumption and in district heating, provided that the infrastructure does not influence market competition.

On 29 January, the Commission adopted the **Work Program for 2020,** in which it defines the interventions it intends to implement during the year to start the transition towards a fair, climate-neutral and digital Europe. Of the 6 pillars of the new European programming, the first is the European Green Deal: the Commission will propose European legislation on the climate, aimed at establishing the objective of neutrality in terms of climate-changing emissions by 2050. The participation of all civil society will be pursued through the European Climate Pact, which will involve actors at all levels - regions, local communities, civil society, schools, industry and private individuals. The EU will also play a leading role in international negotiations ahead of COP26 in Glasgow and present initiatives to address biodiversity loss.

The Commission believes that the Green Deal is the answer to the population of Europe which is asking for a decisive contribution to the fight against climate change and with respect to which, as emerges from the results of the most recent special Eurobarometer (November 2018), 93% believe that the change climate change is caused by human activities and 85% agree that the fight against climate change and a more efficient use of energy can create economic growth and new jobs in Europe.

More recently, the Commission launched the *"Climate Target Plan 2030"* initiative on which a public consultation was activated which closed in June and the forecast of a communication to be issued in the autumn. The initiative identifies the need for the EU to increase climate ambition by

2030 to achieve climate neutrality by 2050, with the forecast of increasing the objective of cutting greenhouse gas emissions by 2030 from the current -40% to a value between 50% and 55% compared to 1990, also modifying the contents of the legislative proposal for a European climate law, adopted on 4 March 2020.

At a national level, in the first days of 2020 **the PNIEC** was sent to the European Commission , implementing Regulation of the European Parliament and of the Council 2016/0375 on the *governance* of the Energy Union, thus completing the process started in December 2018, in during which the Plan was the subject of a discussion between the institutions involved, citizens and stakeholders.

Contributing to the PNIEC are the National Sustainable Development Strategy, approved by the Council of Ministers on 2 October 2017 and by the Inter-ministerial Committee for Economic Planning (CIPE) on 22 December 2017, the National Low Emission Development Strategy to 2050 and the National Energy Strategy of 2013, approved with the inter-ministerial decree of 8 March 2013 and subsequently updated, on 10 November 2017, with the decree of the Minister of Economic Development and the Minister of the Environment and Protection of Land and Sea.

The PNIEC is structured according to five dimensions:

1. decarbonisation;
2. energy efficiency;
3. energy security;
4. internal energy market;
5. research, innovation and competitiveness.

In line with the objectives set by the EU, the main objectives of the PNIEC for Italy are:

- a percentage of energy production from Renewable Energy Sources (RES) in Final Consumption Gross energy2 equal to 30%;
- a share of energy from RES in the Gross Final Consumption of energy in transport of 22% compared to the 14% expected by the EU;
- a reduction in primary energy consumption3 compared to the PRIMES 2007 scenario of 43% a faced with an EU target of 32.5%;
- the reduction of greenhouse gas emissions compared to 2005 levels for all non-sector ETS [4] of 33%, a target 3% higher than that envisaged by Brussels.

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[2] *Gross final energy consumption: Total energy products supplied for energy purposes to industry, transport, households, services, including public services, agriculture, forestry and fisheries, including the consumption of electricity and heat from the electricity sector for the production of electricity and heat, including losses of electricity and heat with distribution and transmission - Directive 2009/28/ EC, art. 2 Definitions*

[3] *Primary energy: an energy source is defined as primary when it is present in nature and does not derive from the transformation of any other form of energy. This classification includes both renewable sources (solar, wind, hydroelectric, geothermal, biomass energy) and exhaustible sources,* such as *directly usable fuels* (crude *oil, natural gas, coal) or nuclear energy . Primary sources differ from secondary sources in that the latter can only be used following an energy transformation (such as petrol following chemical refining or electricity or hydrogen).*

[4] *ETS sectors: industrial sectors subject to the quota trading system (EU emissions trading), established on the basis of Directive 2003/87/ EC (thermoelectric, refining, production of cement, steel, paper, ceramics, glass); Non-ETS sectors: industrial sectors not subject to the ETS system (small-medium industry, transport, civil, agriculture and waste according to Decision 406/2009/ EC (Effort Sharing Decision, ESD).*

Table 1 summarizes the national and European objectives for **reducing climate-changing gas emissions** *(percentage of CO2 equivalent reduction compared to the emission data of a reference year).*

	2020	2030	2050
European	**-20% total emissions** *compared to 1990: [A]* **-21% ETS sector emissions** **-10% emissions from non-ETS sectors** *compared to 2005: [A]*	**-40% total emissions** *compared to 1990: [E]* **-43% ETS sector emissions** **-30% emissions from non-ETS sectors** *compared to 2005: [E]* **- 20% transport sector emissions** *compared to 2008: [D]*	**Zero total net emissions** *[C]* More ambitious scenario, which contemplates maximum intensity in renewable energy, electrification, energy efficiency, hydrogen mobility, alternative fuels-new approach to circular economy, soil and forestry absorption, natural carbon absorption sinks **- 60% transport sector emissions** *compared to 1990: [D]*
Italy	**-13% emissions from non-ETS sectors** *compared to 2005: [B], [F]*	**-33% non-ETS sectors** *compared to 2005: [F]*	

Tab.1 EUROPEAN AND NATIONAL CO2 EMISSIONS REDUCTION OBJECTIVES

LEGEND

[A] Climate and Energy Package (Climate Action 20-20-20)

[B] Decisione 406/2009 Effort Sharing

[C] COM (2018)773: A clean planet for all. Long-term European strategic vision for an economy prosperous, modern, competitive and climate neutral.

[D] Roadmap towards a single European transport area - White Paper 2011

[E] Climate and energy framework 2030 (European Council conclusion October 2014)

[F] Integrated Energy and Climate Plan 2030

The proposed National Plan was the subject of an opinion at the State-Regions Conference, a public consultation, a strategic environmental assessment, as well as a preliminary evaluation by the European Commission, which returned important recommendations to Italy on the proposed document. In implementing the European recommendations, the Ministry of Economic Development established a working table with appointed representatives of the Regions, which saw the Lombardy Region contribute to the improvement of the initial proposal both in reference to the regional role in the transition and in the proposal of additional implementation measures .

As required by the aforementioned Regulation, the European Commission is required to publish the final evaluations of the PNIECs, after having verified that Italy has taken due consideration of the recommendations formulated. The Plan will be operational from 1 January 2021 and the Commission's first assessment of the progress made towards the set targets is expected in the following month of October of the same year.

By June 2024 all member countries will then have to update their respective plans, while by 2029 they will have to present the revision of the PNIEC for the decade 2031-2040.

The next significant steps of national intervention concern:

1. the definition of the long-term strategy for the reduction of climate-changing emissions with a fifty-year perspective ***(Long Term Strategy 2050),*** imposed on EU countries by the Commission, in order to contribute to the long-term objective established by the Agreement Paris;
2. the transposition into Italian law of the European Directives on energy efficiency, renewable sources and electricity and gas markets, which will be completed during 2021.

A.2 THE DIRECTIONS OF THE REGIONAL DEVELOPMENT PROGRAM

The Regional Development Program (PRS) of the XI Legislature, approved by the Regional Council on 10 July 2018 with ***DCR administrative and as an opportunity to improve the quality of life of Lombardy, reconciling the needs of productive growth and involving all local actors: from businesses to citizens, from schools to public administrations".***

Within this priority, the PRS identifies as priority actions:

- the gradual **transition to a low-carbon economy** *(green economy* and circular economy) as a factor for the development of territories, renewed competitiveness for businesses and for the mitigation of climate change;
- the **improvement of air quality** through integrated measures in different fields of intervention e the empowerment of the various public and private entities active in the regional territory;
- improving the quality of the transport system, through the development of **low environmental impact,** integrated, safe mobility and an efficient infrastructure system capable of responding to the needs of the territory;
- **the development of the regional green infrastructure,** understood as a unitary system of **natural, semi-natural and agricultural areas,** to be preserved in its territorial continuity, to guarantee the ecological-environmental balance of the Lombardy territory as a whole;
- the integration of **urban and territorial policies** with those for water quality and defense against hydraulic risk, promoting development and redevelopment oriented towards the protection of water resources, aquatic ecosystems, the reduction of land consumption and the resilience of territorial systems;
- the pursuit of the objective of **limiting land consumption** and the concrete application of regional legislation on the matter, as a primary reference for urban planning policies, to reduce urban dispersion and guide settlement development according to environmental sustainability criteria;

• the regional Sustainable Development Strategy, implementing **the UN 2030 Agenda** for Sustainable Development.

The Regional Development Program, therefore, has defined a transformation perspective towards the sustainability of regional action and the transversal alignment of all economic and development, energy-climate, mobility, natural and agricultural systems, urban planning and territorial, starting from the transition to a low-carbon economy.

To this end, the PRS plans to intervene incisively in regional economic planning and in the orientation of the next programming cycle of the structural funds (2021-2027), in the targets of the Rural Development Plan, in the development objectives of the agricultural sector and of the agri-food system, in the implementing provisions of the Regional Territorial Plan and, consequently, in local planning, in the evolutionary ambitions of the Regional Transport and Mobility Plan, in industrial and research policy choices, in natural capital protection policies, in environmental technical plans and standards for the protection of air quality and the implementation of circular resource management, in the programmatic path of decarbonisation, mitigation and adaptation to climate change.

The transition towards sustainable economic, social and production models is designed by the PRS in a logic of co-responsibility and promotion of greater awareness on the topic, also as a function of the political response to adapt to climate change.

The PRS of the

• **the approval of the Climate-Energy Plan** implementing the European Commission Package *"Clean energy for all Europeans"* and in line with the objectives of reducing climate-altering gas emissions undertaken by the Lombardy Region itself and deriving from the commitments of the Agreement Paris for the climate, the *Compact of States and Regions* and the international *Under 2* protocol *Memorandum of Understanding;*

• the development of actions aimed at **combating air pollution** with the updating of relevant planning and the strengthening of high-performance and innovative measures in terms of reducing polluting emissions into the atmosphere, through the promotion of the integrated development of actions for the quality of air, with particular reference to the thematic areas of agriculture and animal husbandry, transport and mobility, domestic energy production and certain specific types of industrial plants, with the adoption of integrated measures in the various areas of regional competence and the connection with the Government, the Regions of the Po basin and with the direct involvement of the responsibilities of local institutional subjects;

• encourage, in collaboration with Lombard research centers and international networks, the development of **innovative technologies** for the significant reduction of polluting and climate-altering emissions into the atmosphere and the reduction of the carbon footprint and fine particles, which have a heavy impact on the Po Valley, particularly in urban areas;

- encourage the development of innovative technologies to increase the **environmental sustainability of production processes,** for the creation of self-sufficient factories from an energy point of view and for the implementation of *end-of-life* processes that are sustainable from an economic and environmental point of view ;
- provide, in the energy sector, coordinated action strategies for the **reduction of energy consumption from fossil sources, the increase in energy efficiency and production from renewable energy sources,** also with a view to achieving the objectives of **reducing climate-altering gas emissions** hired by the Lombardy Region.

The new planning for energy and climate will have to respond to the needs of increasing sustainable competitiveness, making the identification of targeted and effective intervention strategies, capable of responding to the determining criterion of so-called "system interventions" as a priority.

The result will not be exclusively the result of a broader awareness of the potential of the market for renewable energy sources or energy efficiency, but rather the outcome of a system of promotion and governance *of* the regional economic system. The repercussions and implications on the multi-sectoral industries, including the agri-food-forestry sector, manufacturing and advanced tertiary sectors, appear in all their clarity.

This last aspect represents one of the excellences and virtues that Lombardy brings to the Italian *green economy system.* Just as the proactive approach of *governance* in recent years has made the Lombardy Region emerge as an institutional actor capable of anticipating trends, stimulating opportunities and opportunities for economic recovery and, at the same time, implementing policies to fight climate change and energy sustainability.

The positioning of Lombardy among the leading European countries in the patenting and establishment of new innovative entrepreneurial activities, especially in the energy sector, as highlighted by the recent *"2019 Report on Innovation"* of the National Institute for Competitiveness, demonstrates how the Lombardy region continues to be fertile with respect to the new policy challenges for sustainable development. In patented energy innovations, there is a concentration in the field of energy production and storage systems, responding to development needs.

Within the programming framework defined by the PRS, therefore, and in compliance with the pillars of integration of regional policies and widespread co-responsibility, this policy act intends to orient the path of new definition of regional energy and climate policy directions towards specific goals.

A.3 THE NEW LOMBARD PARADIGM

Among the verbs that the Covid19 emergency has made its own, the verb "propagate" deserves to be regained to give substance to the prospect of new sustainability that is the basis of energy-climate programming.

The new paradigm, in response to the profound slowdown imposed by the health emergency, aims to provide a direct, rapid and widespread response to relaunch the Lombardy region, the epicenter of a propagation of stimuli for the revision of economic policies towards sustainability.

The profound innovation that the Lombard paradigm of energy and climate transition wants to propose is that of interpreting the transition from less to more: from the idea of minimizing the use of fossil fuels and the consumption of natural resources, which was the key objective of the current PEAR, with the idea of increasing, enhancing and amplifying the driving factors of the new sustainable economy in Lombardy, with a relaunch of the territory that starts from its vocations.

The concept of "propagation" intends to recall the importance of starting from specific and local action which, as a result of a phenomenon of contagion and progressive emulation, leads to the extension and diffusion of the change based on specific stimuli that the PREAC intends to generate .

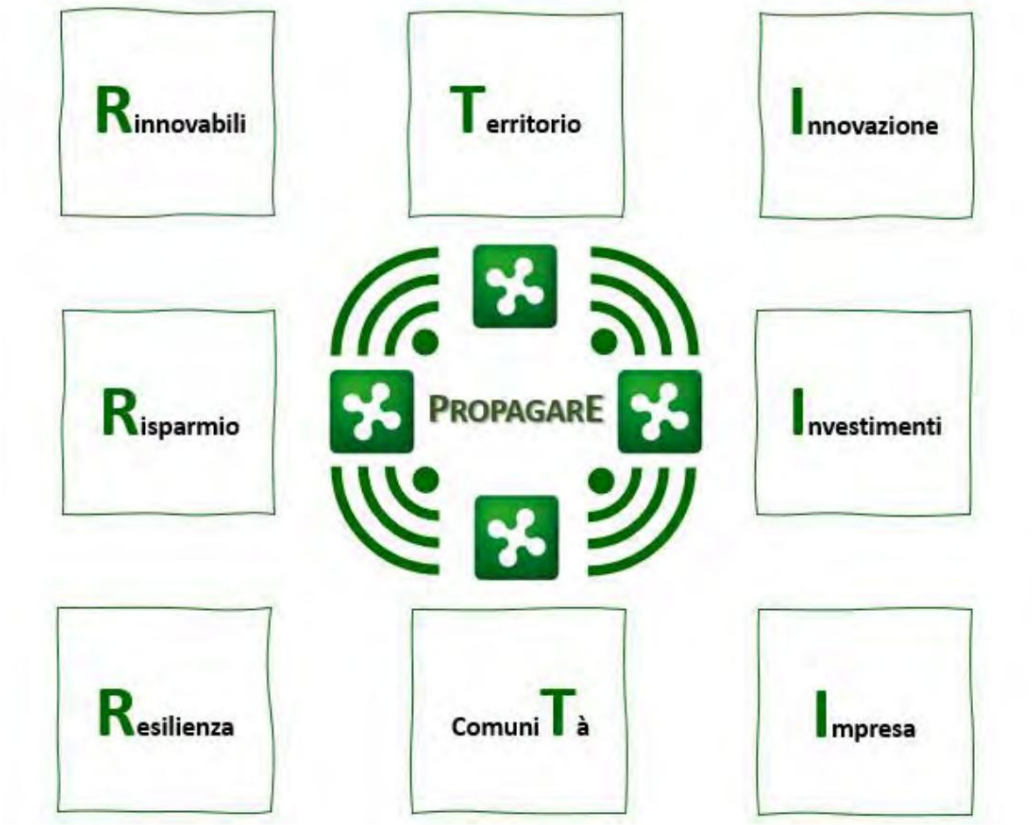


Fig.2: The new Lombard paradigm of PREAC

The common thread of this propagation perspective are the intrinsic vocations of the social, economic and territorial fabric of the region: local communities, businesses and innovation.

In this line, the energy transition and its priority levers of the diffusion of renewable sources and the affirmation of the rational use of energy, aimed at the maximum degree of energy saving in end uses, are an opportunity for Lombardy to propagate the manufacturing capacity of their companies and their natural inclination towards innovation with respect to technological sectors that lend themselves well to the internationalization of products and services.

It is necessary to propagate a new logic of territorial development, of the relationships between urbanized spaces and of these spaces with the natural components and with the physical and immaterial infrastructures, the latter considered with renewed evidence by the epidemiological crisis, which has led to the massive use And

spread to forms of remote work and to a basic economy strongly centered on the capacity for digital exchanges.

Public and private investments must be promoted in the offer of technologies and services for sustainability and the energy transition, with particular regard to support for innovation, which also passes through the promotion of so-called "innovation champions", be they protagonists of consolidated innovation stories or new initiatives.

The opportunities and opportunities of doing business for the energy transition must be promoted, promoting the role of Lombardy companies protagonists of the energy transition as a decisive resource - at a national and European level - for the provision of products and technologies capable of producing the acceleration of sustainability that underlies the Green New Deal
European.

The idea of a new nucleus of energy sustainability, the local community and the creation of networks of communities engaged in the self-production of renewable energy must be propagated.

The new idea of local communities must be propagated in the reorganization of a resilient territorial system, which plays a leading role in the energy transition: local communities place themselves as the main contribution to the mitigation of climate change and, at the same time,
review the criteria for their transformation, in terms of adaptation to climate change.

A.4 THE PECULIARITIES OF LOMBARDY

The Lombardy Region has peculiar characteristics when compared with the national and European context: demographic size and residential and tourist dynamism, industrial and agri-food productivity, breadth of demand and supply of services, especially trade and finance, require governance of natural resources and humanely and effectively evolved stable and safe energy and transportation systems.

With over **ten million inhabitants,** Lombardy is among the top ten regions of the European Union by population and more populous than more than half of the EU member states; Hungary, Bulgaria, Austria, Finland, Denmark, for example, have a population smaller than that of Lombardy. Furthermore, in Lombardy there are 7.6 million tourist arrivals per year, corresponding to almost 23.5 million nights spent in the Region's accommodation facilities. Also in this case, the data indicates how Lombardy records higher presences than many EU states, as well as regions comparable in size such as Belgium, Bavaria, Scotland, Sweden, Poland, Berlin, Hungary, Bulgaria.

Over **a fifth of the national gross domestic product** is produced in Lombardy . Considered independently, Lombardy would be the tenth state of the Union in terms of economic size: Austria, Ireland, Denmark, Finland, as well as all the states of central and eastern Europe that are members of the EU, with the exception of Poland, produce an added value lower than the Lombard one. The gross domestic product per capita is €38,000, while the EU average is around €30,000.

Looking at the employment structure, the Lombardy production system is particularly relevant in the mechanical, electronic, metallurgical, but also textile, chemical and petrochemical, pharmaceutical, agri-food, publishing, footwear and furniture sectors.

The percentage of **added value produced in manufacturing,** although it suffered a decline following the crisis that broke out in 2008, stands at around 23%, more than 3 points higher than the Italian average. The share of employed people in the sector also shows a similar situation: this share constitutes over 25% of the total. It should be noted that the over 70 billion euros produced in manufacturing would place Lombardy in eighth place among the states of the Union for manufacturing production.

Another significant testimony to the industrial capacity of the Region is the export data: in 2018 **Lombard exports** were worth 31.5% of the regional GDP, the highest figure since 1995 and more than 5% higher than the Italian average. Furthermore, the share of Lombard employees in medium and high technological intensity manufacturing corresponds to 9% of total employees in the region. The figure is almost 3 points higher than the Italian average, in line with that of the EU (6.2%). Compared to the "four engines of Europe", the Lombardy figure is between that of Baden-Wurttemberg (16.3%) and that of Rhône-Alpes (5.9%).

The Lombardy productive fabric is characterized by the presence of SMEs and in particular by micro-enterprises. Lombardy is second only to Ile de France, in the entire European Union, for the number of companies in the secondary and tertiary sectors (the available Eurostat data does not include the agricultural sector).
Also in this case, with around 825,000 active companies, it would be one of the top European states (in seventh position) if considered independently. Of these, almost 227,000 are companies that have up to a maximum of 9 employees.

These data are reflected in a **labor market** which, despite sharing national weaknesses compared to its European partners, nevertheless shows a better situation compared to the rest of the country: thus, despite being one percentage point below the EU average, the employment rate Lombardy employment, equal to 67.7% in 2018 (latest Eurostat data available), is 9 percentage points higher than the Italian average. Lombardy's unemployment rate is lower than both the Italian one (equal to 10.6%) and that of some European countries including France, Finland and Sweden.

The industrial fabric of Lombardy is made up, with reference to **companies operating under an authorization regime with environmental implications,** of 1800 plants subject to integrated environmental authorization (30% of the country's plants), of which 750 farms, approximately 30,000 minor plants subject to authorization the only environmental one and by 25% of Italian plants qualified as companies
at risk of a major accident.

In 2017, the most recent data available, **spending on research and development** at a regional level stood at 4.9 billion euros. The growth in spending on research and development was driven above all by businesses, which recorded an investment-to-GDP ratio of 1.33%. Even in the case of patent applications sent to the European Patent Office, Lombardy is in a significantly better position than the national one, but lower than the European average. However, the figure has been constantly growing in recent years.

Lombardy has a vast and complex **university system** made up of 12 university institutions (6 state universities, 1 polytechnic, 5 private universities) and a university high school (IUSS di
Pavia), equal to 16% of the entire country, in which around 200 technical-technical departments operate

scientific. The academic structures are flanked by a multiplicity of high-level public and private research centres.

A significant part of the entire Italian **energy supply chain** is concentrated in Lombardy , which generates 11 billion euros of regional added value per year, compared to the 62 billion of the national one and with a higher than average return of added value at the level of related industries. Italian, equal to 2.2 euros for every euro in the energy sector, thanks to the superior internal integration and greater completeness of the Lombardy supply chain. These are companies with a strong presence on international markets, with a high propensity for technological investments, equipped with highly qualified skills and significantly inserted into global value chains.

