GreenFORCE

Torino Summer School

Final report of team 2

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1. Authors

HAXHIU Leonora, Curricula, POLIS, leonora_haxhiu@universitetipolis.edu.al

TARANTINO Giulia, S313382, PoliTO, s313382@studenti.polito.it

SHIVA SHANKAR Suhas, S308635, PoliTO, s308635@studenti.polito.it

PLANIC Andrija, Curricula, Uni of Belgrad, planicandrija@gmail.com

ENERGY EQUI(Pover)TY

Through addressing energy security

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1 ABSTRACT *(max. 200 words)*

Energy poverty poses a significant and far-reaching challenge in numerous societies, profoundly impacting the well-being and quality of life for individuals. A fundamental measure used to gauge energy poverty is the energy efficiency rating of residential buildings, a vital tool for assessing buildings' energy efficiency and pinpointing families and communities facing elevated energy expenses.

The analysis of energy poverty can be conducted at multiple levels, namely meso, macro, and micro. On a meso scale, geographic regions with the highest energy poverty rates can be identified. On a macro level, the effectiveness of national and regional energy policies in addressing this issue can be evaluated. At a micro level, a detailed examination of the specific conditions of households and housing is possible.

In response to these challenges, innovative solutions have been crafted. These solutions involve enhancing the potential for deducting project costs, potentially up to 100%, based on the scope of the intervention and the poverty level. If this strengthened incentive falls short, measures to incentivize private or institutional entities may be implemented. The United Kingdom's 'Energy Company Obligation' serves as a notable example, providing subsidies to energy providers obliged to implement energy-efficient measures in residential buildings occupied by vulnerable individuals. Annual targets are set to reduce energy consumption and lower energy bills, with intervention costs shared among electric and gas service users. Additionally, proposals to enable the transfer of tax credits to consortia of financial institutions, offering low-interest rates to individuals experiencing energy poverty, aim to alleviate the burden on those most affected.

2 THEORETICAL AND METHODOLOGICAL FRAMEWORK

2.1 Aim of the project *(max. 200 words)*

Energy poverty in the city of Turin refers to a situation where a significant portion of the population struggles to meet their basic energy needs, such as heating, cooling and lightning due to various socio economic factors. Energy poverty should be analysed also as an energy issue, not only as a sociological issue. When viewed only through a social lens, this leads to wasteful public spending. The aim of this project is to identify areas with highest energy poverty and to offer solutions to mitigate this issue and also commitment towards net zero carbon. We are trying to diversify the energy resources of the country.

2.2 Literature review on Just Green Transitions *(max. 500 words)*

The concept of a Just Green Transition represents a significant shift in how we address environmental challenges while ensuring fairness in socio-economic outcomes. As the world faces the urgent need to combat climate change and environmental degradation, it is crucial that our green policies also prioritise justice.

This review explores the various aspects of a Just Green Transition, emphasising its importance in achieving both environmental sustainability and social equity. The Environmental Imperative The need for a Just Green Transition is clear from an environmental standpoint. The Intergovernmental Panel on Climate Change IPCC has repeatedly warned us about the devastating consequences of unchecked climate change, such as rising temperatures, extreme weather events, and loss of biodiversity. Therefore, transitioning to a green economy is

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essential to mitigate these threats. This transition includes adopting renewable energy, promoting sustainable agriculture, and embracing circular economy principles to reduce greenhouse gas emissions and our ecological impact.

Promoting Social Equity However, a Just Green Transition is not just about environmental goals. It recognizes that marginalised communities bear a disproportionate burden of environmental degradation. We see evidence of environmental injustice in the unequal exposure of vulnerable populations to pollution, limited access to clean water, and negative health outcomes. A Just Green Transition strives to address these inequities by ensuring that marginalised communities benefit from environmental policies rather than being further disadvantaged by them. Driving Economic Transformation An important aspect of a Just Green Transition is its potential to drive economic transformation. The shift to a green economy can create jobs, foster innovation, and stimulate economic growth. Initiatives such as renewable energy projects and the development of green infrastructure can provide employment opportunities, especially in areas with high unemployment rates. Additionally, investing in clean technologies can enhance a nations competitiveness on a global scale. Inclusive Governance To achieve a Just Green Transition, inclusive governance structures are crucial. Meaningful participation of all stakeholders, including marginalized communities, in decision-making processes is essential. Policymakers must consider the perspectives and needs of diverse groups to ensure a fair distribution of benefits and to avoid perpetuating historical injustices.