The **regional system of energy production from renewable sources** has very significant dimensions in the national context, considering that 25% of Italian hydroelectric production and 16% of overall energy production from renewable energy sources are achieved on Lombardy soil. The development strategy, however, appears to be conditioned by the almost total absence of a source - wind power - and by the current limitations on the production of energy from woody biomass from plants with emissions higher than the best existing technologies or in any case poorly performing, deriving from the need to reconcile the air quality improvement objectives. These limitations can also be overcome by encouraging the construction of new systems of larger size and advanced technology, mainly to be combined with district heating.

The hydroelectric sector is also directly affected by climate change: in recent decades the alteration of the rainfall regime in terms of distribution, duration and intensity, together with the overall increase in temperatures and the greater frequency of extreme climatic events, have had significant consequences on regional water resources.

These limits of the Lombardy system were explicitly recognized at a national level when, in the context of the so-called *"burden sharing"* (distribution across the Regions of the national renewables development objective), Lombardy was assigned a 2020 objective of 11%. 3% on gross final consumption, compared to a national target of 17%. In the next decade it will be necessary to intensify efforts aimed at further developing the renewable energy system, enhancing territorial vocations and respecting the specific needs of environmental protection.

On the other hand, Lombardy, with its 10 million inhabitants, represents 20% of national **energy consumption** and it follows that, in terms of energy efficiency, it is the Region that must be able to express in practice a fundamental contribution to achieving national as well as regional objectives.

The building stock has a total surface area of approximately 400 million square metres. From a first estimate, the energy savings that could be activated by transforming properties into "nearly zero energy buildings" - also called NZEB, acronym for *Nearly Zero Energy Building* or buildings with very high energy performance whose energy requirement (very low or almost zero)) is covered to a significant extent by energy from renewable sources, produced on site - it is around 5.5 million toe5 (8 million tonnes of CO2 equivalent). The Program's task will also be to

[5] *TEP is the acronym for Tonne of Oil Equivalent = Equivalent Tons of Oil and is a unit of measurement of energy that indicates the quantity of energy released by the combustion of one ton of crude oil. The toe is equivalent to 41,868 GJ or 11630 kWh according to IEA/OECD. There are conversion coefficients in TOE for the main fuels and energy carriers defined by the MISE.*

verify the best efficiency opportunities, identify an order of priority based on the actual capacity to reduce consumption and indicate the appropriate sources of financing.

An important contribution to the transition towards a low carbon economy will also have to come from other economic sectors, relevant in the Italian and regional context, such as transport and agriculture.

The complex and articulated regional context, which has been described so far, has required the development of a **transport network for goods and people** which includes 700 km of motorways, 10,000 km of provincial roads, 1000 km of state roads and 58,000 km of municipal roads, 200 tourist ports, 1000 km of navigable coasts.

Within the Region, the total number of vehicles (with the exception of trailers and motorcycles) has grown significantly over the years, going from 5,278,561 registered in 1990 to 6,831,255 in 2017, with a motorisation rate, i.e. the ratio between cars and inhabitants in the area, equal to 61.3, in line with national values and well above the averages of other European nations. In fact, this is followed by Germany (55.7 cars per 100 inhabitants), Spain (49.3 cars per 100 inhabitants), France (47.9 cars per 100 inhabitants) and the United Kingdom (47.2 cars per 100 inhabitants).

Regarding rail transport, the railway lines in Lombardy went from 1,543 km in 1990 to approximately 1736 km in 2017, with an increase of approximately 200 km. At the same time, the electrified railway lines also grew from 1209 km in 1990 to 1453 km in 2017.

The share of Lombardy railway lines is approximately 10% of the national ones and in a European comparison they are comparable to those of Ireland (1894 km) and Slovenia (1209 km).

Finally, with regard to air transport, over the years economic growth has stimulated international trade and travel, favoring the international transport of goods and passengers which has therefore significantly increased the volume of its traffic, together with that of emissions. Approximately 46 million passengers were registered in the Region for 2018, equal to almost a third of the passengers who transited through Italy (over 150 million) and well above the volume of passengers in nations such as Poland, Sweden, Denmark and Belgium .

But Lombardy is also a peculiar land in terms of the **environmental resources to be protected.**

In Lombardy there are **679 river water bodies and 54 lakes/reservoirs,** considering both natural ones and those of artificial origin. Through a monitoring network spread across the territory, managed by ARPA Lombardia, over 290 water bodies are monitored on a timely basis, checking physical parameters, the presence of any chemical pollutants and biological indicators (flora and fauna). In addition to surface water bodies, there are **27 underground water bodies of different depths and 21 local aquifers,** which are kept under control by an ARPA Lombardia monitoring network of 421 quantitative monitoring points and 500 qualitative monitoring points. The typical **springs** of the Alpine and pre-Alpine belt are also added to the groundwater of the plains and valley bottoms, the evaluation of which is essential to evaluate the availability of water in mountain areas.

In Lombardy there are currently **246 Natura 2000 sites,** divided between two biogeographical regions (alpine and continental), covering approximately 3,735.29 km2 . i.e. 15.7% of the Region. The mountainous part it falls within the Alpine biogeographic region and consists of 115 Natura 2000 sites while the flat portion falls within the Continental biogeographic region and involves 130 sites.

The Lombardy Natura 2000 network is made up of **175 Special Conservation Areas (SAC), 49 Special Protection for Birds (SPA), 18 zones simultaneously SAC and SPA, 3 Sites of Community Importance (SCI)** and a very recent proposal for **a Site of Community Importance (pSCI)** put forward in 2020, relating to a production area of Cobice sturgeon that falls within the riverbed Ticino in the Province of Pavia.

The SCIs and SACs occupy 2,255.75 km2 of the regional surface (equal to 9.4% of its total), of which 1,893.09 km2 in the Alpine biogeographic area and 362.66 km2 in the continental biogeographic region.
The SPAs, however, occupy 2974.34 km2 of the regional surface (equal to 12.5% of the total), of which 2072.60 km2 in the Alpine biogeographic area and 901.74 km2 in the continental biogeographical region. The new pSCI occupies an area of 2.33 km2 falling within a continental biogeographical region which mostly overlaps with the existing SPA (91%).

Lombardy agriculture, thanks to its territorial and climatic characteristics and water resources, occupies a privileged position within the European and international production system, presenting an agricultural added value equal to 11.29% of the Italian one.

The soils of Lombardy are among the most fertile and productive in the world and constitute an impressive carbon reserve, estimated at 123.8 million tonnes stored in the first 30 cm of thickness (ERSAF, 2013; if 200 cm of depth were taken into consideration , the stock would amount to 278.7 Mt). A significant part of this stock is present in cultivated soils, in which the carbon content has significantly decreased over the last 50 years due to intensive exploitation. Therefore, if on the one hand a further loss of carbon from the soil, which would lead to CO2 emissions, represents a climate risk, on the other hand it is precisely agricultural soils that show the greatest potential capacity to recover a higher carbon endowment, which it can lead to increases in the stock estimated at 1-1.4 t/ha/year of CO2 equivalent (Life HelpSoil project, ERSAF, 2017) if the soils themselves are managed in sustainable and conservative ways.

In 2016, based on Eurostat data, the Utilized Agricultural Surface (UAA) in Lombardy corresponds to 958,378 ha, almost 8% of the Italian one equal to 12,843,320 ha, but comparable to that of several European states such as Belgium (1,352,950 ha), and much higher than states such as Slovenia (477,670 ha).
But the UAA is constantly and continuously decreasing due above all to land consumption; this leads not only to a reduction in the overall stock of carbon stored in soils, but, above all, it reduces the potential for sequestration of CO2 from the atmosphere.

The most widespread production directions are cereal-fodder (corn, wheat, alfalfa, other fodder crops), rice and, in particular in some specific areas of the regional territory, industrial horticulture (tomato, melon, onion, ...), fresh-cut products, viticultural, oenological and fruit production. Lombardy is also characterized by a progressive diffusion of so-called "minor" crops (hazelnuts, small fruits, saffron, hops, ...) for which there is growing interest, both in terms of the number of companies and the areas involved.

In Lombardy the livestock sector assumes considerable importance, in particular the dairy and pork sectors. Approximately 1.5 million cattle are raised in the Region, corresponding to 25% of the national production of cattle and 4.2 million pigs, equal to 50% of Italian production; the consistency of Lombardy's livestock heritage is therefore comparable to that of various European states such as Austria (1,879,520 cattle), Belgium (2,373,100 cattle) and Portugal (1,674,970 cattle).

In terms of the UBA (Adult Cattle Unit)/UAA (Used Agricultural Surface) ratio, which represents the livestock density coefficient, Lombardy has an average livestock load of 2.79 cattle units per hectare of UAA, compared to a national average of 0.68.

The high livestock load, together with the contribution of fertilizers, urban sewage sludge and other organic matrices used in agriculture, is at the origin of the surplus of nutrients, and in particular nitrogen, which is released into the environment (groundwater and surfaces and air); it is also responsible for the largest part of the climate-changing emissions attributed to the agricultural sector, which overall amount to 8.6 million tonnes of CO2 equivalent (Inemar, 2017), equal to 11% of total regional emissions.

Livestock farming, therefore, in Lombardy, constitutes an important sector for the regional agricultural economy, but requires attention in relation to the associated emissions of ammonia (NH3) and most of the nitrous oxide (N2O, of which ammonia is partly a precursor), whose emissions are mainly due to the management of livestock effluents and crop fertilization practices, and methane (CH4), whose emissions originate from the enteric fermentation of cattle and, to a certain extent, from the degradation of straws in rice fields.

Ultimately, therefore, the orientation towards increasingly sustainable production systems with reference to soil and livestock management (spreading of animal waste and application of fertilizers to the soil) is the commonly recognized long-term perspective for the contribution of the sector to the mitigation of climate change.

The Lombard agricultural system has also allowed the development of the regional chain of energy production from biogas, through anaerobic digestion of plant biomass and livestock effluents themselves, which today covers 8% of the energy from renewable energy sources in the Region and has represented at the same time an important diversification of the income of the agricultural economy Lombard.

Finally, in Lombardy, as in the rest of Italy and the European Union, **forests** are expanding territorially due mainly to the abandonment of agriculture in marginal areas and the effects of climate change which are favoring the expansion of forests in higher odds. The forest is made up of plants, which absorb atmospheric carbon dioxide to grow; the result is storage of atmospheric carbon in the plant. Therefore, Lombardy's growing forest heritage is a living tool for decarbonisation. Even in this case it should however be remembered that over 50% of the carbon stored in forest systems is actually stored in the
soil.

The estimate of the existing wooded area in Lombardy is 619,893 hectares.

However, the forest heritage is still little used by the wood industry and for energy purposes; this is confirmed by the national ratio between average growth of the biomass stock (3.3 /ha) and withdrawals m^3 (0.37 m3 /ha only approximately 22% of the growth). There are therefore margins for greater uses in industrial supply chains (construction, construction materials, etc.) and for the energy use of the resource, without affecting the stock of carbon stored in forests and, naturally, in areas and conditions suitable for protection from local air pollution.

A.5 THE LOMBARDY REGION STAGES ON ENERGY AND CLIMATE

The main steps taken by the Lombardy Region on energy and climate issues correspond to some relevant measures:

- DGR

  (PRIA), in which the objectives of improving air quality are defined, in line with compliance with the concentration limit values of the main pollutants imposed by community and national legislation;

- DGR _ roadmap phase of regional adaptation to climate change;

- DGR X/3706 of 12 June 2015 *“Approval of the Regional Environmental Energy Program (PEAR) integrated with the strategic environmental assessment (VAS)",* which constitutes the strategic planning tool in the energy and environmental fields, with which the Lombardy Region defines its energy saving and development objectives for renewable energy sources (RES), in line with the mandatory quotas for the use of RES assigned to the Regions within the scope of the so-called *"Burden Sharing" Decree,* and with the Community Programming 2014-2020;
- DGR _ integrated actions and sectoral actions, considering the four macro-sectors: Air Quality and Human Health, Soil Protection and Water Resources, Tourism and Sport, Agriculture and

  Biodiversity;

- DGR _ containing measures to limit the circulation of vehicles, limit the use of low-performance wood biomass heating systems and interventions to reduce ammonia emissions from agriculture;

- DGR XI/449 of 2 August 2018 *“Approval of the update of the Regional Plan of air quality interventions (PRIA)”.*

A.6 ENERGY AND CLIMATE PLANNING IN LOMBARDY

The regional energy planning tool is the Regional Environmental Energy Program (PEAR). The PEAR, approved in 2015, has taken 2020 as its reference horizon and as a strategic objective the reduction of consumption from fossil fuels, which also leads to the reduction of climate-altering gas emissions. PEAR's stated key direction to achieve

the energy sustainability objectives are the combination of energy efficiency and development of renewable energy.

The regional measures contained in the PEAR and developed during its implementation concern:

- ÿ the civil sector: residential and tertiary energy efficiency improvement, public buildings, public lighting, anticipation of standards for almost zero energy buildings in the regional territory, development of district heating networks;
- ÿ the industry sector: promotion of *smart specialization* and technological clusters, diffusion of energy management systems, energy efficiency of companies;
- ÿ the transport sector: infrastructure for electric mobility, biomethane for vehicles and for introduction into the network, evolution of the regional vehicle fleet;
- ÿ the development of renewable energy sources: regulatory actions, including the identification of so-called unsuitable areas, administrative simplification.

Looking at the measures specifically, significant financial support actions have been activated in various areas of the sectors mentioned above.

PEAR has found an important implementation tool in the European structural funds of the 2014-2020 programming period: the ERDF Regional Operational Program has identified a specific Axis 4 *"Supporting the transition towards a low carbon economy in all sectors ": promotion of the energy efficiency of public buildings and public lighting systems and sustainable urban mobility* with a total financial allocation of € 194.6 million . In the initial planning phase, implementation focused on enhancing the exemplary role of public buildings, financing the efficiency improvement of buildings owned by Local Authorities and mostly used as schools or town halls. The economic resources allocated (over €90 million) allow for the energy efficiency of over 180 buildings, with an energy saving of 75 million kWh (15,000 t CO2eq/year). Another intervention was dedicated to making the public lighting network more efficient with the adoption of consumption reduction technologies and "smart" automatic regulation systems (brightness sensors, remote control systems, network energy remote management systems); interventions in 125 municipalities were financed, for a total of 36 million

euro.

More recently, new targeted actions have been activated:

- the energy efficiency of public residential buildings (€15 million);
- the installation of energy storage systems from photovoltaic systems on public buildings (€10 million);

and further measures are being evaluated which could find financing in the investment forecasts referred to in LR 9/2020 "Interventions for economic recovery", concerning the sectors of energy efficiency of public residential buildings, energy efficiency of businesses and installation of electric car charging infrastructure systems.

With reference to financing measures from regional sources, the following deserve mention:

ÿ the various incentive tenders with which the Region has promoted electrical energy storage systems produced by photovoltaic systems since 2016: the first two initiatives were promoted in

three-year period 2016-18, and thanks to a financial allocation of 9.4 million euros they allowed the installation of over 1500 systems for a total storage capacity of 12 MWh. A
a further initiative still underway has seen the financing of 2285 plants with an allocation of 8.4 million euros. Finally, at the beginning of 2020, a further intervention dedicated to the installation of photovoltaic systems and storage systems by Public Bodies was launched; the expected financing is 10
Millions of euros.

ÿ the agreement with the Ministry of Economic Development for the co-financing of an incentive intervention for small and medium-sized enterprises in Lombardy for the realization of the energy diagnosis of their production sites or for the adoption of an energy management system compliant with ISO 5001 The call awarded funding to 369 applications, for a total of 1,142,335 euros. The importance of pursuing energy efficiency also in the production sector has led the Lombardy Region to participate again in state co-financing, asking for the modification of some criteria that companies had identified as critical. A new agreement with the MISE Ministry was therefore approved and a new similar notice was issued in February 2020; the overall allocation is 2,238,750 and provides for higher contribution thresholds compared to the previous call (€8,000 for diagnosis and €16,000 for ISO 50001, compared to the previous €5,000 and €10,000). At the same time, financing measures are being studied for the interventions that the energy diagnoses have suggested for the companies that have joined and will join.

The **Regional Plan of Air Quality Interventions** (PRIA), updated in 2018, provides measures in the sectors of mobility, industrial production, public and private transport, energy production from renewable sources and energy efficiency, agriculture and others, pursues objectives of reducing emissions with local impact such as fine particles and nitrogen dioxide but which have co-benefits in terms of CO2 reduction .

The most authoritative sources (WHO, on the occasion of the IPCC Special Report of December 2018 "Health and climate change") underline the fundamental importance of dealing with the climate issue in synergy with other policies with attention to "conflicting" policies. The fact that **air quality and climate change** are strictly interdependent is increasingly clear in the scientific community , also with regards to the impacts on human health: the aforementioned WHO report asserts how human activities that destabilize the climate are also those responsible for direct impacts on human health. The use of fossil fuels for energy production, in transport, industry and for heating buildings is the main source of carbon emissions: this is both the main driver of climate change and a significant contribution to pollution

outdoor and indoor local atmosphere.

Furthermore, the sectors that produce the most climate-changing gases - energy, transport, industry, agriculture, waste management and land use - are also the main sources of fine particles and other important air pollutants. Among these pollutants there are "short-lived" climate-altering pollutants such as black carbon, methane and ground-level ozone, which also has repercussions on human health.

The regional action, outlined in the 2018 PRIA update, continues with measures to progressively limit the circulation of the most polluting vehicles. The limitations are primarily aimed at the urban areas of municipalities with larger populations and with the availability of alternative public transport services. At the same time, an accompaniment to the limitations aimed at encouraging the "modal shift" towards mobility systems is implemented

collective or individual with low environmental impact and for the progressive replacement of the most polluting vehicles through direct incentives (contributions or tax breaks) or through legislative and regulatory actions that orient towards the use of low-emission impact engines. With these initiatives, the commitments that the Region signed in the 2017 Po Basin Agreement are implemented.

The provisions concerning the limitations of vehicle circulation concern up to 570 Municipalities, where a population of approximately 7.8 million inhabitants resides, i.e. equal to 78% of the Lombardy population. The limitations in Lombardy apply to the largest Low Emission Zone at European level. In this context, incentive actions for the replacement of polluting vehicles and the MoVe-In project are developed.

As regards incentives for the conversion of polluting vehicles, a new tender for the replacement of commercial vehicles was launched in 2018, then relaunched for 2019-2020. The tender is aimed at micro, small and medium-sized enterprises with operational headquarters in Lombardy that demolish a owned vehicle and purchase, also in the form of financial leasing, a vehicle belonging to the pure electric and hybrid categories. A tender for the replacement of private vehicles was also launched, aimed at replacing polluting vehicles circulating in Lombardy with low-emission vehicles intended for the transport of people, in a path of innovation based on technological neutrality and the relationship with the emission characteristics of the vehicle, with the aim of encouraging the scrapping of petrol vehicles up to Euro 2 and diesel vehicles up to Euro 5 and the consequent purchase of low-emission cars, newly registered or used. The tender was opened on 10/1/2019 and closed on 11/29 due to exhaustion of the allocated resources, equal to 18 million euros.

MoVe-In is the Lombardy Region's experimental project with which innovative methods are promoted for the control of vehicle emissions, through the monitoring of mileage, taking into account the actual use of the vehicle and the driving style adopted. A black box, installed on the vehicle, allows the information necessary for this purpose to be collected through the satellite connection to a dedicated technological infrastructure. The project, applied to the new framework of traffic restrictions, provides, in the event of adhesion, a different articulation of the current structural traffic limitations for the most polluting vehicles with a kilometric exemption and the regional identification of the number of kilometers that can be used by each emission class of a vehicle subject to limitations that can be used on portions of regional territory subject to circulation restrictions.

Based on the scenarios evaluated as part of the PRIA 2018, the emission savings related to the implementation of the set of measures relating to private commercial and passenger transport vehicles is estimated at 1,983 t/a for NOx and 132 t/a for PM10 (among the pollutants of greatest importance for air quality) and in 41 kt/a CO2, 18 t/a for N20 and approximately 9 t/a for CH4 (emissions of greatest importance for climate change).

Finally, a contribution to mitigation comes from the **Regional Mobility and Transport Program** (2016) which aims to make the 16.4 million journeys that affect the regional territory every day more sustainable with investments in intermodality, cycling mobility, on electric mobility and which therefore contributes to achieving the objectives of reducing emissions generated by the transport sector.

In reference to policies for **adaptation to climate change,** Lombardy has undertaken a pioneering path in Italy which passes through the **Guidelines** for adaptation to change

climate developed in 2012, to the **Regional Strategy for Adaptation to Climate Change,** adopted by provision of the Regional Council in 2014, up to the preparation of a **Document of action** adopted by the Council at the end of 2016.

The latter represents a *governance* tool which on the one hand recognizes and defines the priority areas with respect to the effects produced by the climate on our territory, and on the other identifies interventions to minimize the risks and impacts on the population, on material goods and natural resources and to increase the resilience of society, the economy and the environment.

The document responds to the principle of so-called *mainstreaming* which indicates the integration of adaptation in the various sectoral policies, both in terms of interventions and necessary resources.

Therefore, with all the directorates general involved and with the regional stakeholders, an important work was carried out to identify the shared adaptation measures, around 30, belonging to the programming already in place in the sectors identified as priorities in relation to the impacts of climate change: health human health and air quality, soil and territory protection, water management and quality, agriculture and biodiversity, tourism and sport.

The Adaptation Document has thus not imposed "top-down" measures with respect to the plans and programs in force or under development in the various sectors but indicates adaptation directions that can be implemented with the tools available to that specific policy.

The Regional Strategy and the Action Document therefore also performed the function of recognizing and highlighting all those tools that the Lombardy Region has at its disposal in its territorial governance action, aimed directly or indirectly at achieving the objectives of adaptation to climate change. In fact, there are various regional plans and programs that regulate or can have a strong influence on adaptation measures and that implement actions that, although not explicitly dedicated to adaptation, pursue objectives that are entirely or partially overlapping with it.

Finally, it should be noted that specific funding for projects on adaptation and reduction of emissions into the atmosphere were obtained through **LIFE tenders.** These include the ***Master Adapt*** on the specific theme of adaptation to climate change, and the integrated ***Prepair*** – life developed with all the regions of the Po valley for the creation of a "basin" policy with respect to the issues of air quality and reduction of emissions into the atmosphere; ***GESTIRE2020,*** another project that develops, among other things, communication activities regarding climate change and the effects on biodiversity.

The Lombardy Region, also with the support of the Lombardy Foundation for the Environment, also takes part in a dense and dynamic **network of international institutions,** including the nrg4SD network of regional governments for sustainable development, the Climate Group, the Under2MoU (Memorandum of Understanding), RegionsAdapt, the Four Drivers for Europe and the ENCORE Conference of Regions for the Environme

With particular regard to the RegionsAdapt initiative, the Lombardy Region took part in it, as a founder, following the process of preparing the Regional Adaptation Strategy with the declared intention of supporting the importance of the regions in building an effective process of adaptation, as sub-national governments are closer to the processes and peculiarities of their territory than the national level in this area. This same experience of networking in working groups with international experts and stakeholders gave further strength and authority in the final definition of the Action Document for adaptation to climate change.

A further aspect taken care of by Lombardy is that of **communication,** which is particularly important in this area both in terms of informing/training and in terms of transmitting one's data. The international recognition of the increasingly important role of the regions in the global challenge to climate change requires transparency and clarity of the data collected and processed and also a commitment aimed at increasing the awareness of governments themselves, businesses and citizens in their own territory. The Lombardy Region, also thanks to its adherence to international voluntary protocols, makes monitoring data relating to climate-altering emissions available and allows an open discussion with all stakeholders in order to be able to progressively improve and re-orient its actions to achieve of the objectives.

Numerous environmental communication/education initiatives on the topic of climate change have been conducted. By way of example, we recall the specific publication to increase the recipients' knowledge and awareness of environmental issues and with different social, economic and geopolitical profiles, in order to develop greater involvement and responsibility of the individual; or even the School for the Environment (with ARPA Lombardia and Polis), with which training courses have been developed aimed at public administrations and in particular at officials of local authorities on the topics of air quality and climate change, in order to provide not only knowledge and training on these topics but also highlight the tools available to these subjects to initiate local interventions to reduce emissions into the atmosphere and to adapt their territory to
climate changes.

The implementation of the regional energy and climate programming conducted so far, in all its various actions summarized, from its launch to today and with respect to the objectives set for 2020, has shown the achievement of the targets set relating to the reduction of CO2 emissions in the 20% compared to the reference year of 2015 and of the production of energy from RES, as much as the objective assigned by the State through the Burden Sharing mechanism or the distribution between the Regions, corresponding to 11.3% of gross final consumption , as much as the most challenging objective that the Region has decided to set itself of 15.5%.

With reference to the objective of reducing energy consumption in the residential, productive and tertiary sectors, a significant decline was recorded in 2014 and a strong recovery in 2015, trends mostly correlated to the relative economic situations, with a more impactful than other sectors.

Faced with a trend scenario6 which, as shown in Figure 3, regarding final energy consumption by sector, sees a practically constant trend for the next ten years, a greater intensity of action is undoubtedly necessary for the priority objective of reducing of energy consumption from fossil sources, in order to achieve the ambitious regional objectives relating to the reduction of climate-changing gas emissions by 2030 and 2050 and contribute to the targets proposed by the PNIEC at national level.

[6] BAU (Business as Usual) scenario, in which the policies currently activated are considered.

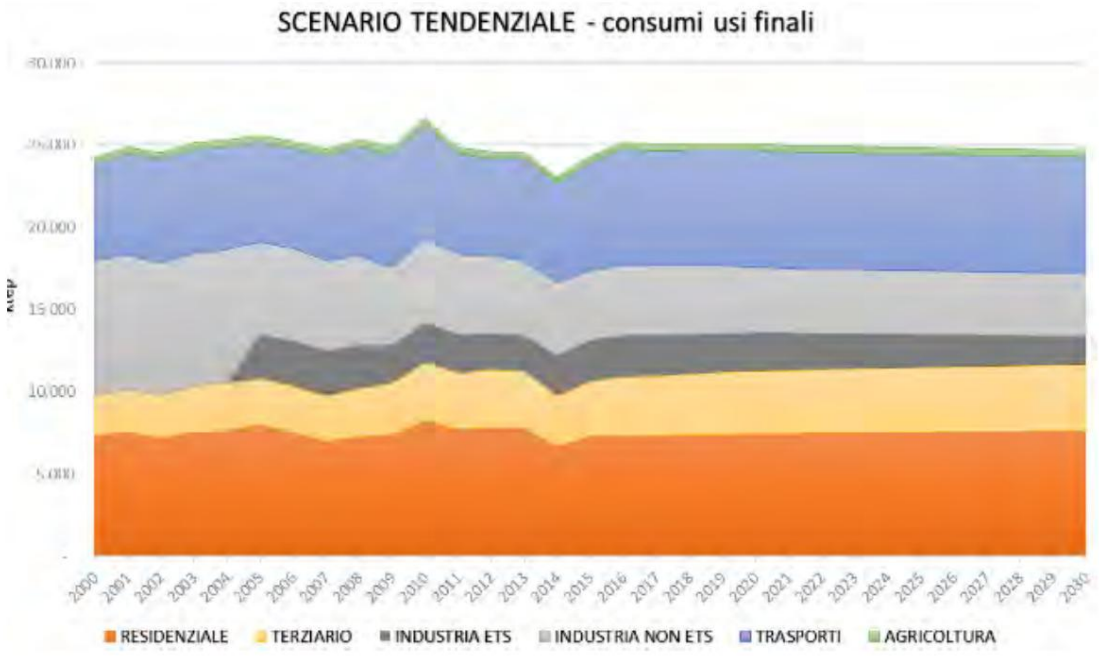


Fig.3: Tendency scenario of end use consumption *(Lombardy Infrastructure)*

A.7 THE STATUS OF CLIMATE-ALTERING EMISSIONS AND THE INTERNATIONAL OBJECTIVES TAKEN

The Lombardy Region, adhering to the international initiatives of the *Climate Group and the Compact of States and Regions* **(CS&R)** in 2014 and the *Sub-national Global Climate Leadership Memorandum of Understanding* **(Under2MOU)** in 2015, has undertaken voluntary commitments regarding the reduction of climate-changing gases for the 2020, 2030 and 2050 horizons.

The reduction targets compared to the emissions recorded in 2005 refer to the sum of direct emissions generated by all sources in the regional territory, with the exception of those from the ETS industrial sectors and indirect emissions from agricultural and waste management activities, not connected to energy uses are as follows:

- 20% reduction by 2020;
- 40% reduction by 2030;
- 80% reduction by 2050.

The targets refer to final energy consumption and therefore also include the so-called "shadow emissions" or "indirect emissions", generated by the production of electricity consumed in Lombardy, even if its production did not necessarily take place on regional soil.

The evolution of CO2 emissions, estimated for the period 2018-2020 in relation to the reference year 20157 show the desired achievement of the target by 2020. The reduction is certainly related to the reduction in emission activities recorded during the economic crisis phase of 2008, but is also attributable to the improvement in transformation efficiency

[7] Source: Report Lombardy - CDP's 2017 States and Regions Platform - these are preliminary estimates for 2015, which will have to be consolidated after the preparation of the final version of the INEMAR 2014 inventory

energy (primary energy consumption/final energy consumption)8 and the development of sources renewable.

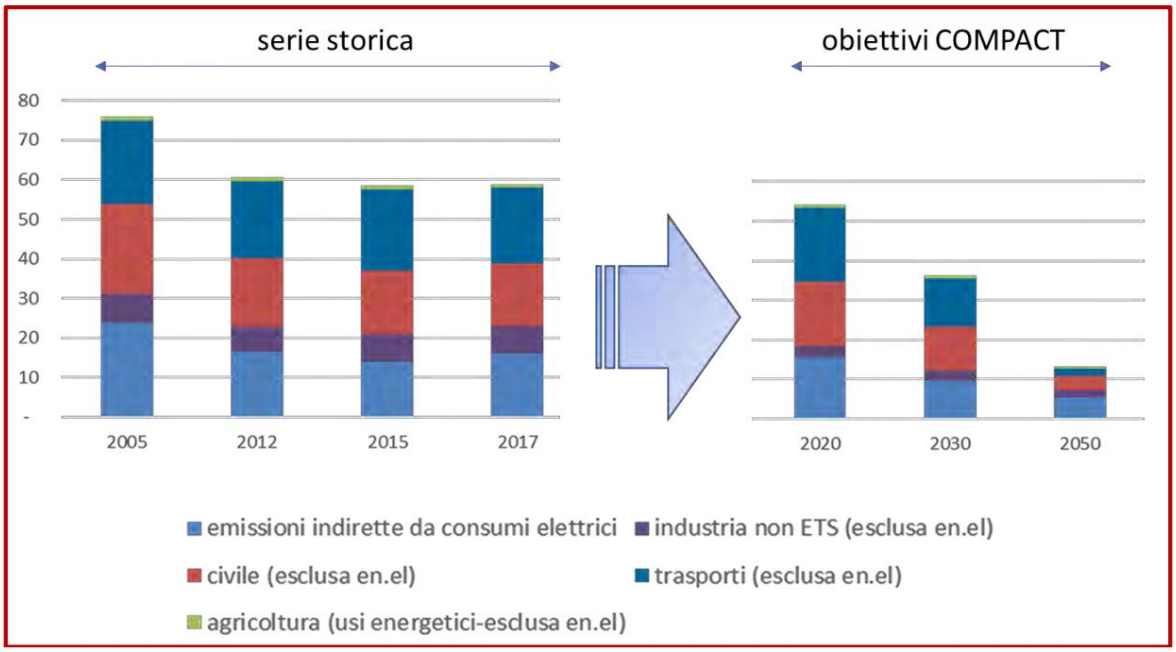


Fig.4: Trend of regional climate-changing emissions from energy uses and voluntary reduction targets compared to 2005 *(Lombardy Infrastructure)*

With the signing of the CS&R and the Under2MOU, the Lombardy Region has reiterated its commitment to defining a regional program for the mitigation of climate change, as a tool for connecting regional policies aimed at reducing emissions of climate-altering gases. This program is in fact the new PREAC, which will have to take as a reference the quantitative objectives to which the Lombardy Region has committed itself at an international level.

The Program must have the function of:

ÿ support to those responsible for regional policies in defining sectoral targets, the role of regional policies with respect to these targets and the tools and lines of action;

ÿ integrated analysis, evaluation and monitoring of costs, effectiveness, impacts of the measures.

Since the largely predominant part of climate-changing emissions (around 79%9 in terms of CO2 equivalent) is of fossil origin, i.e. it derives from the various activities that make up the energy system, the first objective must be the definition of a path of progressive reduction the use of fossil fuels as well as a new energy production structure for the Region, in line with national objectives.

[8] Consider, for example, that the electricity generation park has reduced its emissions per MWh produced by approximately 35% since 2000. Source: Lombardy Report 2017.

[9] INEMAR data processing - ARPA Lombardy (2017), INEMAR, Atmospheric Emissions Inventory: emissions in the Lombardy Region in 2014 - public review. ARPA Lombardy Environmental Monitoring Sector. The inventory concerns emissions generated by activities present within the boundaries of the regional territory. However, "shadow" emissions, i.e. emissions deriving from all final energy consumption present in the territory, are not included.

It is necessary, however, to consider that 21% of climate-changing gas emissions are due to gases other than CO2, specifically:

- ÿ 13% from CH4 (methane), mainly from the agriculture sector, but also from treatment waste and from the extraction and distribution of fuels;
- ÿ 5% from N2O (nitrous oxide), mainly from the agriculture sector;
- ÿ 3% from F-gas (fluorinated gases), from the industrial sector and from the use of solvents.

This required, already in the 2015 PEAR, an intersectoral evaluation of intervention measures aimed at the progressive reduction of climate-changing gas emissions.

For each sector considered (residential and tertiary, industry, transport), the PEAR contains scenarios ("high" and "medium") of reduction by 2020 in CO2eq emissions from energy activities which have constituted a fundamental reference for energy sustainability objectives that the Lombardy Region has undertaken as part of the CS&R for the year 2020. For the purposes of the new energy and climate programming, it is necessary to identify the renewed framework of measures to be implemented to achieve the new objectives, for subsequent time horizons, and evaluate its effectiveness.

The emissions of climate-altering gases deriving from activities other than energy ones are mainly attributable to the agriculture sector but also to waste treatment and fuel extraction. Also in this case, convergence with sectoral policies will therefore be necessary.

A.8 THE REGIONAL ENERGY-CLIMATE SYSTEM AND ITS EVOLUTION

This chapter intends to provide a summary of the current configuration of energy production and consumption data as well as the trend of the main climatic parameters of Lombardy, reference values for the construction of future directions.

A.8.1 OVERVIEW OF REGIONAL ENERGY PRODUCTION AND CONSUMPTION

Since the beginning of the 2000s, energy consumption in Lombardy has shown an oscillating trend, characterized by two maximum and minimum peaks in 2010 and 2014 respectively. It is significant that, starting from 2012, consumption has in any case attested below 25 Mtoe. In 2017, final energy consumption, net of network losses and self-consumption, amounted to 24.3 million toe.

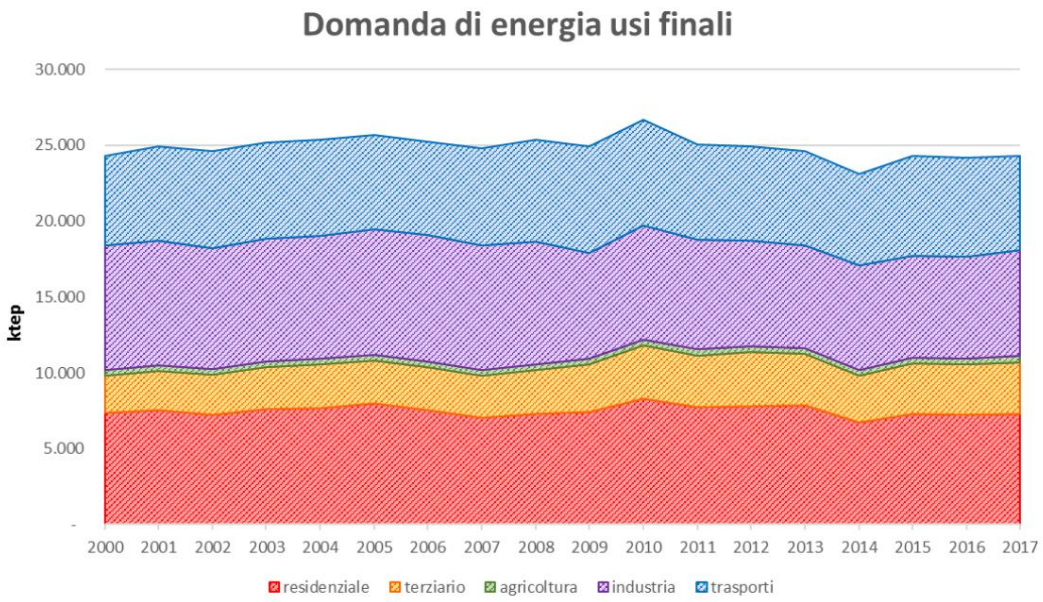


Fig.5: Final energy consumption in Lombardy in the period 2000-2017 (ktoe), by sectors *(Infrastrutture Lombarde, 2019)*

As regards the distribution of consumption (Figure 3), the most energy-intensive sector is always confirmed to be the civil sector (including the tertiary and residential sectors), to which consumption of approximately 10.5 million toe is attributed, corresponding to 40% of consumption totals. Consumption in the residential sector amounts to 7.3 million toe and has seen, since 2000, a fluctuating trend mainly due to the seasonal dynamics of the climate, for which there have been peaks in consumption (mainly of natural gas) in 2005 and in 2010, corresponding to the coldest years. The analysis of the general trend, taking the year 2000 as a reference, reveals a substantial balance. This data can be considered positive, since, despite a net increase in living space, there is no corresponding increase in energy consumption. Differently, the tertiary sector, which in 2017 recorded consumption of 3.4 million toe, experienced an increase of more than 40% between 2000 and 2010, while in recent years the trend has been substantially stable.

Consumption in the industrial sector stands at values just over 7 million toe. The energy consumption of the ETS industrial sector amounts to approximately 2.8 million toe, while the consumption of the non-ETS sectors reaches 4.1 million toe. This gap highlights how the Lombardy productive fabric is made up of small and medium-sized enterprises which account for 60% of the overall consumption of the industrial sector.

Consumption in the transport sector stands at 6.3 million toe, of which more than half can be attributed to extra-urban transport.

Considering the consumption relating to energy carriers - divided into the sectors mentioned above - natural gas records the highest consumption, with approximately 8.6 million toe. This is followed by the consumption of petroleum products for 5.9 million toe, divided respectively between diesel (4.1 million toe) and petrol (1.8 million toe). Electricity stands at 5.7 million toe.

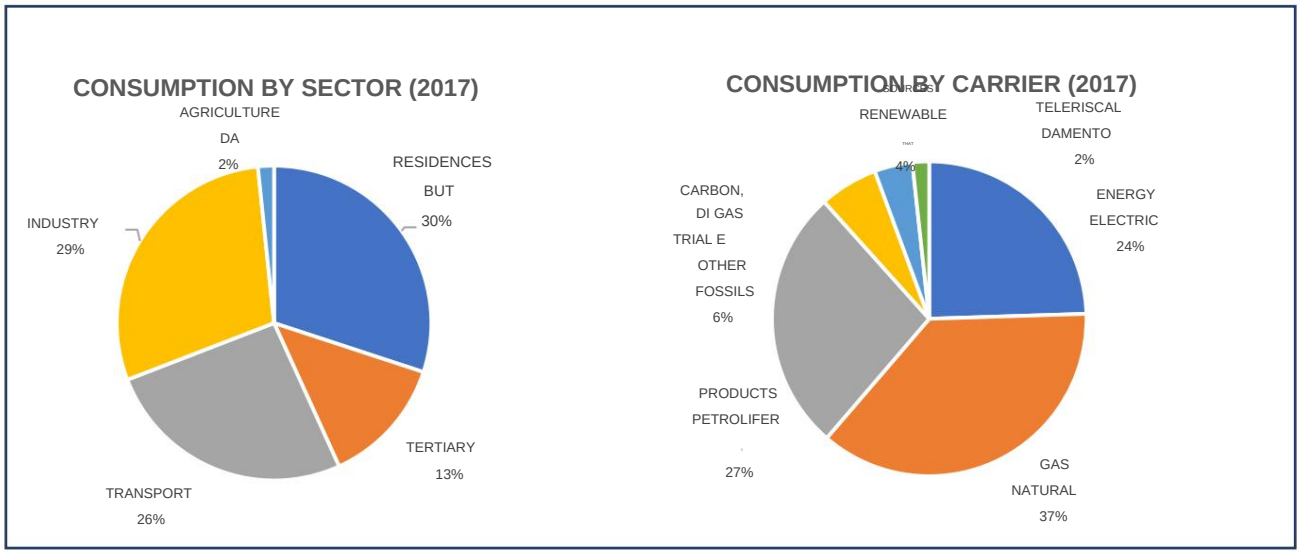


Fig.6: 2017 regional consumption data by sector and by carrier *(Lombardy Infrastructure)*

In 2017, through the energy transformations carried out by the regional park of production plants - mostly powered by natural gas, but also including transformations from renewable primary sources - approximately 45.5 TWh were produced (equal to 3.9 million toe) of electricity. Added to this is imported electricity, equal to approximately 23.4 TWh (2 million toe). The share of coverage of domestic production compared to imports is equal to 66%, thus establishing an electricity deficit of 34%.

The objectives of the beginning of the millennium, which aimed to reduce the deficit to 10%, no longer have any reason to exist. Furthermore, the Lombardy plant park - including fossil fuel thermoelectric plants, waste-to-energy plants, hydroelectric plants, solid, liquid and gaseous biomass plants, photovoltaic plants - is more than adequately sized to meet the electricity needs of the regional territory. Renewable sources cover just over a third of the electricity produced in Lombardy, equal to approximately 15.5 TWh, represented for over half by hydroelectric sources, which exceeded 9 TWh in 2017. The second renewable source for the production of electricity is biogas, used in cogeneration plants with 2.8 TWh produced, followed by photovoltaic with 2.3 TWh.

Considering renewable thermal energy sources, i.e. those that produce thermal energy for heating, heat production amounts to approximately 1.8 million toe (approximately 21 thermal TWh). Around 40% of this thermal energy was generated by heat pumps - in particular with air/air technology, serving tertiary and residential activities. A third is due to the domestic use of solid biomass. The heat derived from combustion in cogeneration and/or thermal plants in district heating networks is equal to 16%. The remaining part comes from solar thermal systems and from the waste-to-energy processing of the biodegradable fraction of waste.

Overall, thermal renewables account for just over 57% of the total energy production from renewable sources, while the remaining part is generated by renewables
electrical.

The share of coverage of final consumption with renewables in 2017 came to just under 13.8%, a value well above the target share attributed to Lombardy by the national Burden Sharing Decree.

A.8.2 OVERVIEW OF THE REGIONAL CLIMATE INDICATORS OBSERVED

Global warming, a now clear and incontrovertible phenomenon, is not uniform across the entire planet, with a more marked increase in temperatures on the emerged surfaces of the Northern Hemisphere, therefore also including Europe and in particular, as regards our latitudes, the Mediterranean has been defined by IPCC documents as a "hotspot" region of climate change (IPCC, 2018), i.e. an area where climate change is more present, and where therefore the impacts could become increasingly evident in the future.

Several studies have attempted to analyze the Italian climate trend with the aid of historical series temperature and precipitation. Below is the ISAC CNR study based on thermal anomalies compared to the reference period 1981-2010:

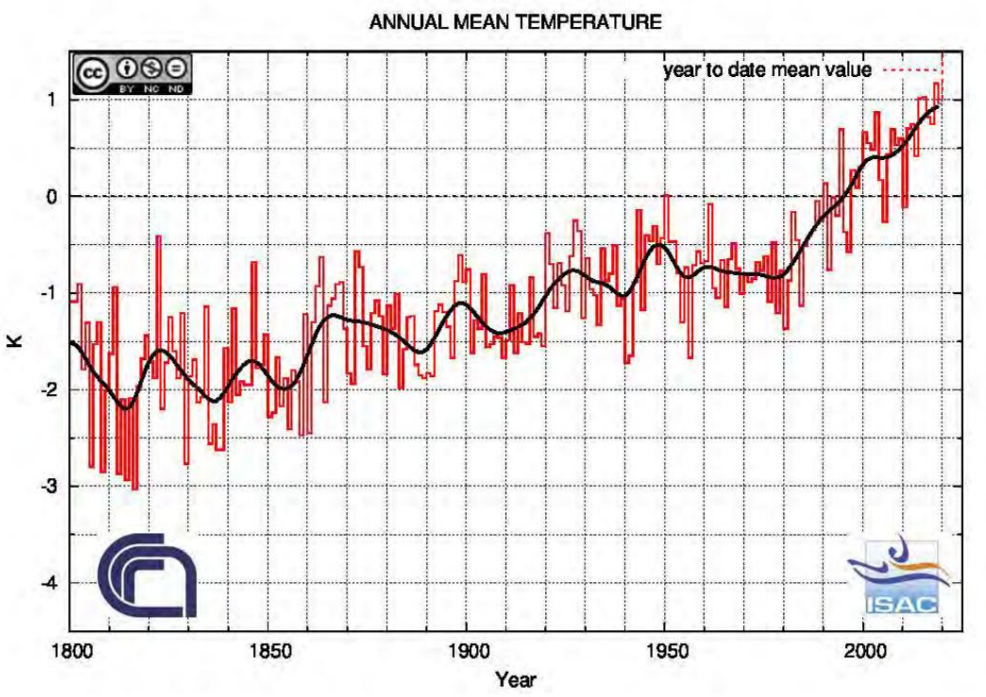


Fig.7: Annual average temperature anomaly compared to the thirty-year reference period 1981-2010. Source ISAC - CNR, 2020

The graph shows **an acceleration of the trend of increase in average annual temperature starting from the 1980s.** Previous years were characterized by warming, but with the presence of cycles with colder years alternating with milder ones. Also noteworthy is **the trend that belongs to the decade just ended,** after a small stationary period after the 2000s.