Challenges and Criticisms Despite its potential benefits, a Just Green Transition faces challenges and criticisms. Some argue that the costs of transitioning to green technologies may disproportionately affect low-income households, exacerbating inequality.

There are also concerns that green policies may lead to job displacement in traditional industries. Addressing these challenges requires careful planning, robust social safety nets, and programs to support the reskilling of workers. So as part of the process to provide safe, clean and secure energy to the people, the countries like The USA, The UK, India, China and few European countries are leading their way by diversifying the renewable energy resources which inturn helps in energy independence from the fossil fuels which prices are driving high due to Ukraine and Russia conflict, also as move towards Net Zero and energy security for every country.

References:

(https://www.aerb.gov.in/english/regulatory-facilities/nuclear-power-plants)

.(https://www.gov.uk/government/publications/powering-up-britain#:~:text=We%20will%20move%20towards%20energy,will%20play%20in%20that%20transition)

(https://sustainabilitymag.com/net-zero/top-10-nations-that-are-leading-the-renewable-energy-charge-countries-emissions)

(https://www.whitehouse.gov/briefing-room/statements-releases/2022/12/13/fact-sheet-u-s-africa-partnership-in-supporting-conservation-climate-adaptation-and-a-just-energy-transition/)

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2.3 Mapping Turin's Strategic Development Priorities *(max 500 words)*

Energy poverty is a socioeconomic phenomenon characterised by inadequate access to affordable and reliable energy services, which can have a significant impact on the quality of life and well-being of individuals and communities. It is typically associated with low-income households and vulnerable populations.

Subsequently, following a careful identification of areas at risk or currently affected by energy poverty, the city of Turin has developed strategies to improve and/or resolve issues that can exacerbate this problem. The central themes for which strategies have been developed revolve around improving energy efficiency, with a focus on energy retrofit programs for existing obsolete residential buildings. This includes enhancing insulation, upgrading windows and doors, and improving heating and cooling systems.

Another central theme is the source of energy production and distribution in the area. The promotion of renewable energy systems, such as solar panels, in both residential and public buildings is encouraged to reduce energy costs and dependence on conventional energy sources.

It's important to note that these areas are characterised by low-income families. Therefore, to ensure that these strategies are implemented, initiatives should be developed to make social housing accessible despite efforts to improve energy efficiency in the buildings themselves.

Another strategic priority outlined by the City of Turin is to increase the number of green areas in urban areas to combat the phenomenon of urban heat islands, which is becoming increasingly widespread and dangerous.