The measure of **temperature change** represents the most uniform signal of climate change. Elaborations by ARPA Lombardia on data from the Climate Service of the Copernicus Programme10 , developed by the European Union in collaboration with the European Center for Medium-Term Weather Forecasts (ECMWF), including those obtained by averaging the annual average daily temperature data over an area representative of the entire **Lombardy plain,** show how in the last 40 years there has been a **gradual increase,** characterized by an important variability

[10] https://climate.copernicus.eu/

from year to year but with a **clear trend, which over the entire period can be approximated as +0.5 °C/decade.**

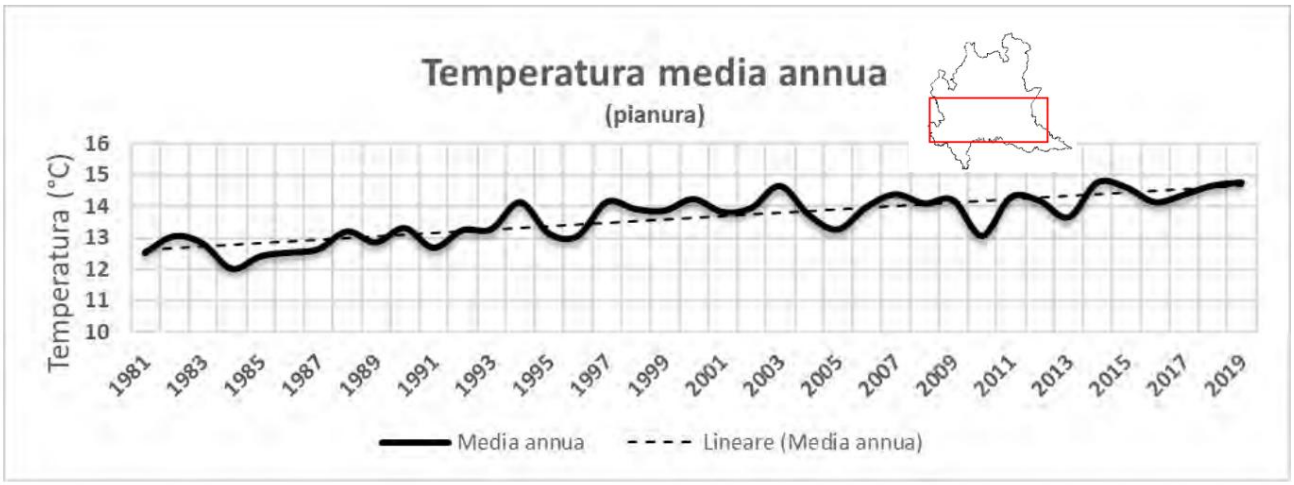


Fig.8: Average annual temperature on the plain as a function of time. The annual data is subsequently averaged over the entire area highlighted by the red box. ERA5 Copernicus data – ECMWF Reanalysis, ARPA LOMBARDIA processing

Two indicators applied to the Milan Brera time series, recognized globally at a scientific level (Karl, 1999; Peterson, 2005), are the **number of tropical nights** (Figure 9) and the **number of summer days** (Figure 10) and characterize in particular the duration of the summer season of the year for which they are calculated; the visualization of the temporal trend of the indicator allows to evaluate any long-term variations that emerge from interannual variability (climate change), and to characterize the expected climatic value (average of the index in the period 1981-2010).

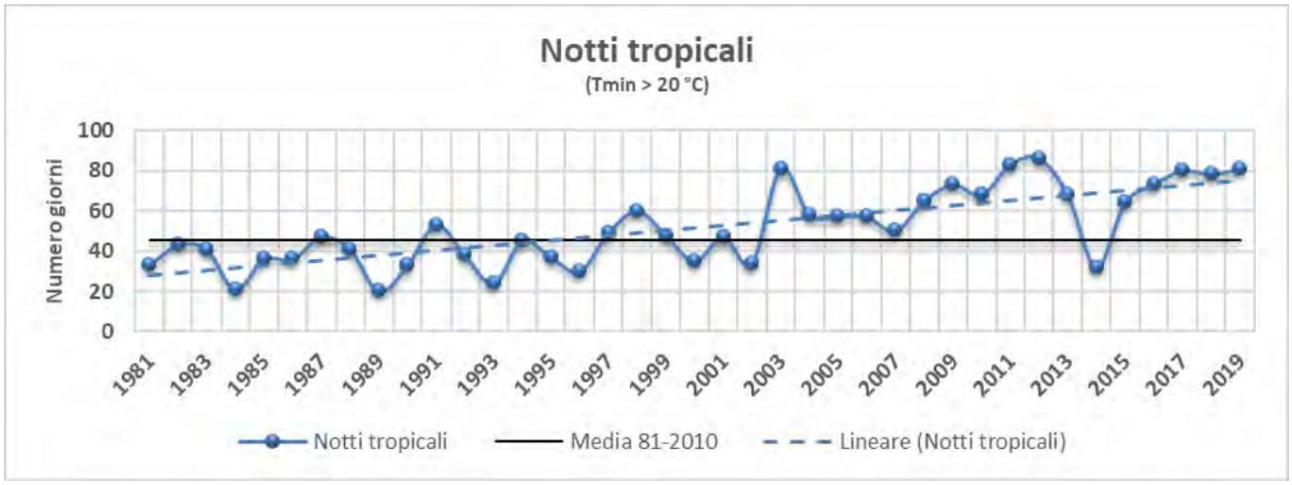


Fig.9 Number of tropical nights in Milan Brera = number of days per year in which the minimum temperature was higher than 20 °C. Processing and data ARPA LOMBARDIA

Fig.10: Number of summer days in Milan Brera = number of days per year in which the maximum temperature was higher than 25°C. Processing and data ARPA LOMBARDIA

In both indicators there is an increase, in particular for tropical nights: in fact, starting from 2003, all subsequent years (except 2014) were above the reference average calculated on the climatological standard period 1981-2010. Regarding summer days, it is possible to appreciate the frequent peaks starting from the 2000s, which do not necessarily mean a hotter season than normal, but more precisely a longer summer season and therefore with values above the norm even in the late spring and autumn months. early autumn.

The other indicator is the number of **days of frost (Error. The reference origin was not found.11),** which is significant for evaluating the winter months. It is clear that it is becoming less and less cold in the center of Milan: the distinction is clear between the winter months prior to the nineties and those following, especially since 2012. It is worth specifying that for minimum temperatures, especially in winter, the difference is wider with the peripheral and rural areas around the city.

Fig.11: Number of days of frost in Milan Brera = number of days per year in which the minimum temperature was lower than 0°C. Processing and data ARPA LOMBARDIA

Different absolute values but very similar trends for all indices can also be found in other historical series studied in Arpa Lombardia11, located in detail in the cities of Sondrio,
Brescia, Pavia and Mantua.

As regards the distribution of **rainfall,** Lombardy presents a strong territorial climate variability determined by the presence of the reliefs. Processing conducted by ARPA Lombardia with respect to the reference climate 1971-2000 comparing it with a "recent climate", such as the one 2001-
2015, show that on average there are no important changes in the precipitation regime with regards to the cumulative annual values; and that the only noteworthy variations are represented by a decrease in the amount of precipitation on the extreme southwestern plain and on the western pre-Alpine mountains, while a slight increase is generally present on the eastern sectors. However, it must be remembered that annual cumulative precipitation presents strong differences from year to year, which are not adequately represented by the average value alone for the entire period.

Therefore, as there is no obvious signal of increase or decrease in precipitation, the focus of observation must be the variation in the distribution of precipitation over the year: a direct consequence of climate change could be an increase in the number of days with intense precipitation in the future . A useful indicator is the number of days with cumulative precipitation greater than 20 mm (R20) which on average represents moderate or heavy rain events. In **Error. The reference source was not found.** the reference climatic period was compared with the difference obtained considering another period, the most recent one with the available data corresponding to the years from 2006 to 2015.

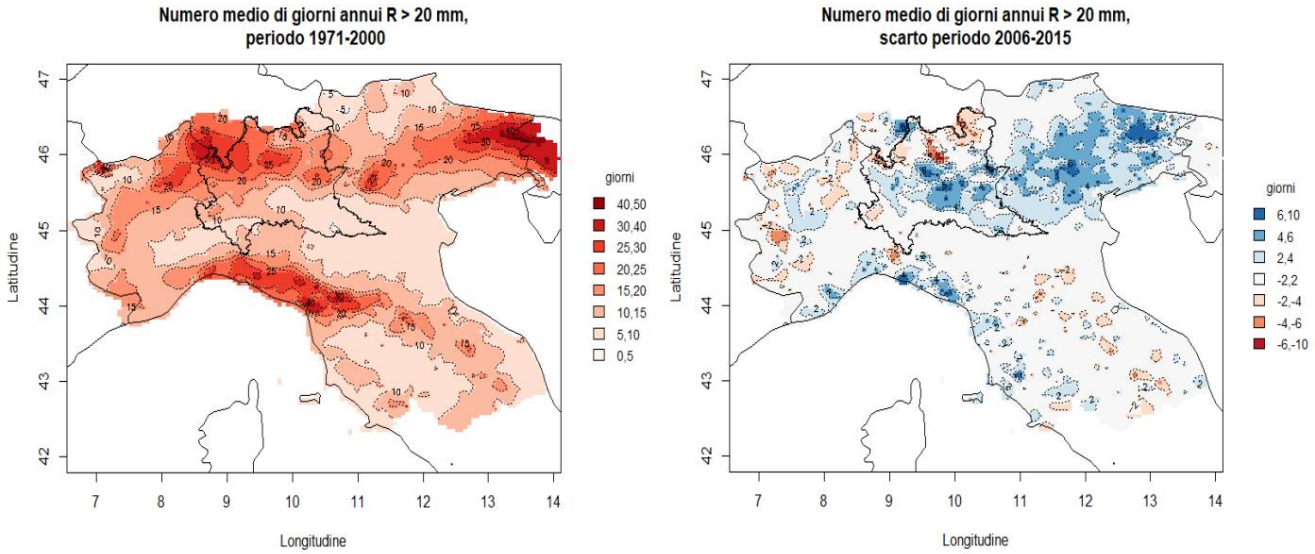


Fig.12: Number of days per year with cumulative precipitation exceeding 20 mm for the period 1971-2000. Alongside the gap for the period 2006 - 2015 Source from ArCIS, processed by Arpa Lombardia.

It is clear that the indicator is higher in the pre-Alpine sectors (up to 30 days/year), which are most affected by showers and thunderstorms between summer and autumn. Looking instead at the difference, we can see how the indicator has grown in the plain sectors, a symptom of more intense rainfall

[11] https://www.arpalombardia.it/Pages/ricerca-Dati-ed-Indicatori.aspx?tema=Idrometeorologia

on these areas, to be attributed with good probability, also in this case, above all to an increase in storm phenomenology in the warmer months.

Alongside the increase in temperature we are witnessing a progressive decrease in the areal and volumetric extension of **glaciers** mainly due to the progressive lengthening of the ablation season, and the general increase, in frequency and intensity, of summer and late heat waves early autumn. Confirming data comes from the Alpe Sud – Monte Sobretta glacier (Valfurva – SO) in Alta Valtellina, monitored by Arpa Lombardia since the second half of the nineties: in the period 2006-2019 the glacier lost approximately 62% of its surface. Since 2006, the retreat of the front has been over 70 metres, with a constant decreasing trend since 2014. Between 2018 and 2019 the retreat was 8 metres.

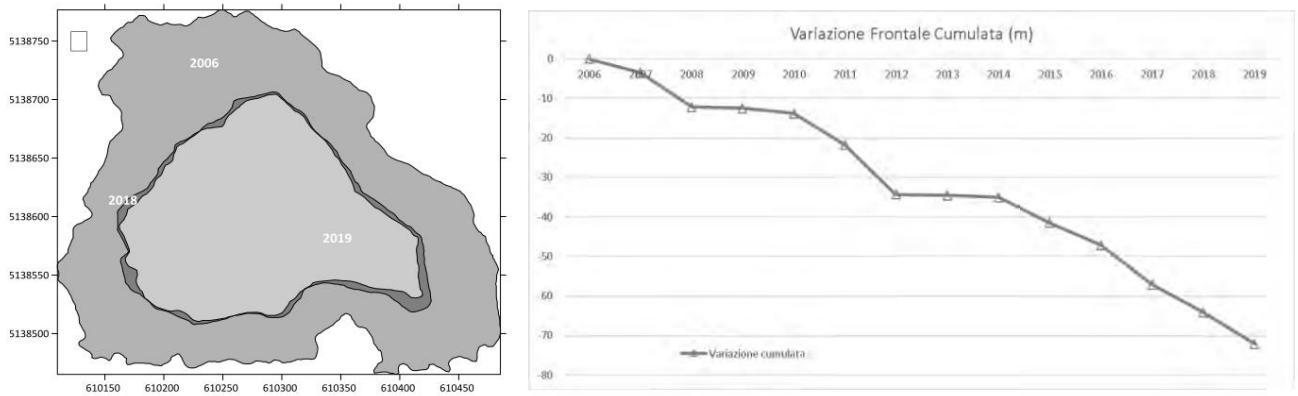


Fig.13: Areal variation (left) and cumulative frontal variation (right) of the Monte Sobretta glacier since 2006. Data and processing Arpa Lombardia.

B. THE NEW ENERGY-CLIMATE POLICY

B.1 THE NEW OBJECTIVES

Lombardy, with its peculiar and distinctive characteristics and its weight in the national context, fully described in paragraph A3, intends to express an indispensable contribution to the achievement of national objectives.

The new strategic planning act, the PREAC, will outline the stages of a path that will lead **Lombardy to be a region with net zero emissions12 by 2050 and in a cutting-edge position in the commitment to implementing climate policies and developing a system competitive and sustainable economy.**

In a national context in which fiscal leverage and market dynamics are still outside the scope
regional skills, regional action will be focused on a real increase in the value of its territory based on four pre-eminent guidelines:

1. **Reduction of consumption by increasing efficiency in end use sectors**
2. **Development of local renewable sources and promotion of self-consumption**
3. **Growth of the production system, development and financing of research and innovation service of decarbonisation and the circular economy**
4. **Adaptive and resilient response of the Lombardy system to climate change**

The following chapter outlines in detail the perspectives relating to the indicated macro-objectives; below, however, we intend to emphasize the **strategic directions** to which these perspectives must conform, in coherence with the paradigm shaped by the propagation of the driving factors of the new
Lombard sustainable economy.

+ REDUCTION IN EMISSIONS

Greenhouse gas emissions in terms of CO2 equivalent in 2017 reached 69 million tonnes, with a reduction of 20% compared to 2005, thus reaching the 2020 reduction objective ahead of schedule. However, the road to achieving The 2030 objective (-40%) implies the implementation of further incisive policies to reduce consumption and transform the energy production system from fossil to renewable.

A first indicative subdivision of the expected effort to reduce CO2eq emissions for each sector is shown in Table 2, where only the sectors for which the reduction commitment has been made within the *Compact of States and Regions are considered.*

[12] By net emissions we mean the result of limiting the emissions of climate-changing gases net of the absorption of them emissions (soil, forests, natural sinks, etc).

Sectors	Historic			Objective 2030 (-40% compared to 2005)	
	2005 (MtCO2eq)	2017 (MtCO2eq)	Variation 2017 is 2005	MtCO2eq reduce	Objective to It's 2030 2005
Indirect emissions from consumption electrical	23,8	16,1	-33%	-13,8	-58%
Of which electricity in uses Industrial	*12,5*	*7,8*	*-34%*		
Of which electricity in the civil sector	*10,7*	*7,7*	*-23%*		
Of which electricity in Transport	*0,6*	*0,6*	*0%*		
Industry (not included in the EU ETS)	7,3	6,9	-6%	-3,8	-52%
Residential and tertiary	22,7	15,8	-30%	-8,2	-36%
Transport	21,1	19,1	-9%	-5,5	-26%
Waste	3,2	2,6	-19%	-1,2	-37%
Agriculture	8,5	8,6	1%	-2,0	-23%
Total considered for the Compact lens	**86,5**	**69,1**	**-20%**	**-34,6**	**-40%**

Tab.2 Sectoral greenhouse gas emissions objectives in 2030 for Lombardy.

Reference	Quantity (Mt CO2eq) Average	per capita emission (t CO2eq/ inhabitant)
Reference emissions from 2005	86,5	8,5
2020 emissions	69,2	6,9
Emissions 2030	51,9	5,2
Emissions 2050	0	0

Table 3: net emissions reduction objectives for the Lombardy Region, excluding the ETS sector

The objective of reducing climate-altering gas emissions corresponds to a reduction of between 28 and 32% in final energy consumption compared to 2005 and to a production from renewable energy sources of between 31% and 33% of final energy consumption. energy, windows of objectives corresponding to more or less challenging scenarios which, in the development of the Programme, will also need to be appropriately weighed in terms of economic sustainability and redistributive impacts.

+ SAVINGS IN CONSUMPTION

Reducing consumption in all end-use sectors is the main *driver* of the new regional policy for the energy transition. Reduction in consumption, even before efficiency, because the energy with the greatest added value - economic and environmental - is that which is not consumed unnecessarily: it is the logic that must underlie the real transformation of life and production models.

In quantitative terms, it is estimated that final consumption by 2030 will be between 17.5 and 18.5 Mtoe, compared to the 25.6 million toe consumed in 2005, with a reduction, compared to the consumption recorded for 2017, including between 6.8 and 5.8 Mtoe, or approximately 25% of current consumption.

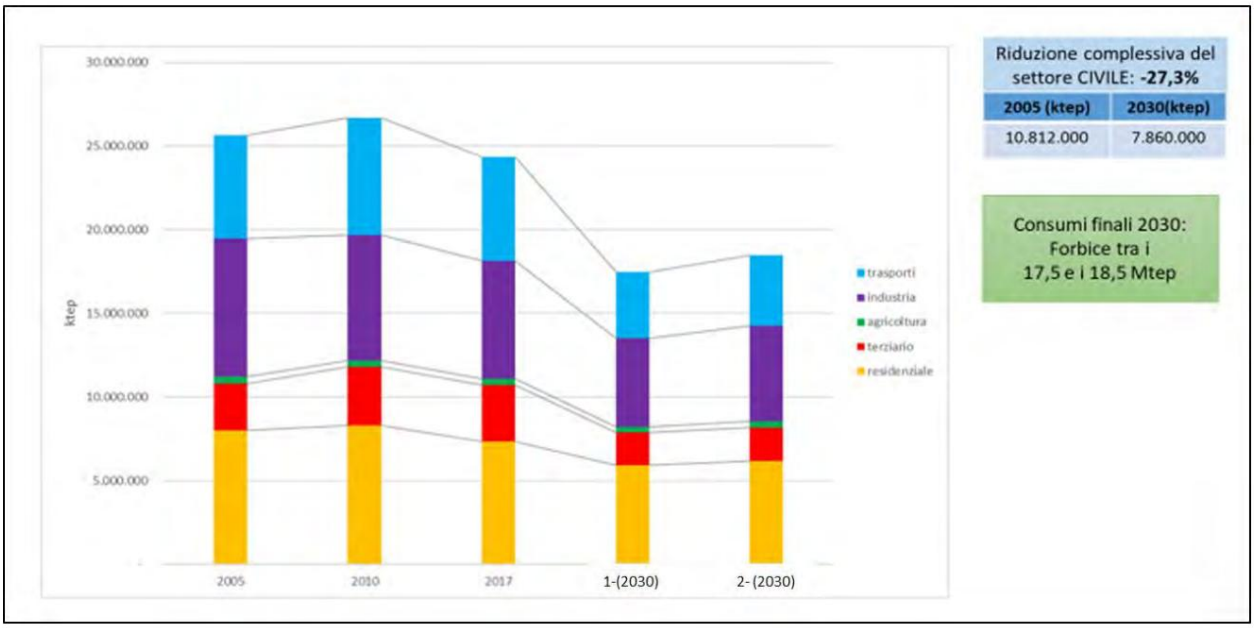


Fig.14: First hypotheses of energy consumption reduction objectives by sector *(Lombardy Infrastructure)*

Compared to the sectors that will require greater commitment, it is highlighted that the civil sector has made an important effort to improve efficiency in the last 15 years: technological evolution and the changed sensitivity of consumers open up, in this sector, concrete possibilities for achieving important reduction objectives of consumption. An even more intense commitment will have to concern the industry, transport and agriculture sectors. The latter presents an emission framework mainly due not so much to energy consumption but to agro-zootechnical practices, with however interesting prospects for increasing the absorption of CO2 from the atmosphere ("negative emissions"), both in the arable land and forestry sectors.

Emissions relating to electricity consumption mainly derive from building stock and non-ETS industry; they are equally divided between the industrial sector and the civil sector and for the latter the tertiary sector accounts for 2/3 while the residential sector accounts for 1/3. The action to reduce indirect emissions from electricity, therefore, is implemented through energy efficiency and the penetration of renewable sources into the electricity production system.

The civil, residential and tertiary sector, which absorbs 44% of final consumption mainly using gas, consists of a residential building stock of approximately 4.7 million residential units and more than 400 million m2 . The non-residential construction sector is also significant in size: 5,834 school buildings for an estimated useful surface area of 14.5 million m2 . 161.491 public housing services housing for a surface area of approximately 9.8 million m2 . to which the buildings in the commercial and industrial sector, which must be quantified through careful research and integration of various information sources.

The leading role of public construction must be safeguarded and, therefore, must be the subject of an overall efficiency plan for 2030, set out within the PREAC. This is a significant challenge that requires careful planning of action priorities, progressive stages and funding sources, considering specific initiatives for Local Authorities and for

sectors in which the Region has planning competences (healthcare, schools, public housing). To make it truly applicable, however, it is necessary to respond with specific measures to the real support needs, transversal to all public bodies in the area, aimed at:

- strengthen the ability to plan efficiency interventions and encourage the emergence of demand, also in the context of interventions dedicated to other priorities (e.g. seismic adaptation, usability, etc.),

- encourage forms of demand aggregation and create economies of scale
- strengthen their ability to evaluate project proposals and their economic, social and legal sustainability, especially when proposed to entities in the framework of innovative public-private partnership contracts and/ or contracts based on energy performance *(energy performance contract).*

In line with what is regulated by the new community directives and using the technological possibilities offered by the important land registers that the Region has equipped with over the years, the digitization of sector data will be pursued, with the introduction of the "digital building file" tool. , for the development of smart buildings and progressively greater knowledge of the consumption of public building stock.

With reference to interventions on private residential/commercial/industrial construction, interventions will be needed to amplify demand and make individuals aware of the potential for energy and consequently economic savings, as well as the financial mechanisms available, enhancing the information assets held by the Region Lombardy (Energy Cadastre of Buildings - CENED).

Efficiency measures for public and private buildings require huge financial commitments;
for this reason it is necessary to act according to economies of scale. Furthermore, it should be kept in mind that, associated with long-term investment programs, there are significant co-benefits:

ÿ Reactivation of a sector in crisis and recovery of the loss of value after the health emergency

ÿ Relaunch of the financial system towards local sectors

ÿ Correct allocation of public resources towards virtuous economic and social development models

ÿ Economic bill saving response for end users

ÿ Capital strengthening of public and private properties

ÿ Achievement of environmental and, indirectly, health protection objectives

ÿ Well-being and quality of life of the people living in the environments being improved

ÿ Active contribution to the energy independence of the country and the region (each percentage point of energy saving reduces gas imports by 2.6% - EU data)

With reference to interventions on buildings, design capable of integrating circular economy objectives must be promoted and, therefore, the use of building life cycle analysis techniques in order to pursue the objectives of reducing the use of raw materials , the reduced generation of construction and demolition waste and the sending of the waste produced for recovery.

For the civil sector, the following objectives will also be pursued:

a) in reference to the historic real estate heritage, deepen the knowledge of techniques applied to historic and valuable buildings to obtain energy improvements by establishing collaborations with the Superintendencies for support actions that enhance the application of the most suitable and innovative technologies on the heritage listed building;

b) investments in the field of energy efficiency will have to go hand in hand with those of sustainable territorial development, from a system perspective that will see the application of recent regional laws on hydraulic invariance, reduction of land consumption and urban regeneration, with the creation in particular of green areas with a significant presence of trees (tall trunks), both due to their anti-pollution function and to guarantee an ecological network also within urban centres, which can further protect the biodiversity and create a healthy and beautiful space for citizens; c) a regional training program for technical designers and certifiers accredited and recognized by the Region is necessary, to increase

the design and construction quality of architectural and urban planning interventions, in particular from the point of view of environmental sustainability.

In the context of policies relating to public residential assets, it is appropriate to link structural interventions in construction with policies on the fight against energy poverty. In fact, it is not effective to stop at mere economic support for vulnerable families to combat this phenomenon. It is necessary to intervene upstream, addressing as a priority the problem of the age and intrinsic inefficiency of public buildings and activate measures which, by redeveloping this heritage in terms of energy efficiency and integration of energy production from renewable energy sources, allow for cost savings to be achieved public to be reinvested in the measure, according to an evolved energy income model that goes beyond the bonus on the bill and raises users' awareness of saving consumption.

The level of penetration of renewable sources by 2030 must make it possible to cover between 31 and 33% of final consumption, relaunching the objective that the European Union and the State have set themselves. In Lombardy it will mean producing between 5.5 and 5.9 million toe from renewable sources, compared to the current values of 3.5 million toe.

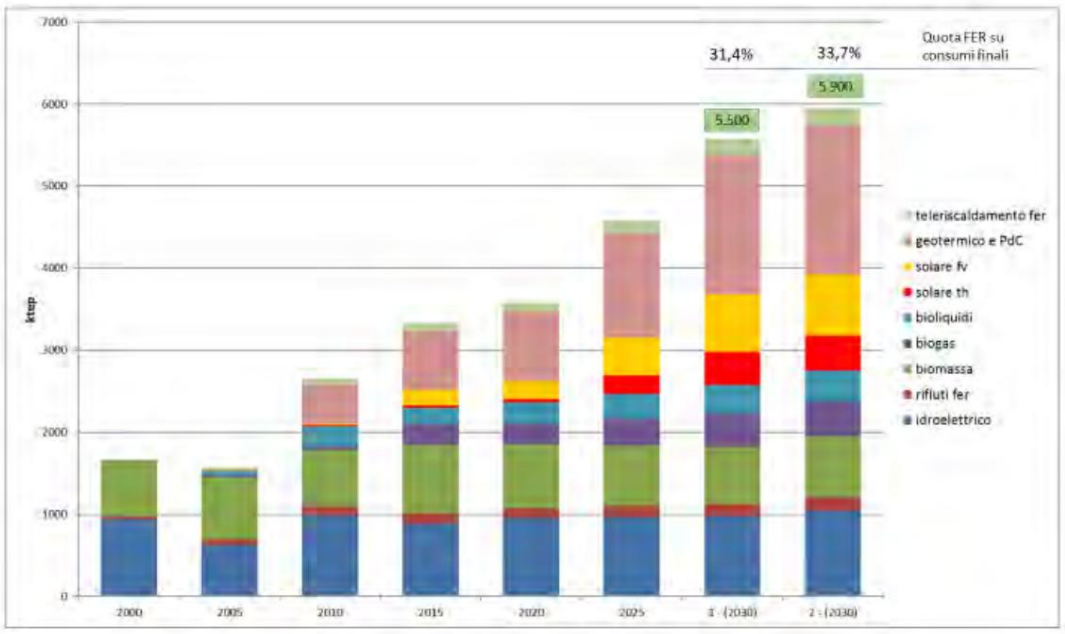


Fig.15: First hypotheses of development objectives for renewable energy sources *(Lombardy Infrastructures)*

The distribution between thermal renewables and electric renewables will be significantly affected by the different ability to impact the energy production mix on a regional scale. In this sense, electrical renewables present particularly promising development margins.

As recalled in the Integrated National Energy and Climate Plan, the interventions necessary for the growing decarbonisation of the system require systems and infrastructures that can have significant environmental impacts. The stability of the energy system requires, in fact, a series of physical infrastructures for the creation of which it will be necessary to promote forms of dialogue and sharing with the institutional representatives of the territories.

Among renewables, a more significant increase is expected from **photovoltaics** and technologies related to **heat pumps,** and from the combination of the same, in particular at the service of residential and tertiary users. These technologies are particularly suitable for inclusion in building redevelopment processes, which are the cornerstone of energy efficiency policies.

The conditions must be ensured for a significant **increase in the photovoltaic park,** primarily affecting the roofs and appurtenances of buildings and abandoned or compromised areas.
An analysis of the energy potential offered by the roofs and appurtenances of buildings - private and public, for domestic, commercial, industrial and service use - must be developed, especially in public and private complexes that can be classified as "large consumers" with a significant potential for self-consumption in its various forms (single, collective, energy community).
At the same time, an action must be launched to enhance the potential offered by the "attractive areas", consisting of landfills or closed and restored landfill lots, quarries from abandoned areas, without further extractive exploitation with completion of environmental recovery and restoration activities, from abandoned industrial areas and from areas with certification of successful reclamation or closed reclamation process, including Sites of National Interest. This activity will also be able to define an initial mapping of degraded agricultural areas in order to estimate their potential for the construction of large-scale photovoltaic systems. This analysis of possible solar source development scenarios will be fundamental in the regional definition activities

"suitable areas", envisaged by the PNIEC according to an operational regulation awaiting definition by the State. At that time it will be necessary to evaluate whether to confirm or modify the system of "unsuitable areas" defined by PEAR in 2015 while simultaneously evaluating the opportunity to introduce greater protections for Lombard agricultural land in the PREAC, making the limitations more stringent in relation to the possibility of install "ground" photovoltaic systems on agricultural land.

With reference to photovoltaic systems, it will be appropriate to start an action to stimulate the maintenance and maintenance of the efficiency of existing systems, combining monitoring tools, authorization levers and favorable conditions especially for small systems and, where possible, encouraging the repowering of the systems and /or their integration with other technologies (for example the installation of heat pumps in properties already equipped with photovoltaic systems for electricity production).

By following guidelines that aim to maintain a minimum level of performance of existing systems, it will be possible to look at the development of an industry specialized in plant maintenance in the Region.

Potential tools include mechanisms for:

- promote the repowering and revamping of existing plants, through simplification of authorization processes, within the limits of regional competences;
- prepare an *alert* service for the competent authorities in reference to conditions of particular inefficiency;
- link authorization titles and maintenance of minimum performance levels.

Furthermore, it will be appropriate to evaluate the progress of knowledge regarding the potential of ***agrovoltaic*** technology and the possible possibilities of implementing innovative agronomic management projects integrated with energy production, avoiding the subtraction of agricultural surfaces and guaranteeing the protection of use by agricultural purposes of the soil, as well as the continuity of crops.

Solar **thermal** has decidedly more moderate margins for growth compared to photovoltaic since, being less economically profitable for the same amount of energy produced, it does not have the same potential for penetration into residential and tertiary sectors. Despite this economic cost-benefit gap, a significant increase is still hypothesized, compared to the current situation, by virtue of the positive integration with other renewables both in the context of new buildings and as regards energy requalifications.

District heating (with district cooling) can play an important role in a scenario of evolution towards renewables which allows the transformation potential to be fully exploited.

District heating, as an energy infrastructure capable of recovering and efficiently conveying large quantities of waste and renewable heat across urban areas, is recognized internationally as the technology of choice for the energy transition towards a decarbonised system. The ability to be integrated with various centralized heat sources, waste and renewable heat recovery, which benefit from the economy of scale effect and the peculiarity of being distributed over the territory allowing synergy with local resources, allows it to be considered a stable technology and with very high shares of renewable energy. At a regulatory level, the European directive on energy efficiency includes it among the

efficiency technologies and has found strong development in Northern European countries where it covers more than 50% of the heating needs of the civil sector and is mainly powered by recovered and renewable heat.

By pursuing a competitive end-user cost compared to an individual solution, iI district heating requires important infrastructure investments which must be evaluated and addressed according to system logic with companies and with a long-term prospective vision, starting from the expansion potential of Lombardy's district heating cities, with a good possibility of increasing the recovery and renewable share.

Data obtained from analyzes by AIRU, UTILITALIA and the Polytechnics of Milan and Turin13, compared to a heating requirement in the civil sector of approximately 81 TWh, a share of approximately 40% (32TWh) is potentially suitable for being connected to a district heating network . In light of this, the heat sources in the Lombardy region have been mapped which could be used to cover part of the district heating demand identified in the following mix:

- 40% waste heat recovery (industrial processes, thermoelectric, waste water treatment) • 27% from renewables (biomass + geothermal + solar thermal) •
  33% with cogeneration mix

Among bioenergy, significant sources for the Region are solid biomass and biogas.

As highlighted in the regional energy balance, **biogas** is the second renewable source for electricity production. The production park consists of almost 400 plants, for an installed power of 285 MW, 75% powered by agricultural and livestock waste and the remaining 25% by Organic Fraction of Municipal Solid Waste (FORSU). These plants correspond to a regional supply chain worth 2 billion in investment and on average 300 million/year in management and maintenance. The supply chain will be affected by the closure of national incentives, which will see a peak concentration of expiry in the period 2026-2028 which will affect 86% of the plants. It is therefore essential to define a strategy for maintaining the installed power that takes advantage of all the different options available (conversion to biomethane of individual plants or district systems, flexible use for balancing the national electricity production system, production of synthetic methane with hydrogen from electric RES and CO2 present in biogas, district heating networks) and is strongly connected with the prospects of the Regional Plan towards the circular economy under construction. The topic has implications for the economy of the agricultural sector since these plants represent an important diversification of the income of Lombard farmers.

With reference to **solid biomass,** for the purposes of domestic use, a decisive renewal of the installed thermal park must be aimed at in order to limit its impact on air quality. The use of biomass in the civil sector has a significant impact on air quality, which must be taken into account in an integrated approach to climate and air quality issues.

Good development potential must be reserved for this technology in the Alpine and pre-Alpine areas, where this source, if integrated into the appropriately incentivized forest-wood-energy chain, can represent an element of forest management and, consequently, defense hydrogeological, as well as the pivot of a local economic system that can counteract the phenomena of

[13] Preliminary data from the study “Evaluation of the potential for diffusion of efficient district heating on the national territory including new generation systems with waste and renewable heat sources” AIRU-Utilitalia-PoliMi and PoliTo (2020).

depopulation of mountain areas. Local district heating networks in such areas can be an active part of new forms of energy communities.

Hydroelectricity has limited margins for growth if we consider the current starting point, which sees one of the most consistent and efficient installed fleets in Europe.

Alongside this consideration, it is necessary to understand the potential and impact of the process of renewing expiring hydroelectric concessions. The art. 12 of Legislative Decree 79/1999, as recently amended by law. 11 February 2019, n. 12, gives the Regions the power to regulate the methods and procedures for assigning concessions for large water diversions for hydroelectric use and their performance. LR no. 5 of 8/4/2020 regulates the methods for carrying out the assignment procedures, the deadlines for starting the procedures, the admission and assignment criteria, the participation requirements and the evaluation criteria of the project proposals. By virtue of this new scenario, important interventions could be generated for the repowering of existing plants as well as for the sustainable management of Alpine and pre-Alpine reservoirs. Furthermore, following the technical-economic characterization process of each plant subject to the tender, underway by the Region, it will be possible to know minimum improvement margins in terms of energy, generation power and producibility of the complex of works and evaluate the integration into the objectives of granting concessions and, therefore, planning.

It is necessary to consider in all phases: the aspects of maintenance and protection of the territory, the short and long-term hydrogeological protection, the protection and valorisation of the water resource, the respect of vital water flows and the related employment prospects.

Table 4 summarizes the forecast developments for each individual renewable source.

Technologies powered by RES	Forecast	Penetration of interventions	Increment
Hydroelectric	Minimum increase in electrical power compared to the installed power	Increase of approximately 6% compared to the power installed to date	300 MW
Bioenergy	Solid: limited increase linked to local district heating networks Biogas: maintenance of installed power post-incentives with possible conversion to biomethane and/or through flexible systems	Solid: Increase of approximately 20% compared to the power installed to date Biogas: Stabilization of installed biogas capacity	30 MWh
Heat pumps	Strong increase in all heat pump technologies	100% increase compared to current power	800 MWh
Solar photovoltaic	Strong increase	Increase between 150% and 240% compared to the installed power	3.400 – 5,600 MWel
Solar thermal	Strong increase	250% increase compared to installed power	100 MWh

Tab.4: RES forecast developments by technology

In reference to the forecast development objectives of district heating, the aim will be to achieve a share of 10% of the potential identified in the Lombardy region and corresponding to 3.2 TWh (+70% of the current share of district heating in Lombardy equal to 4.4 TWh) powered by waste heat, cogeneration and renewable sources additional to those identified in table 4.

The use of intermittent renewable energies requires adequate availability **of electricity storage;** at the same time, energy storage enables the increase in the incidence of renewable sources in the industrial, residential and transport sectors. The economic relevance of storage is significant: according to Assolombarda, extrapolating for Italy the data of investments expected from the USA for the period 2020-2024 of 33.6 billion dollars, in our country the development of the sector is worth between 4 and 5 billion euros. The PNIEC places the increase in storage capacity mainly in the Centre-South.

In the regional context, two main aspects deserve attention:

ÿ the evolution of a distributed energy storage scheme, a programmatic line already launched by concentrating financing on domestic systems or systems connected to public administration buildings, and which could also be strengthened by the storage role of electric vehicles when *Vehicle* technology expands *to-grid,* technology that allows electric cars to be used to input or receive electricity into or from the public energy distribution network in order to contribute to its stability, when necessary;

ÿ industrial research prospects on electrochemical processes (electrochemical cells), chemical processes (accumulations of substances in gaseous or liquid forms), thermodynamic processes (compressed air accumulations, phase changes of specific materials, thermo-electrical processes), as well as in the field of recovery of valuable battery components. These sectors have wide margins of penetration, significant availability of financing in Europe and ease of entry into the market for a very favorable demand context.

With regard to the issue of **energy security** - without prejudice to the competences of the State and the entity managing electricity transmission, the evolution of the national network and the security of supply - the Lombardy Region is affected by the coal *phase-out* process by 2025 and from the process of grid adaptation to the safe integration of non-programmable renewable energy sources.

In reference to the objective of eliminating coal as a fuel for energy production, in the Lombardy Region there is only the "La Marmora" power plant in Brescia equipped with 1 of the 3 multi-fuel boilers, which can be fueled by both gas and coal. The power plant is a cogeneration plant serving the district heating network which covers 70% of the demand of the population of the Municipality of Brescia. The plant management company (A2A Spa) has developed an action plan, an integral part of its own broader decarbonisation programme, which provides for the cessation of the use of coal which has already taken place and by the end of 2022 the compensation of production energy through increased heat recovery from waste-to-energy plant fumes, without modifications or increases in potential, increased recovery of thermal waste from steel production processes in the Brescia area, creation of thermal storage systems in power plants.

To accompany the *phase-out,* the National Plan also envisages the construction of 3 GW of new gas capacity, 50% of which with open cycle turbines, so-called *peaker plants,* which allow rapid activation on demand and participate in the "market of capacity" a mechanism with which the national grid manager Terna procures capacity through long-term supply contracts awarded through competitive auctions.

This national planning forecast, which is not accompanied by specific assessments of coherence with regional planning at the moment, has triggered requests for the construction of new power plants in the regional territory. These new plant proposals should be inserted into an overall new generation context, capable of taking into account the overall need to satisfy the energy needs of the regional territory and compatibility with the context
local.

The verification of the environmental compatibility of these requests is carried out by the Region in the context of expressing the opinion in the national Environmental Impact Assessment procedure.

With reference, however, to regional electricity needs, we observe the **presence of an adequately sized gas production plant park,** which sees the thermoelectric plants underutilized due to the market dynamics and the consequent level of energy prices, which favor imports compared to production.

Lombardy certainly has a significant share of the need to adapt the network to the penetration of renewables for which peaker plants represent a partial response and, therefore, cannot abstain from evaluating their implementation. However, in light of the context described so far, it is appropriate to define **planning criteria that exclude the provision of installing new systems and favor even partial transformation interventions of existing systems.** Furthermore, for the purposes of environmental compatibility, transformation interventions must be favored for plants that operate in cogeneration conditions (heat recovery), compared to those that operate in a dissipative regime, as well as plants located in areas other than those critical for the quality of the air (dgr 3934/2012).

+ INNOVATION, + INVESTMENTS, + BUSINESS

Innovation can make the energy transition an unprecedented economic opportunity. The energy supply chain, which pervades all economic activities, and its innovative transformation is a capital for the territory. Assolombarda estimates this supply chain in Italy at 62 billion euros, 11 billion for Lombardy, with a multiplier greater than 2 (each euro of added value generated activates another in the rest of the economy), which becomes 2.2 for Lombardy for the superior internal integration and greater completeness of the supply chain.

The transformation of the supply chain required by the decarbonisation objectives of the next decade must aim to increase the value of the Lombardy energy ecosystem. By virtue of the change in the expected energy mix, with an increase in renewables and structural adaptation of networks (including automation and control), energy infrastructures will gain importance
increasing

Confindustria Energia has estimated private investments by companies in Italy in energy infrastructure of 96 billion euros over the next decade. Among others, 29.2 billion are estimated for energy production plants from renewable energy sources, 14.1 billion for the electricity grid, 10.9 billion for efficiency and mitigation connected to activities that use hydrocarbons and another 10, 9 billion in refining for innovative products such as biofuels.

Again with reference to investments, the PNIEC establishes an additional need with respect to current policies for the next decade in technologies, processes and infrastructures to achieve the identified objectives of 184 billion euros; in proportion to the GDP of the
Lombardy, it is estimated that for the decade 2020-2030, similar objectives will require approximately 34 billion additional euros in Lombardy compared to current investments, of which approximately at least 5 for development
of photovoltaics.

We are, therefore, faced with a fertile substrate for investments which can be further strengthened by the resources of the European economic programming of the structural funds for the period 2021-2027, intended for the transition towards green and fair energy, adaptation to climate change and to an intelligent and innovative economic transformation.

The energy transition path must focus on competitiveness, both in the direction of strengthening the agricultural and manufacturing supply chains, and in the consolidation of assets that make Lombardy an attractive territory for new business investments in the green *sectors*
economy.

This is the case of the sector of renewable sources for the production of heat as well as electricity, such as agroforestry biomass, in which the main players are predominantly Italian, in some cases specifically Lombard. For example, almost all the companies that own and manage district heating systems with electrical co-generation are Italian (97%), as are those that deal with the procurement and supply of raw materials (for 95%).

Even in the field of design and installation of new systems and in the production of the components of which they are composed, the role of "made in Italy" and "made in Lombardy" is decidedly relevant.

Furthermore, Lombardy is an elective land for manufacturing *clusters* and a laboratory for potential technological districts in the *green sectors,* just as the Lombard quotas of professionals and companies operating in the segments of design, installation and management of systems are widespread and numerically significant. , as well as in the marketing of the technologies making up the supply chains
themselves.

According to the GREEN ITALY 2019 report, in the period 2015-2018, 78,000 Lombardy companies made *green* investments for 77,691 million (18% of the national total) employing 660,000 work units (21.3% of Italy's green jobs).

Lombardy is the main national player in the production of new materials for construction and the energy efficiency of existing buildings. Lombardy is the leading experience in Italy for energy recovery through waste treatment, which has seen international experiences established in the territory in the creation of urban district heating networks, which combines the affirmation of an important microeconomy with an efficient model of management of a complex cycle (waste) and energy supply (urban district heating).

The post-health emergency context has imposed new challenges and new development models on the production and research fabric, which are added to an already existing mutation path that pushes towards decarbonization and adaptation to climate change, supported by the diffusion of technological and digital innovation.

This context places, today more than ever, innovation as a driver of the competitiveness of the Lombardy production and economic system.

The objective of the Program, therefore, must not only be to strengthen the characteristic and local supply chains described, but to open our gaze towards a new design of reality which sees the territories connected and the resources and economic activities managed through smart technologies in a network of relationships capable of offering broad opportunities, beyond the local.