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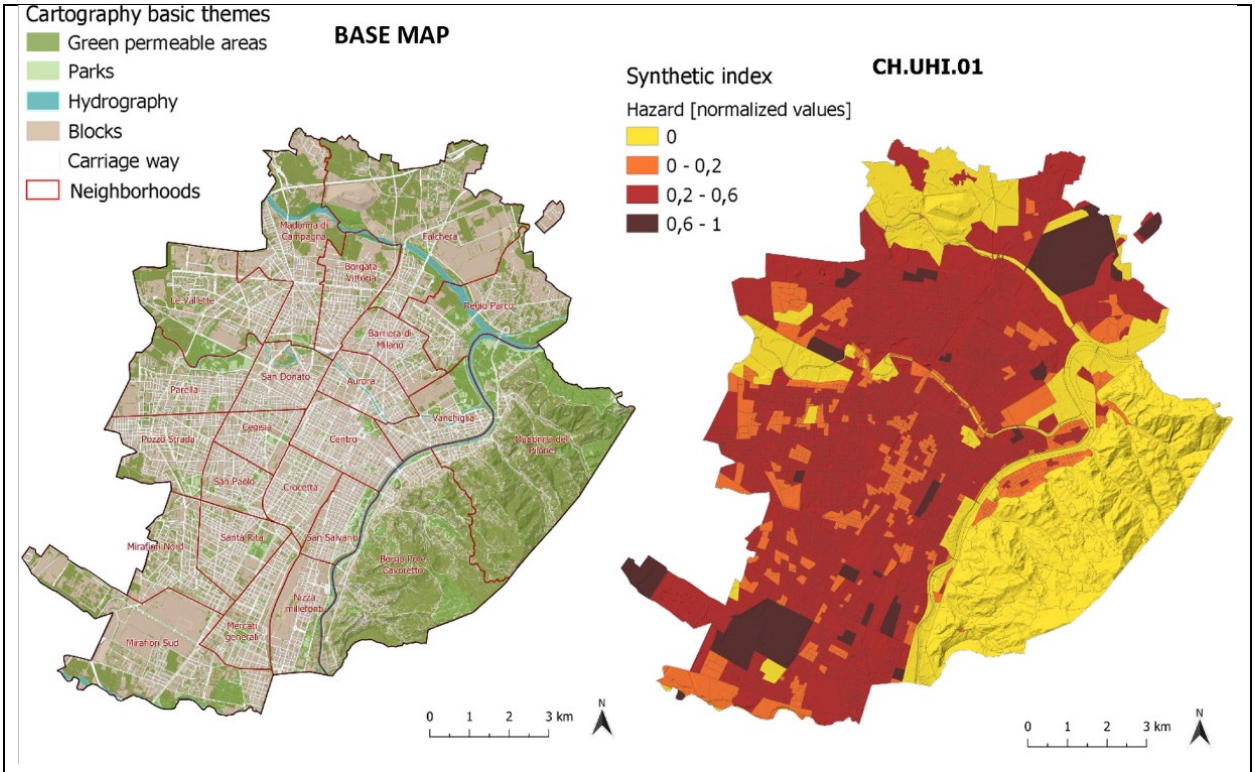

FIG.1, Green areas and parks in Turin, FIG. 2, Heat Island in Turin (G. Melis, E. Di Gangi, M. Ellena, N. Zengarini, G. Ricciardi, P. Mercogliano, G. Costa, Urban Heat Island effect and social vulnerability in Turin: Prioritising climate change mitigation action with an equity perspective, Science Talks, Volume 8 (2023))

By following these general strategic guidelines, we will be able to develop solutions to combat the issue of energy poverty through more in-depth and detailed studies of the areas affected by the phenomenon and their intrinsic urban characteristics.

2.4 Methods *(max. 500 words)*

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Case Study + Our development priorities

As you can see from the image below, the issue related to energy poverty is widespread in specific areas of the city of Turin.