This key to understanding the ongoing transformation requires PREAC to operate on some lines of action:

ÿ build a solid system of relations between public and private that allows the identification of innovative production realities to support the evolution of;

ÿ promote the use of resources that accelerate the demand for technology and innovative products, especially in the construction sector, including professional services with high added value rooted in the Lombardy region

ÿ strengthen the existing production fabric with the push towards new emerging strategic assets.

Some of the **strategic assets** to focus on to achieve technological leadership conditions are:

- production from renewable energy sources (4th generation district heating, geothermal energy low enthalpy, bio-fuel, energy storage) and digital management of the systems;
- decentralization of production and dynamic and interactive interaction between producers and consumatori *(smart meter, blockchain)*
- energy efficiency in the civil and industrial sectors (technologies for insulation in the building sector, solar integrated into the building, integrated energy management in the production sector, innovative energy recovery from waste management systems)
- smart management of energy systems (smart urban and industrial districts, energy communities, Vehicle to Grid (V2G) as a bidirectional energy exchange technology between the grid and electric vehicles)
- hydrogen, on a short range for penetration into the transport sector and on a medium-long range as a technology capable of contributing to the transition by increasing the flexibility of the system with power-to-gas, large-scale storage and the production cycle -conversion-use
- decarbonisation of transport (biomethane also for transport, electrification of the eHighway motorway network , induction charging) and production activities (progressive elimination of coal from cycles where sustainable)
- defense technologies against climate change through the capture and sequestration of CO2 in agricultural soils and in energy-intensive industrial systems.

Technological innovation processes must favor maximum returns from the use of the primary energy resource, counteracting the risk of speculative trading.

From a prospective perspective and as also foreseen by the PNIEC for the national energy system, the energy transition path will pass through a "hybrid" electricity-gas system, which will see the development of renewable gases (biomethane, green hydrogen and synthetic methane) and the diffusion of alternative fuels in transport. The research sector, therefore, will have to be directed towards gas and

non-biological renewable fuels. But not only; the evidence regarding the progressive reduction in the costs of electrolysis could make so-called "green" hydrogen, i.e. produced exclusively from renewable sources, a precious ally for de-carbonizing the energy mix.

In fact, having hydrogen obtained from renewable electricity production in periods of excess production is an opportunity that can be directed towards the decarbonisation of energy-intensive industrial sectors, or it can be used to power long-distance commercial transport and trains powered by fuel cells, or to mix it in variable percentages in existing gas networks for multiple uses (heating of buildings, industrial processes).

Finally, the new generation system will be characterized by strong growth in non-programmable and small-scale renewables, with growing management complexity for the network and an equally growing demand for flexibility for balancing.

In reference to **existing industrial assets,** the prospect of decarbonisation of the sector and the increase in energy recovery, in perfect alignment with the directions of the new Plan
Regional towards the circular economy under construction:

- the use of secondary solid fuels (CSS) deriving from waste will be promoted in Lombard cement factories, replacing fossil fuels such as pet coke, evaluating the extension of their use also in the steel industry, also requesting the necessary changes to the "end of waste" legislation, replacing part of the fossil coal used in the fusion cycle. With reference to favoring the fate of CSS in cement factories, the use of waste that is not otherwise recyclable in cement factories, in place of pet coke, must be subordinated to the production needs of the sector and used only in those plants that have undergone risk assessment. 'environmental impact.

- the path of progressive adaptation of Lombard waste incineration plants to the energy efficiency criteria contained in the updating of the best available technologies (MTD) identified with the EU Implementing Decision 2019/2010 will be defined, which provides for the adaptation of all installations by 2/12/2023.

Innovation will have to be imbued with new skills and opportunities that come from the innovative technological frontiers of big data, artificial intelligence, circular economy, industry
4.0.

Finally, taking into account that companies in the energy supply chain are already knowledge-intensive, we will have to focus on the propagation in the manufacturing world of skills capable of bringing innovation and supporting the advancement of new professionalisms and the renewal of existing professionalisms. This will allow us to intercept the opportunities offered by emerging strategic assets and the effects of rapidly improving technologies.

The definition of the macro-objectives of the regional program will have to consider the economic, social and employment effects, in the medium and long term, in the various sectors involved in the energy and ecological transition process, with evaluation of the employment impacts.

As part of the process of just ecological and energy transition, it will be appropriate to introduce dedicated protections for workers, starting with retraining and relocation paths through collective bargaining.

As regards the new skills and professional figures required by the future transformation process, it is necessary that adequate planning is carried out as the result of a constant relationship between the production system and the professional education and training system.

Climate change and the profound loss of biodiversity and resources have marked the crisis of the global economic, financial and consumption model which is suffering a further shock from the global health emergency in a cause-effect relationship that needs to be studied; in an attempt to build new growth models and overcome the risk of definitive competition between global and local, it is necessary to strengthen the relationships between civil and institutional infrastructures and reconnect the territories in bidirectional network structures within an already strong and collaborative regional dimension .

Reinvigorating the spatial-territorial dimension in policies can have significant benefits if the local capacity to seek integrated solutions and with less vertical approaches to the issues is taken into account as well as the strengthening of the capacity for action that the Region can have if consensus and capacity is broadened participation of the territories in achieving the objectives.

In the review of the global dimension, the regional - but also macro-regional - territories
those that are internally more cohesive and generative will be more competitive overall.

The necessary territorial management systems must be capable of adapting to changing economic, social and environmental conditions and to changes also in the sphere of human values, given that the ongoing mutations also have the character of cultural challenges.

The energy transition is inserted in a context that is overall undergoing transformation under the pressure of other technological, digital, economic, ecological and demographic transitions.

The social context is the subject of a real revolution governed by access to digital tools and services, a net increase in the collaborative sharing economy and the affirmation of the self-producing dimension of energy.

New models of mobility, tourism, co-working, co-living, business, often even micro, based on the sharing of goods, services, information and skills are changing the culture of consumption and production, shifting the boundary between public and private in direction of “dis-ownership”.

And the local demand for the construction of energy communities fits into this perspective, around which different components of the territory can be grouped: public administration, businesses and citizens.

The Lombardy Region, in collaboration with the competent SIREG structures, supports and promotes the creation of energy communities by supporting - including financially - territorial initiatives, their possible aggregation and guaranteeing technical assistance.

The Region intends energy communities not only as a means of increasing the widespread generation and self-consumption of energy from renewable sources but also, from a subsidiary perspective, as a tool for direct participation of the local level in the energy transition as well as for combating the growth of conditions of energy poverty.

The PREAC, taking into account the renewable resources available at a local level, will have to push the accelerator on access to "0 km" energy, possible and foreseen by the RED II directive, through the energy communities that can represent the pillars of a resilient energy system.

Precisely with regard to the incisive development of renewables, as the main tool for decarbonisation of the regional energy production system, it must be pursued by enhancing the availability of local resources and the territorial vocation, guaranteeing coherence with the evolutionary scenarios of climate trends that influence the resource availability.

Therefore, **the PREAC must outline the regional measures implementing the objective of penetrating renewable energy sources for territorial contexts.** Also in order to guarantee facilitating conditions for the alignment of regional policies, as better represented in the following chapter, the reference contexts that best lend themselves to this declination are the territorial systems identified by the Regional Territorial Plan: the mountains, the piedmont system, the metropolitan system, the irrigated plain.

Finally, in relation to connectivity between territories, it will be necessary to look at *smart* development **of the urban environment in a new key.**

Cities are extremely complex systems, with a very fragile balance, highly energy-intensive and large emitters of climate-changing gases, so it is best to start from their *"smart"* transformation to encourage better integration into the network of renewable energy source systems, the rationalization of consumption energy, reduction of CO2 emissions and a better level of service to the end user.

However, the Lombardy Region and the whole of Italy are not characterized by megacities, but by Municipalities and many medium or small cities which, as has partly happened for medium-sized cities at European level, have remained excluded from this important transition process and renewal. To date, a change of scale has been missing in the topic of the smart city; compared to large metropolises, there are very few cases in which the principles of the smart city have been applied to medium-sized cities.

These small polarities are characterized by a strong local identity; so for the current society of collaboration, sharing and networks, smaller cities must cooperate by networking and leveraging available resources.

For this reason the smart city model must be adapted and extended at a territorial level, building a model for the *smart region,* understood as an intelligent city spread over a territory, with a long-term development and innovation perspective, moving from intelligent planning of cities to intelligent territorial planning.

In this way it will be possible to build an intelligent infrastructure on a territorial scale, connecting multiple poles and capable of uniting the communities of the territories.

The **transformation of mobility,** then and even more so in these places, will be easy to take root and will strongly contribute to modifying the territories and the relationships between them; as well as being directed towards less polluting vehicles, increase in collective and soft mobility, improvement of connections on a regional scale, transformation towards sustainability of the goods transport system,

improvement of the public transport offer, implementation of integration between the different transport modes - according to the shared objectives of the Regional Plan for Air Quality Interventions (PRIA) and the Regional Mobility and Transport Plan (PRMT) - mobility must be oriented towards energy transition objectives which aim **at the use of more efficient energy carriers and the integration of electric vehicles into the electricity distribution network, such as**

contribution to optimal load balancing.

Spread of energy communities, penetration of renewables for local macrosystems and *smart Region* as a widespread smart city are the levers of transformation and empowerment of territories in achieving the PREAC objectives.

+ RESILIENCE TO CLIMATE CHANGE

The challenge of climate change also forces the regional energy system not only to share with other sectors a mitigation strategy aimed at achieving the goal of zero net carbon emissions by 2050, but also to enter into an adaptation path that makes it less vulnerable to the impacts of the climate and more resilient in the face of the evolution of energy demand, the penetration of renewable technologies and the conditions imposed by the markets for the supply of the necessary raw materials.

The impacts of climate change will manifest themselves in terms of thermal anomalies, variations in interannual precipitation regimes and an increase in the frequency and intensity of extreme meteorological events capable of increasing the risk factors (economic, environmental and management) of widespread energy systems on the regional territory.

First of all, the *patterns* of supply and demand for both electrical and thermal energy will be affected , as will the *performance* of these energy production systems based on renewable sources which will be increasingly required in pursuit of the objective of a gradual decarbonisation of energy resources.

Beyond the more general adaptation objectives, referring to a plurality of sectors and sectors, the resilience approach requires, as far as PREAC is concerned, the consideration of at least three crucial aspects:

ÿ **The supply and structural factors of development of the energy system.**

A sustainable and low-carbon energy system must first of all guarantee its resources in terms of raw materials necessary for its operation (natural gas during the long transition phase towards complete decarbonisation, available renewable and recovery sources, components and interoperability of *smart grids).* Then it must be able to be flexible enough to make the most of the know-how and the evolution of technologies, without becoming rigid on technological solutions that are too binding, and it must have the ability to protect against factors of economic-financial and geo-political instability capable of compromising its competitiveness.

ÿ **The safety, sustainability and flexibility of distribution networks.**

The development of non-programmable renewable electrical sources (solar photovoltaic and, in part, hydroelectric) requires carefully evaluating the suitability of distribution networks. Consistently

with what will have to be developed at a national level, regional policy will have to focus on increasing flexibility (for example through electricity storage capacity and demand management) in continuity with what has already been done up to now - on the promotion of communities of energy and *smart grids* and on the development of electric mobility as potential grid balancing measures.

ÿ **The assessment and management of risks (and opportunities) deriving from natural and technological factors susceptible to the impacts of climate change.**

For the hydroelectric sector it will be necessary to coordinate its optimization and development forecasts with the expected changes in the rainfall regime and, more generally, evaluate the impacts of temperature increases on summer and winter air conditioning needs.

For this last area, it will be essential to work in close collaboration with the Regional Agency for Environmental Protection for the definition of a set of climate indicators to be monitored over time using the existing regional meteorological network, as well as for the production of climate projections of the parameters and of climate indicators to be used for the construction of impact scenarios on the regional energy system and, consequently, highlight the need for adaptation of the latter to the effects of climate change.

Naturally, strengthening Lombardy's resilience to climate change does not only involve improving the adaptive response of its energy system, although this is essential for the safety and operation of its components.

The so-called "hard" adaptation measures must be accompanied by ecosystem-based measures, i.e. actions aimed at sustainable management of the territory through conservation, recovery and restoration of ecosystem services. This approach could represent an effective and at the same time cost-effective ally.

Resilience, therefore, must also be pursued with measures aimed at the development of **agricultural models that are conservative and improve the ecosystem functions of the soil resource** and are more diversified, at the conservation of biodiversity, at environmental restoration, at the recovery of degraded areas and at improving the management of forest areas, which make up relevant adaptation strategies.

The sustainable management of agricultural systems through **new agricultural, agronomic and zootechnical practices** that mitigate emissions and allow soils and crops to respond to the effects of climate change, contributes to increasing productivity, improving the provision of ecosystem services through the sequestration of carbon and therefore reduce CO2 emissions
atmosphere.

The emissions of climate-altering gases, in particular methane and nitrous oxide, for which the contribution of the sector is significant, will be addressed with containment measures in synergy with the sectoral planning on the matter with the regional Air Quality Intervention Plan
(PRIA) and with the financing lines of the Rural Development Plan (PSR).

The important woodland and forestry heritage is also an important ally in the fight against climate change as well as in soil protection, and urban forestation, understood as the exponential increase in green and tree-lined surfaces in the urban and peri-urban spaces of cities,

today it could be, also for Lombardy, one of the key tools to reduce the calamitous effects of climate change.

As part of the needs for **sustainable urban regeneration,** governed by the recent regional law n.18 of 26 November 2019, the recovery objectives of the abandoned building stock and degraded, underused or abandoned areas must be aligned with the PREAC objectives of energy requalification of buildings, development of energy production systems from renewable energy sources and restoration of ecosystem functions, all with zero ecological soil balance.

A reflection is needed regarding **food production and consumption.** At a global level, the agri-food production sector determines approximately one fifth of climate-changing gas emissions. In Lombardy this contribution reaches 11%, equal to approximately 8.5 million tonnes emitted per year (INEMAR 2017 data). In reality, the entire sector also includes pre-production activities (feed, structures,...) and post-production (packaging, transport, transformation,...). The soil contains a large quantity of carbon (123.8 million tonnes in the first 30 cm) and the agricultural practice of deeply plowing the soil mineralizes the stored carbon, accelerating the release of CO2 into the atmosphere. At the same time, the use of nitrogen-based fertilizers generates emissions of nitrous oxide, a gas with a climate-altering power 300 times higher than carbon dioxide. In Lombardy it is estimated that the contribution of nitrous oxide corresponds to 36% of greenhouse gases. Intensive farming also has a strong impact, resulting in methane emissions, 23 times more climate-altering than CO2. In Lombardy, methane from agro-zootechnics contributes to 59% of the total climate-altering gases from agriculture.

However, agriculture can play an important role in strategies to combat climate change. An example of a new green business model is represented by **carbon sequestration in soils ("carbon farming",** see EU Communication *"FarmToFork"),* which through the removal of CO2 from the atmosphere can contribute to climate neutrality objectives and can be promoted , both through the intervention tools of the Community Agricultural Policy (CAP), and through public "carbon market" initiatives that can be activated at a local level. The increase in carbon in soils is also closely associated with the improvement of their functions and the generation of ecosystem services (erosion control, regulation of hydrological flows, support for biodiversity) which, in addition to the mitigation effect of climate change, are crucial for adaptation to its impacts and for the development of more resilient territorial and rural systems.

The agricultural and forestry sector can then continue to perform an important function in producing energy from renewable sources and reduce emissions of climate-altering gases through the improvement of cultivation and breeding techniques. Greater impetus can be given to the use of local forest biomass in the construction and wood processing industries.

Downstream of the food supply chain, a further negative element on the climate is **food waste,** a significant part of which occurs in homes. At a family level, food waste is estimated to be around 700 g per week. In Lombardy this leads to waste equal to approximately 365,000 tonnes per year. Alongside this, we must consider the waste linked to the supply chain, which amounts to approximately 20 kg/m2 of commercial surface, equal to approximately 55,000 tonnes per year. Overall, the figure reaches 420,000 tonnes/year of food lost *(ARIA SpA calculations based on Waste Watcher - Last Minute Market Observatory data).*

Alongside this, a further important aspect to consider is the lifestyle of consumers, which also includes food consumption. In fact, considering for example average estimates of annual per capita consumption (source ERSAF, Meat Observatory), equal to 17.1 kg for cattle, 1.8 kg for sheep, 21 kg for poultry, 30.7 kg for pigs, the emissions " shadow" associated with this lifestyle would oscillate (considering a high variability due to differences in the diet on farms, in the breeding regime, in the geographical areas, etc.) between approximately 5.6 and 6.8 million tonnes of CO2

equivalent. This value is close to the emissions of the entire Lombardy agro-livestock sector.
(ARIA SpA elaborations on ERSAF data, CREA Center for research in agriculture and analysis of the agricultural economy – 2016 Report Italian zootechnics and climate change mitigation).

The carbon footprint of meat and dairy products is at least 10 times higher than that of vegetable products, so it is clear that a dietary style that reduces meat consumption and shifts towards richer diets in vegetables, legumes and fruit can make a decisive contribution in the fight against climate change at a global level (replacing one meat-based meal per week with one based on a more Mediterranean diet can lead to a saving of 180 kg CO2 /year pro- you understand). Even in this case, however, it is important to keep in mind that the topic is complex and that just changing eating habits does not always necessarily translate into direct benefits for the climate. For example, it has been calculated that the consumption of 1 kg of fruit imported from New Zealand or South America, if transported by air, leads to higher CO2 emissions than that generated by 1 kg of meat or cheese produced in Italy or Lombardy. Similarly, it should be considered that Lombardy agriculture stands out for its technological efficiency and this often leads to emissions per unit of product that are lower than those of less intensive production systems: it is no coincidence that the carbon footprint of milk in Lombardy is today 1.7 kg of CO2 emitted per kg produced, while it was 3.6 kg/kg 50 years ago, when livestock farming was less productive and less advanced.

Ultimately, it is necessary for the evolution of the population's diet to be accompanied by actions aimed at preserving the most suitable agricultural soils, developing cultivation models capable of maintaining high quantitative and qualitative standards while reducing environmental impacts, and encouraging more local consumption of food (shorter supply chains), intervening on transport which significantly contributes to final emissions (currently, 98% of agricultural production is transported at a distance greater than 50 km from the place of production), and finally intervening on all post-production phases -collection, starting with packaging, which in turn affect the overall emission picture.

B.2 THE MACRO-OBJECTIVES OF THE PROGRAM AND THEIR SECTORAL DECLINATION

The new regional energy and climate programming, included in the new set of strategic directions just described, will be focused on the macro-objectives:

1. Reduction of consumption by increasing efficiency in end use sectors
2. Development of local renewable sources and promotion of self-consumption

3. Growth of the production system, development and financing of research and innovation service of decarbonisation and the *clean economy*
4. Adaptive and resilient response of the Lombardy system to climate change

This chapter proposes a reading of these macro-objectives from another point of view: using a matrix, they have been broken down in relation to the traditional civil, industrial, agricultural and transport sectors, to which it was deemed appropriate to add the section of individual behaviors, in consideration of the important contribution expected with respect to a new vision that focuses the program on the theme of awareness and participation of individuals as well.

Sectors	Macro-goals	Increased efficiency in end-use sectors	Development of the local renewable sources system and promotion of self-consumption	Growth of the production system, development and financing of research and innovation al service of decarbonisation e of the clean economy	Adaptive and resilient response of the Lombard ai system climate changes
Private residential		Maximize and optimize private investments in the sector of profound building redevelopment.	Predict and support development in the ->photovoltaic ->domestic heat pumps sector	Agreement with the construction sector for the relaunch of energy redevelopments, which are primarily profound.	
		Spread knowledge of existing tools to finance energy efficiency (national and regional incentives). Maximize Amplify the relaunch of the tool in the communication field of the ecobonus strengthened by the State in post-health emergency relaunch policies	->low enthalpy district heating powered by geothermal energy O idrotermia; ->domestic storage systems	Support private companies that invest in private residential also through the sharing of data obtained from regional DBs (knowledge system at the service of the economy).	
			Promote widespread generation and self-consumption.		
		Activate policies to fight energy poverty for incompetent individuals outside the context of public residential construction.	Experiment with temporary national regulation on energy communities in the context of condominium buildings		
Public residential		Relaunch of support for EELLs for the in-depth redevelopment of public residential housing with funding sources mainly to be found in new 2021-2027 and in the mechanisms of also national support *(Thermal Account e Self-consumption)*	Provide for the mass inclusion of renewables in the context of the in-depth redevelopment of buildings, even if not aimed primarily at the efficiency of European POR-FESR energy programming. Priority -> photovoltaic sources through Of financing from mechanisms national support (Thermal Account e Self-consumption) and district heating powered by renewable sources e waste heat recovery.	Relaunch of the Public Private Partnership through support for local authorities.	
		Structured support to Municipalities through the Energy and Climate Point for Municipalities (PECC) established with the ENEA and GSE national representatives and with ANCI		Collaboration with the centers of client on the territory regionally simplify for supply, aside of public bodies, goods and services	

	Policies to fight energy poverty for incompetent individuals in the public residential construction sector		energy compatible with regional incentives are set per energy efficiency	
Private tertiary sector	Maximize and optimize private investments in the sector of profound building redevelopment.	Identification of tertiary areas suitable for the installation of renewable energy systems, in particular photovoltaic	Sharing of rules and indications to simplify and encourage interventions (revision of regional guidelines for authorizations)	
	Interventions regulatory per strengthening the energy performance needs of large-scale retail trade structures Organized	In areas with high heat needs, consider using low enthalpy district heating		
Public tertiary sector	Ten-year regional program for the redevelopment of public buildings/for public use, defining priorities for action, progressive stages and sources of financing It is Of mainly to be found in the new European programming POR-FESR 2021-2027 and national support mechanisms (Thermal Account)	Develop specific programs for the involvement o photovoltaics in the construction efficiency of public buildings from RES. In particular: functional of the goals ->photovoltaic ->heat pumps ->revamping Also through sources Of financing from national support mechanisms (Conto Termico e Self-consumption)	private individuals for the inclusion of tertiary public, Also through the promotion of Public Private Partnerships (PPP) for Energy Performance It is Contracts (EPC), so that public resources invested contribute to generating a stable demand for skills e qualified jobs on regional territory.	
	Promotion of the integration of energy efficiency and renewable sources in all of management, requalification, adaptation and development of public assets, ensuring that the financing lines for the sectors in which the Region has planning competences - including schools, healthcare, cultural heritage,		Collaboration with the centers of client on the territory regional simplification for the supply, by public bodies, of goods and services compatible with regional and state incentives for energy efficiency;	

	sports facilities, etc. – can be integrated with state incentives dedicated to energy efficiency and RES			
Civil sector All	Structured support to sustainable Local particular to Municipalities through the Energy and Climate Point for Municipalities (PECC) established with the national representatives ENEA and GSE and with ANCI	Development of energy communities Authorities on the basis of analyzes and in specific territorial areas.	Stimulation for the use of professional services that accelerate the deployment of technologies for RES and energy efficiency	Relaunch the theme of smart cities as fundamental for the resilience of the Lombardy system as well as a key tool for the sustainable connection or integration between commercial areas and residential areas.
	Creation of programs training for officials public and external technicians on energy efficiency and use of financial instruments dedicated to them, in collaboration with GSE, ENEA, CNR, professional associations and public universities in the area			Development of indicators, guidelines and provisions intended to innovate regional and local territorial and urban planning and programming tools (PTR, PGT, PTCP), to promote energy efficiency of urban and territorial systems, efficient use of resources (air, water, soil, etc.), and counteract the phenomena of *urban sprawl* = rapid and disorderly and therefore energy-intensive growth of cities. Integrate the use of plant systems in building design.

				Alignment of the recovery objectives of the abandoned building heritage and degraded, underused or abandoned areas of the regional law n.18 of 26 November 2019 with the PREAC objectives of energy requalification of buildings, development of energy production systems from energy sources renewables and restoration of ecosystem functions as adaptation to climate change, strengthening the resilience of territories; all with zero ecological soil balance. It is
Industry	Promotion of efficiency measures for buildings and company production processes through support for industrial entities to join energy management systems (ISO 500001, ISO 140000 and EMAS) and the use of state incentive tools for energy efficiency	Identification of industrial areas suitable for the installation of renewable energy systems, photovoltaic. In areas with high heat needs, in particular consider the use of low enthalpy district heating and the use of waste heat recoverable through district heating.	Incentive for business aggregation in energy districts.	Development of sustainable energy communities in industrial areas with high demand. Push for energy technological
	Analysis of industrial areas with the presence of potentially recoverable energy waste	Growth of intelligent networks *(smart grids),* both electrical and thermal, is the instrument come per	innovation. in the sectors productive, promoting laboratories and business incubators united by performance objectives of technologies, materials and systems in the operational phase, with particular reference to technologies and systems that involve the use of renewable energy sources. a	Support for the creation of *smart* industrial districts.
		Evaluate Of encourage synergy between industry and territory for the use of low temperature heat sources combined with a the use of heat pumps, while reducing the payback times of industrial investments.		

	Promote the development of competitive conditions in the productive world on the issues of efficiency and rational use of energy, also by raising awareness among end consumers	rationalization and efficiency of the regional energy system. Interventions in favor of the development of *smart grids* and *smart cities* must be consistent with the strategy outlined by the Lombard Digital Agenda, in relation to		
	infrastructures enabling services as a substrate for the efficiency of processes structures/buildings.	Encourage energy diagnoses of basis for digital interventions which are a s and necessary technology.	Addressing and rewarding the development of research activities towards promising sectors of regiona interest such as: energy efficiency technologies in construction, materials and components from recovery chains (demolition aggregates, natural fibers for insulation, etc.), energy storage in the form chemistry, production of innovative biofuels, energy harvesting technologies (= recovery of thermal, kinetic, luminous, metabolic, electromagnetic energy etc., Construction Regional register of	
		Definition of areas suitable for installations of renewable energy source systems to facilitate the administrative process of installing systems by companies.		
		available in the environment). Regional Energy Sources (ReFER) for monitoring development Support for development of research-based processes, in carbon dioxide confinement cooperation with the Energy Services Manager (GSE) and the corresponding national system SIMERI (Italian System for the Monitoring of Renewable Energy). Tool that acts to simplify and dematerialize the declarative and authorization processes.	projects and activities for the progressive technologies relating to local renewable (CCS - Carbon Capture and Storage - or Sequestration).	
		Implementation of actions for the retrofitting and maintenance of existing systems, also using monitoring tools made available to the GSE		
Transport	Push towards the improvement of the private and public vehicle fleet.	Diffusion of hydrogen (produced by renewable plants or systems	Development of electric mobility as an industrial driver.	Structuring the transport system in a highly resilient way,

		of waste gasification), as well as biomethane, also for the strategic protection of the biogas production chain, and its integration into the methane distribution network, for a more effective and efficient allocation also for transport use (as also prefigured by legislative decree 28/ 2011).	Strengthening of mobility infrastructure	capable of responding to extreme conditions in the wake of the experience and issues that emerged during the Covid-19 health emergency.
	Support for sustainable and shared mobility structural interventions within urban areas.			
	Incentive for the dissemination of electric charging infrastructure public and private, also through funding sources from national support mechanisms (White Certificates)	Facilitation for the development of bidirectional Vehicle to Grid (V2G) technology, which allows electric vehicles to store and return energy, as an integrative, effective and cost-effective tool for stabilizing the grid with respect to penetration of non-programmable and intermittent renewables	Integration of the electrification of the motorway network in order to favor the electric traction of hybrid vehicles, heavy goods transport vehicles equipped with a pantograph or equipped with induction charging systems through suitable equipment located below the road surface	Observation of the evolution and progressive regulation of smart working and e-learning systems to make the reduction of the need for mobility permanent for the benefit of the reduction of emissions and, as regards the mobility of goods in urban areas, to make such transport the as sustainable as possible.
	Concessions for alternative mobility to the private car with use of two-wheel mobility (bicycles and scooters, scooters, bike sharing) to meet the needs of adapting mobility to the post-health emergency recovery phases, through an increase in custody and of charging infrastructure in public offices, workplaces, sales points, etc., contributions for purchases, recognition of benefits in the event of home-work travel (kilometre allowance, mechanical assistance, LPT discounts,...).		Relaunch of the professional figures of mobility managers for a new planning of home-work travel, smart-working management through regional coordination of initiatives	
	Promote improvement of the public transport offer in terms of accessibility, frequency, travel time, service range and locations served			

	Make a national request for incentive mechanisms for electrification, for the purposes of the general objectives of decarbonisation of transport, for the public transport sector in line with the measures envisaged for biomethane and biofuels.			
	Promote and support the development of ITS (Intelligent Transport System) technologies and the infomobility system. Software platforms for real-time demand management with predictive capabilities on the development scenarios of traffic conditions will contribute to the management of the traffic system mobility, allowing the capacity of networks to be optimized (real-time monitoring and management of road and railway flows) and to improve user behavior with consequent positive effects on the environment.			
Agriculture	Spread of sustainable agricultural models, capable of maintaining high quantitative and qualitative standards of production, reducing consumption of energy, water and natural resources	Maintenance strategy for the biogas production plant park powered by agro-zootechnical wastewater that exploits all the different options available (conversion of individual plants or district systems to biomethane, flexible use for balancing the national electricity production system, hydrogen production).	Support for agricultural businesses by maintaining the potential of biogas. Development of agrovoltaics in suitable areas, as part of integrated projects for the exercise of agricultural activity.	Increase the level of resilience of the regional electricity network by using the flexibility offered by agricultural biogas production plants. Implementation of agricultural practices that result more

			Enhancement of sustainable assets with respect to woodland and forestry emissions also for the purpose of climate-altering gases, through the capture and sequestration of carbon to promote the production of pellets in the soil (negative emissions) and the from the local supply chain reduction of emissions in the livestock sector, in synergy with the relevant sectoral planning, with the EU Communication COM(2020)381 final “FarmToFork” and the guidelines for the 2021-2027 CAP and with the regional Plan of Interventions for Air Quality.	
		Promotion from the community mountain energies focused on the sustainable use of resources premises, in particular local biomass for self-production of energy.	Support the production of plant-based carbon building materials	
Transversal sector: style of life and measures behavior of individuals.	Activation and dissemination of better techniques for measuring and accounting for consumption (smart metering), in order to increase users' awareness of their consumption and potential savings margins, awareness of the economic convenience of efficiency stimulating it energy.	Promotion of incentive forms technologies to support functionalities to enable participation in the energy and community energy.	Develop specific national and regional users to self-produce and accumulate active pation in the electricity market, encouraging the assumption of the identity of “prosumer” - that is, users aware of their ability to consume efficiently and of the opportunity to produce renewable energy ourselves, with a consequent benefit for the entire energy system (Active Demand). Definition of specific training, programs also intended for public utility designers, small and managers, medium-sized enterprises, the qualification of professionals operating in the construction and plant engineering supply chain.	Empowering end users and activating tools to influence their actions towards use energy, sustainable mobility models and informed purchasing choices regarding the reduction of food waste and the selection of products with limited climate-changing emissions and protection of soil productivity.
	Promotion of training campaigns aimed at increasing citizens' awareness of the issue of efficiency as a positive value for well-being and economic savings.			

	Starting from the regional data of the CENED land register (ENergetic Certification in Construction) build a system of simulation of energy efficiency interventions, RES integration and storage systems, capable of showing different possible intervention scenarios with different levels of investment, energy saving and savings economically actionable.		

Tab.5: PREAC objectives-sector matrix

B.3 THE TERRITORIALIZATION OF THE DEVELOPMENT OF THE RENEWABLE SOURCES SYSTEM

The objective of strong penetration of renewable energy sources in the Lombardy energy system defined in this Policy Act must be governed and planned with the aim of facilitating the growth of sustainable and efficient supply chains.

The development model must be consistent with the territories based on the availability of the resource, the network structure, the consumption model and the best environmental integration; however integrated and connected, capable of responding to advanced security needs.

The diffusion of energy production plants and systems starting from renewable sources must, therefore, be appropriately territorialised.

The contextualization on different territorial scales, from the regional one up to its specification for homogeneous supra-municipal areas requires that the strategies and objectives are declined taking into account environmental, landscape and territorial specificities; sectoral policies and territorial policies must therefore dialogue to outline effective lines in different contexts and to enhance and strengthen Lombardy's role in supra-regional networks and systems.

The relationship between the environment and the territory appears clearly evident for example in reference to the requests for the development of numerous small hydroelectric derivations in the mountains rather than the insertion of large photovoltaic systems in the plain areas.

PREAC will be called upon to address this issue as part of the definition of "suitable areas" for the installation of RES plants, a task attributed by the National Plan to the Regions according to criteria
which are in the process of being defined.

Also in order to guarantee facilitating conditions for the alignment of regional policies, the reference contexts that best lend themselves to the local declination of the development of renewable sources are the territorial systems identified by the Regional Territorial Plan.

The PTR identifies six territorial systems, not strictly perimetered, but to be considered as interrelated elements of the territory, characterized by homogeneous strengths, weaknesses, threats and opportunities. The systems to which PREAC will refer are: the mountains, the piedmont system, the metropolitan system, the irrigated plain. As regards the lakes and the river system, they can be considered transversal to the 4 specific sectors.

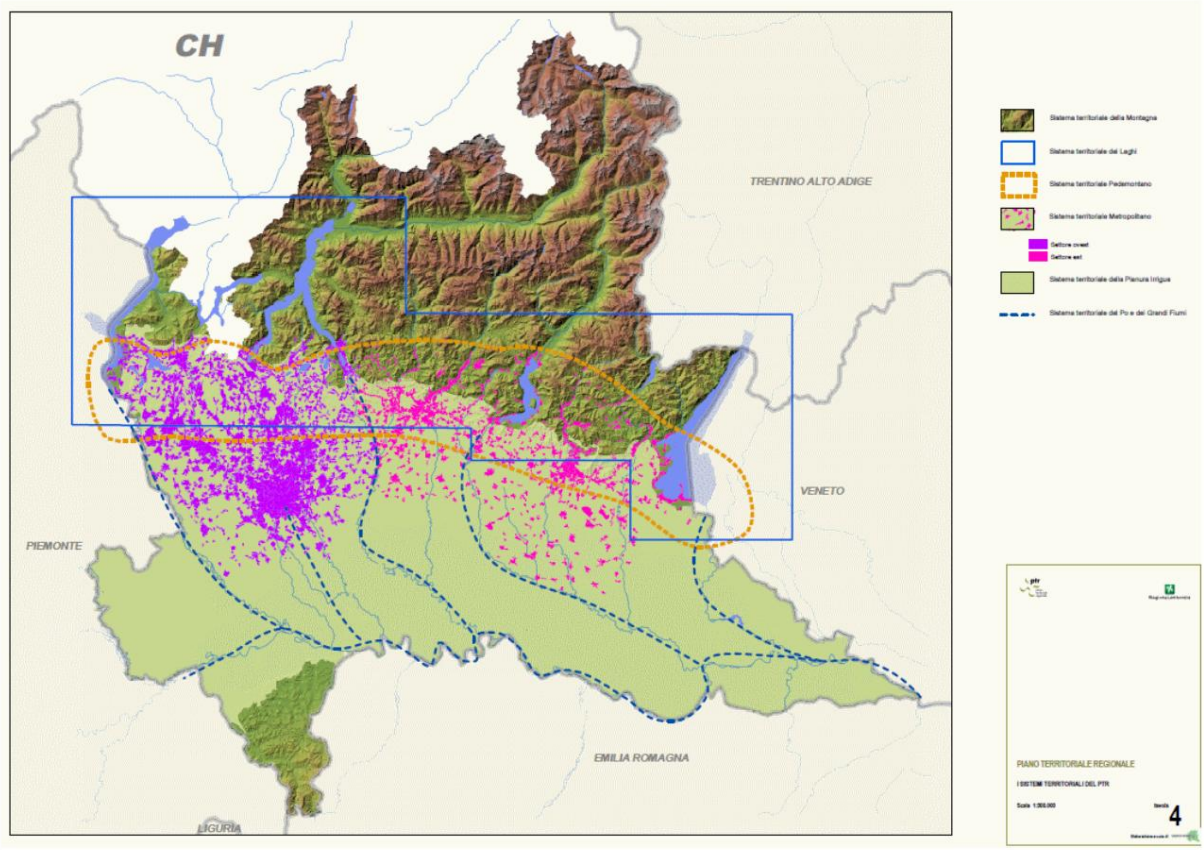


Fig.16: territorial systems of Lombardy. Source: PTR, 2010.

Mountain territorial system

The mountain territory corresponds to the northern areas of the Region. It is characterized by a strong permanence of natural characteristics, particularly intact in the areas located at high altitudes, by a high availability of water resources, also for the purposes of energy production, and by a varied and remarkably beautiful landscape. The aspects linked to biodiversity and sites of community interest for the protection of habitats are particularly important. Mountain forests play a multiple role linked to habitat conservation, hydrogeological defense and are important carbon dioxide deposits. They can also provide important quantities of solid biomass for local energy production. The problems are linked to the marginality of some areas, depopulation and hydrogeological instability.

Piedmont territorial system

The piedmont system is developed along the east-west axis from Lake Garda to Maggiore. Predominantly hilly territory, it represents the transition element between the mountain environment and the metropolitan area, presenting intermediate characteristics between the two systems. The piedmont system enjoys the presence, in the hilly area, of areas of high landscape value (small moraine lakes, historic villas with large parks and gardens, ancient villages) and, in the pre-Alpine area, easily accessible locations with views also towards the Insubrian lakes . One of the main problems is the pulverization of urban settlements (sprawl) which leads to land consumption due to low-density construction. The fragmentation of the urbanized area also determines a strong dependence on private means of transport. Air pollution phenomena are typical of urban areas which include some of the most populated capital cities (Bergamo, Brescia in particular). The existence of a sector also contributes to pollution phenomena

highly developed productive and commercial area along the road axes especially towards Milan. The piedmont area is characterized by the presence of large lakes. This water heritage is strategic in terms of fresh water reserves, and represents a natural resource to be carefully managed and preserved in its various uses (drinking, irrigation, energy, industrial, tourism, recreational, ...).

Metropolitan territorial system

The metropolitan system corresponding to the central band of the Region, between the foothills area and the northern edge of the irrigated plain. The greatest population densities as well as the greatest energy consumption are concentrated in this territorial area. Some important problems from an environmental point of view are concentrated here, including air quality, critical situations linked to intense traffic, strong urbanization and widespread soil waterproofing.

Territorial system of the irrigated plain

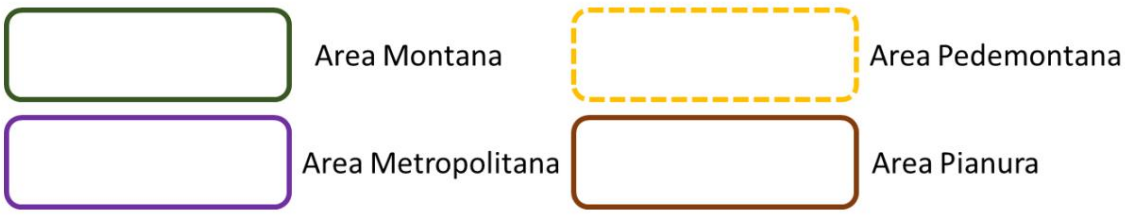
The Lombardy irrigated plain constitutes an area of great agricultural productivity, rather diversified; agricultural and livestock activities are particularly important from an economic point of view. Agro-zootechnical settlements produce significant impacts on soil, water and air resources, due to the use of pesticides and chemical fertilizers and organic matrices such as livestock effluents, urban sewage sludge and OFMSW compost (residues of plant protection products and nitrates in water , release of ammonia into the atmosphere, accumulation of phosphorus, metals and organic pollutants in soils). Agricultural activities determine an intensive use of water for irrigation, a use that frequently conflicts with the needs of other types of water use (energy, naturalistic-environmental, tourist-recreational, navigation, ...). In recent years, also as a result of ongoing global warming, water crisis conditions have been periodically appearing. From a settlement point of view, this area presents urbanization concentrated in the inhabited centers and not as widespread as in the metropolitan and piedmont areas.

ELEMENTS FOR THE TERRITORIALIZATION OF RES

Some of the main elements that characterize the different territorial systems from an energy point of view are shown in the following thematic maps.

Energy consumption is concentrated in the metropolitan area and in the provincial capitals (mainly including those in the foothills) being mainly linked to the number of inhabitants. At the same time, from the analysis of the percentage weight of civil consumption on total consumption (including industrial and transport consumption) it is clearly highlighted that consumption in the mountain area is mainly attributable to the civil sector, while the Municipalities in the bands between 40% and 50% are those on average with the regional total.

Territorial area legend:



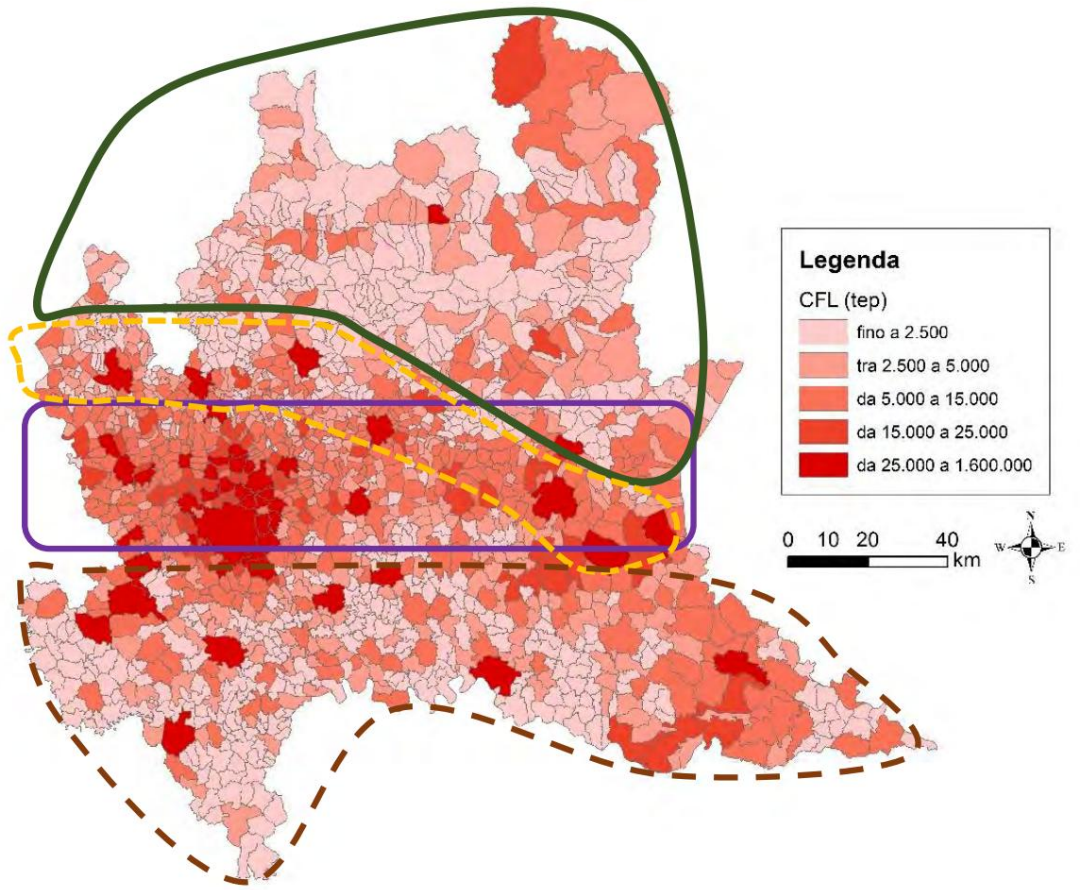


Fig.17: Gross final consumption (CFL) in the civil sector.

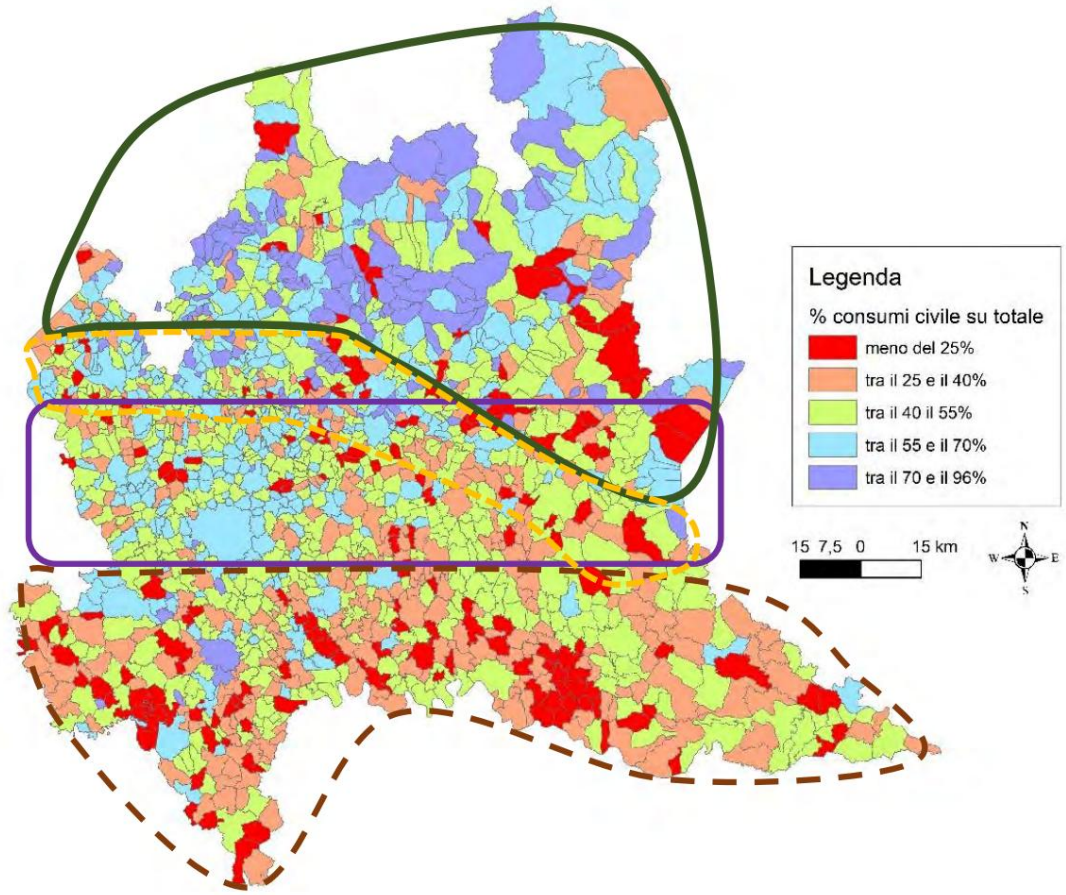


Fig.18: Percentage impact of the civil sector CFL compared to the total.

A qualitative-quantitative breakdown of consumption referring to consumption in the civil sector (predominant sector with regards to regional energy consumption) is shown in the following table. The capital municipalities of the foothills, Varese, Como, Lecco, Bergamo and Brescia were
inserted in the Pedemontana area.

System territorial	Energy consumption in the civil [Mtep]	Weight of consumption of macro area on the total of consumption in the civil sector	Percentage weight of civilian on total consumption energy
Montana	1,2	11%	56%
Foothills	2,4	22%	48%
Metropolitan	5,4	50%	47%
Plains	1,9	17%	37%

Tab.6: Distribution of energy consumption by territorial system

The clear difference emerges between the metropolitan area and the mountain and plain areas, with the particularity of the foothill area acting as an intermediate buffer area. This difference, already highlighted by the territorial analysis in the Regional Territorial Plan, is therefore also confirmed at the level of energy consumption. An important indication is obtained from the percentage weight of civil consumption on the total, in fact it is noted that in the mountain area there is a preponderance of civil consumption (in particular in the residential sector) while in the plain area there are different consumptions attributable to consumption in agricultural and partly industrial production sectors linked to agro-industry. The metropolitan area and the foothills, as regards the weight of the civil sector, are in the mid-Lombardy range. Here the strong tertiarization of the territory plays a decisive role.

Plants powered by renewable sources have a more specific distribution. Therefore more than 90% of the hydroelectric power is identified in the mountain area, being mainly linked to the availability of water resources and rainfall, including snow, as well as the difference in altitude linked to the orography. The part of non-mountain systems is linked to the area of the large Lombard rivers.

The solid biomasses are concentrated in plants limited to areas with availability of raw material, while those powered by biogas have developed in the plain area essentially
in the provinces of Lodi, Cremona and, slightly less, Mantua and Pavia.

Renewable plants that exploit geothermal energy are concentrated in the metropolitan and piedmont areas. Even the availability of geothermal energy is located in two large areas on the basis of the hydrogeological sector where heat is removed: mainly lithological for the mountain area and, partly in the foothills, mainly groundwater for the metropolitan and plain areas.

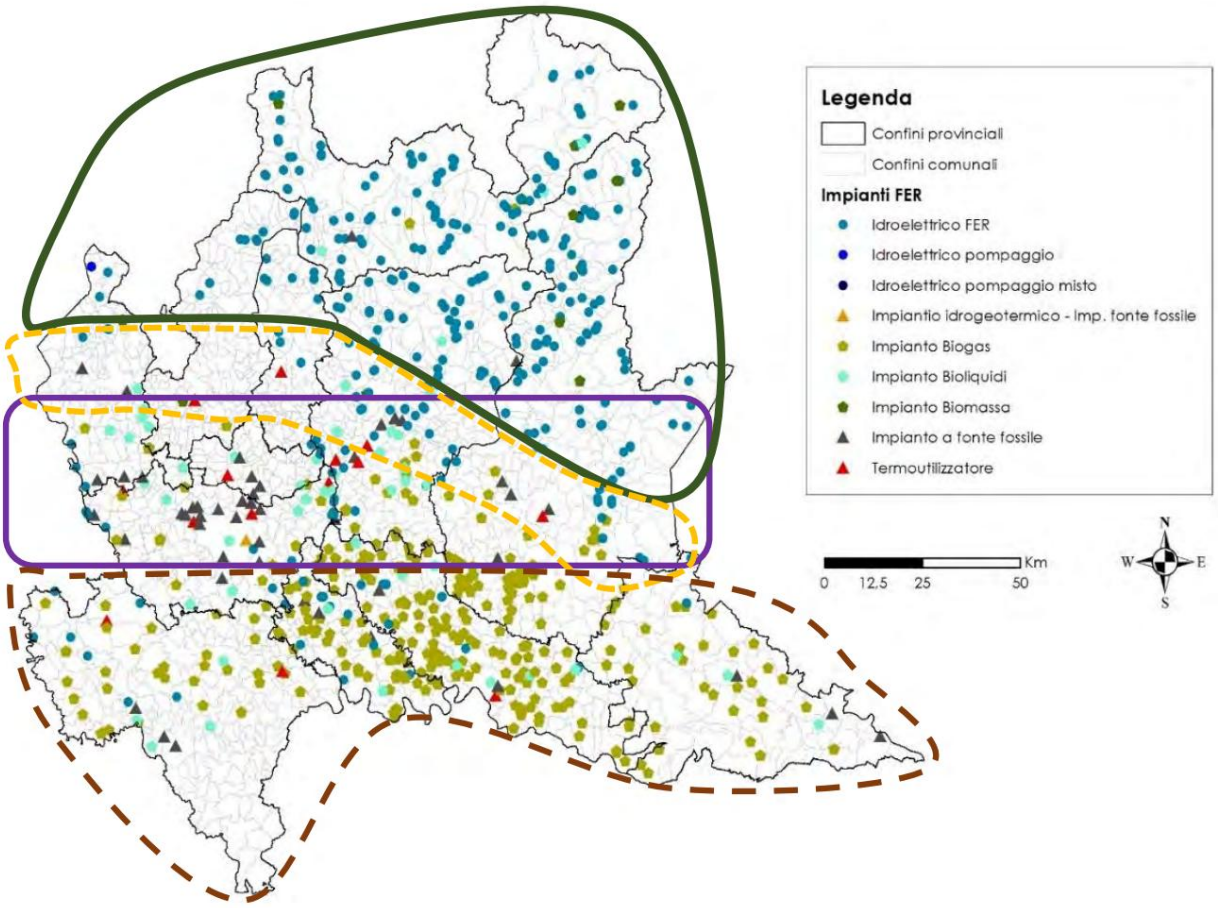


Fig.19: Distribution of systems powered by renewable sources.

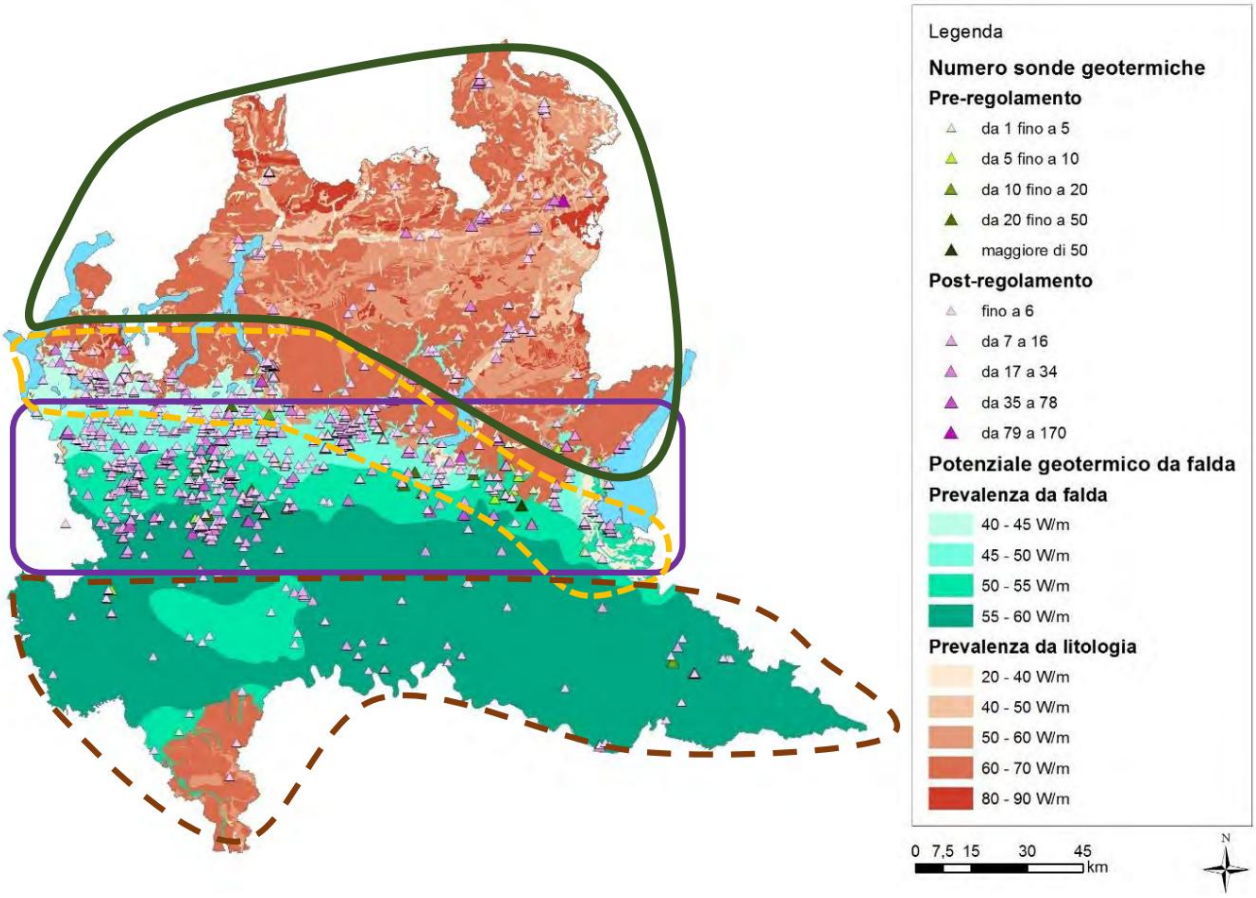


Fig.20: Map of geoenergy potential and distribution of installed geothermal probes.

REFERENCE MATRIX FOR THE TERRITORIALIZATION OF RES

In order to build the territorialization of the RES, as well as to define the best location of the suitable areas of the plants, a synthetic SWOT analysis was carried out for each system territorial.

Area Montana

Strengths	**Points of weakness**
Richness of forest resources Good availability of water resources High landscape value High biodiversity Good air quality	Hydrogeological instability Parceling of forest properties Abandonment of forest areas Marginality of some areas Depopulation
Opportunity	**Threats**
Energy Communities Act Territorial impacts on hydroelectricity from the LR 5/2020 Relaunch of the forest-wood-energy supply chain Sustainable tourism (cycle tourism) Increase in widespread and agritourism accommodation Mountain agriculture	Climate change underway (reduction of glaciers and change in water regime) Overexploitation of mini-hydroelectric power Urbanization of the valley floor Loss of biodiversity High tourist traffic

Tab.7: SWOT analysis of the mountain system

Foothills area

Strengths	**Points of weakness**
Availability of water resources (large lakes) Landscape value Presence of medium sized cities well structured Cycle tourism	Air pollution phenomena Water pollution Settlement pulverization (sprawl) Industrial and artisanal abandoned areas Traffic in urban areas High motorization rate
Opportunity	**Threats**
Urban regeneration Efficiency improvement in the production sector Soft mobility Tourist cycling development Development of electric mobility	Climate change (intensification of precipitation) Increase in hydrogeological instability phenomena Further urbanization Anthropic pressure on the landscape Ecological network fragmentation

Tab.8: SWOT analysis of the foothills system

Metropolitan Area

Strengths	Points of weakness
Presence of the regional capital, attractive and dynamic, economically and culturally High rate of separate waste collection Capillary public transport network (in the Milanese urban area) Strong presence of tourism	Critical air quality Groundwater pollution situations High land consumption High population density Presence of sites to be reclaimed Presence of abandoned industrial areas Mobility congestion entering the Milan area
Opportunity	**Threats**
Urban regeneration Concentration of energy consumption to be managed with smart grid systems Creation of Smart cities Recovery of industrial areas Development of circular economy for material recovery Soft mobility interventions Electric mobility Biomethane incentives	Climate change (intensification of precipitation and heat waves) Increase in flooding phenomena Further increase in urbanized areas

Tab.9: SWOT analysis of the metropolitan system

Plain area

Strengths	Points of weakness
Strong agricultural sector Presence of urban centers relevant from a landscape, artistic and cultural point of view Network of cities and towns of interest	Groundwater pollution Soil depletion Overuse of water resources Excessive use of agricultural monoculture Critical air quality
Opportunity	**Threats**
Low impact quality agriculture Recovery of valuable agricultural landscape Energy Communities Act Development of agrovoltaics Relaunch of the biogas sector (biomethane and/or redefinition of incentives) Biomethane incentives	Climate change (extension of drought periods) Scarcity of water resources Loss of agricultural land due to urbanization Closure of biogas production plants due to changes in the incentive system

Tab.10: SWOT analysis of the plain system

Based on the characterization of consumption and the first SWOT analysis, for each territorial system the main indications to follow in the analysis of the actual potentials that the PREAC will develop are reported below, taking into account all the elements, including economic impact,
necessary.

The Increase column shows a hypothesis for the distribution of the potential for new installation of RES, naturally consistent with the objectives indicated in paragraph B1.

System territorial	Potential energy framework	Potential RES development	Increment
Mountain	Consumption shifted decisively to the civil sector. Consumption coverage in the civil sector can take place through mix of biomass, geothermal and solar thermal. The impact of the positive 5/2020 regional law on hydroelectric on renewable electricity consumption needs to be verified	Biomasse solide: use in district heating systems and technological increase in domestic systems. Low enthalpy geothermal energy: to be considered in new buildings of the civil sector (both residential and tertiary) coupled where possible with photovoltaic Solar photovoltaic: increase to be assumed on buildings in the residential and tertiary sectors Hydroelectric revamping: possible increase in power of basin and run-of-river hydroelectric plants in the new concession phase	Biomasse solide: 30 MWh Heat pumps (low enthalpy geothermal): 80 MWh Solar thermal: 10 MWh Photovoltaic: 200 MW Hydroelectric: 250 MW
Hills/Lake	The high consumption in the capital municipalities and in the industrial and tertiary areas settled along the road axes. In the civil sector the energy production can be covered by integrated photovoltaic heat pump systems. In support, an increase in solar thermal production is possible. Centralized low-enthalpy district heating systems need to be developed. In industrial areas, waste heat to be connected to integrated urban district heating networks is considered. The consumption electrical will be covered in part by the increase in Of solar photovoltaic power.	Heat pumps (geo, hydro and aerothermal): intensive use in the civil sector Low temperature district heating: to be considered in areas with high population density and high presence of industrial users Rooftop solar photovoltaic: massive development is to be expected in all residential, tertiary and productive sectors. Ground-mounted photovoltaic: to be foreseen in degraded areas, abandoned industrial areas, former quarries, former landfills Hydroelectric revamping: possible increase in power of run-of-river hydroelectric plants along the main river banks in the new concession phase	Heat pumps (including district heating at low enthalpy): 240 MWh Solar thermal: 25 MWh Solar photovoltaic: 900 MW Hydroelectric: 50 MW

Metropolitan	High consumption both in civil and industrial sector. In the sector the energy production will be covered by heat pump systems integrated with photovoltaics. In support, an increase in solar thermal production is possible. Centralized low-enthalpy district heating systems need to be developed. In industrial areas yes consider the thermal waste to be connected to networks Of district heating integrated urban. The consumption electrical will be covered in part by the increase in solar photovoltaic Of power.	Heat pumps (geo, hydro and aerothermal): intensive use in the civil sector Low temperature district heating: to be considered in areas with high population density and high presence of industrial users Rooftop solar photovoltaic: massive development is to be expected in all residential, tertiary and productive sectors. Ground-mounted photovoltaic: to be foreseen in degraded areas, abandoned industrial areas, former quarries, former landfills	Heat pumps (including district heating at low enthalpy): 400 MWh Solar thermal: 50 MWh Solar photovoltaic: 1400 MW 3.3 TWh thermal energy in the grid district heating
Plains	Consumption limited to urban areas. In urban areas yes hypothesizes the use of integrated systems with heat pumps and low-energy district heating networks enthalpy. Electricity production can be integrated by the production of photovoltaic energy on agricultural land (agrovoltaics linked to agricultural businesses). The biogas plant park is preserved through the introduction of biomethane production plants the inclusion in the It is system of balancing the electricity grid.	Heat pumps (geo, hydro and aerothermal) and low enthalpy district heating: use in the civil sector Rooftop solar photovoltaic: massive development is to be expected in all residential, tertiary and productive sectors. Ground-mounted photovoltaic (Agri-voltaic): to be foreseen in agricultural areas marginal and of lesser interest for cultivation with the method of supporting agricultural income and co-aimed at the implementation of environmental redevelopment of agricultural areas and in areas uncultivated, degraded and abandoned areas, former quarries and former landfills. Biogas: Maintenance of biogas production capacity	Heat pumps (including district heating at low enthalpy): 100 MWh Solar thermal: 20 MWh Solar photovoltaic: 2000 MW Biogas (maintenance of the existing park): 400 MW

Tab.11: potential RES development by territorial system

Summary table of RES development by territorial system.

	biomass solid	heat pumps	solar thermal	photovoltaic	hydroelectric	Biogas*	
metropolitan	30	70	10	200	250	0	
piedmont	0	240	25	900	50	0	
mountain total	0	400	50	1400	0	0	
plain	0	90	15	2000	0	400	
	30	**800**	**100**	**4500**	**300**	**400**	

*maintenance of the power of the installed fleet.

Tab.12: total potential RES development by territorial system

The development of renewable energy must be territorialized but also characterized by **strong decentralized expansion.** A penetration model, consistent with the territories, but capable of looking at optimizing the distribution of energy demand by encouraging **self-consumption and the creation of energy communities.** The latter are a significant tool for valorising local resources; therefore, a differentiated diffusion according to territorial systems is hypothesized.

Territorial system	Energy communities
Mountain	Circumscribed mountain areas with concentrations of end users Integrated use of biomass, solar thermal and photovoltaic To support the development of the forest-wood-energy supply chain
Foothills	In the most urbanized areas and in densified, even integrated, industrial and tertiary districts Networks of photovoltaic systems connected to energy networks including those of electric mobility Use of geo-hydrothermal district heating networks
Metropolitan	In the most densely populated areas and in energy-intensive industrial and tertiary districts, including integrated ones Creation of intelligent production networks based on photovoltaic systems connected to electric mobility networks Use of geo-hydrothermal district heating networks
Plains	Limited areas linked to agro-livestock companies

Tab.13: Development of energy communities by territorial system

For energy communities, it is also necessary to foresee a *"learning curve"* on the part of citizens, which can be favored by promotion, in particular by encouraging the creation of energy communities in condominium buildings envisaged by the temporary national regulation, significant in highly urbanized contexts, subsequently moving on to supercondominiums that can offer interesting surfaces and power for market operators.

The other front of interest for the development of energy communities is represented by small municipalities where the technical conditions for implementing the initiative with their citizens are found, more likely possible in a second phase when the 200 kW limit ceases, of the current national regulation.

B.4 THE RELATIONSHIP SYSTEM

Lombardy and all the major European and global economies are today involved in the energy transition process. This is an evolutionary process, supported by the spread of technological and digital innovation, in which the public territorial governance system plays a fundamental role. However, we cannot ignore multilevel *governance* and a truly participatory approach to planning and intervention choices with all the subjects and representatives of the territorial socioeconomic system.

The profound condition of indeterminacy and uncertainty on the economic and social impacts of the health emergency linked to the coronavirus accentuates the need for a joint reading of the new evolutionary dynamics that will arise and, for the interpretation of which, it is necessary to have different and integrating skills.

To support a real participatory construction of energy-climate policies, the Lombardy Region established in July 2018 a ***"Regional Observatory for the Energy Transition and the Circular Economy"*** where companies and trade associations, trade unions, ANCI, UPL sit , the main universities of Milan, Bergamo, Brescia, Varese, Pavia, the RSE and ENEA research bodies, the GSE responsible for national incentive management, environmental associations, financial associations, Integrated Regional System.

The Regional Observatory wants to be the place where this operational sharing approach finds a stable home and where the proactive contributions and any differences in views and interests, brought back to the public interest, are systematized. The Program construction process will continue to make use of the ongoing Observatory activities which were started even before the institutional strategic environmental assessment processes, so that the state of knowledge and the prospects for development.

Again with reference to the system of relations, the cooperation activity with the international networks of which the Lombardy Region is a member will have to be continued and developed, also evaluating the opportunity of new partnerships and agreements aimed at achieving the objectives of combating climate change, and providing in particular for participation in the activities of the United Nations Conferences of the Parties with a view to expressing a position of Lombardy and contributing to the importance of the action of subnational governments.

Finally, the evolutionary transition path requires the Administrations responsible for policy planning to have a complex, digital, integrated and effective system in its ability to communicate the progressive achievement of objectives.

For the Lombardy Region, in the construction of the PREAC, it will be fundamental to develop an integrated, secure and validated system of information sources and subjects holding data useful for the purpose.
This system will be equipped with information dashboards that will allow the Lombard company to have transparent vision of the progress progressively achieved.