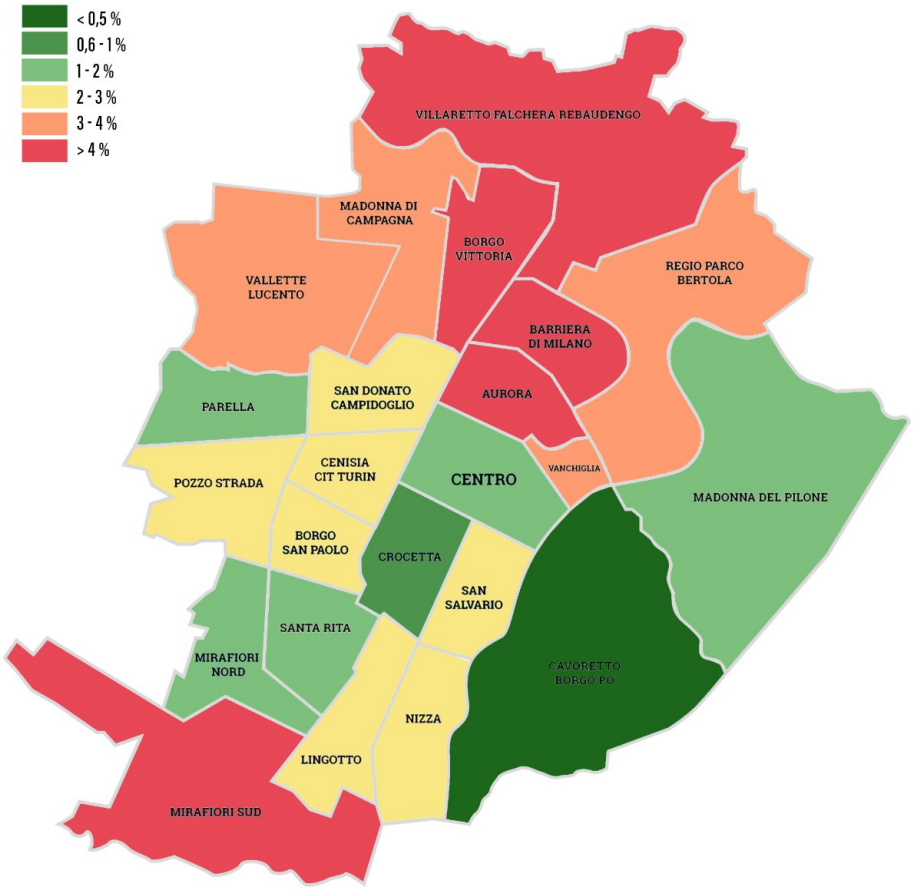

Fig. ... - Energy poverty of families by neighbourhoods (Fabbisogni e consumi delle famiglie vulnerabili: caratterizzazione del fenomeno e politiche di mitigazione e contrasto. Simone Maggiore, Anna Realini, Marco Borgarello (2020))

In order to address this issue effectively, it is crucial to focus on the redevelopment of existing buildings. Specifically, there is a need for a comprehensive approach to energy management in existing structures. This involves implementing measures related to the production and management of energy systems, improving the energy performance of building envelopes (such as thermal insulation of roofs and walls, replacement of external windows), and enhancing thermal comfort (through the installation of solar shading devices).

However, as previously mentioned, these types of interventions often face challenges in certain socio-economic areas of the city of Turin. Notably, the issue of energy poverty is more prevalent in neighbourhoods such as Mirafiori Sud, Falchera, Aurora, and Barriera di Milano. These

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neighbourhoods often feature a high concentration of existing housing units with poor energy efficiency and outdated energy systems, resulting in high energy costs for residents.

Additionally, these areas have a significant number of public residential housing units that are exclusively accessible to low-income individuals, making it challenging to carry out the revitalization of existing properties. Similarly, privately-owned residential units acquired through the process of alienation contribute to fragmented property ownership, further complicating efforts to implement collective projects. This situation generates scepticism and a low willingness to invest in building modernization.

The issue becomes even more critical when residential units rely on centralised heating systems, such as district heating, as is the case in specific neighbourhoods like Mirafiori Sud and Le Vallette.Furthermore, the neighbourhoods mentioned above are in a condition where both low to moderate income levels and a high energy poverty index prevail. This condition indicates a specific state of vulnerability for these neighbourhoods regarding energy redevelopment efforts.

From recent studies conducted by the Epidemiological Observatory of the Local Health Authority (ASL) of Turin 3, the health condition of individuals has been analysed to assess a possible correlation between the onset of certain diseases and the condition of energy poverty. The study has indeed revealed that individuals in conditions of energy poverty (in more disadvantaged socio-economic situations) may have a poorer state of health, increasing the risk of premature mortality due to extreme heat and/or cold. In the city of Turin, this disparity is more pronounced in the most disadvantaged neighbourhoods, resulting in a difference of approximately 4 years in life expectancy compared to, for example, the hillside areas.

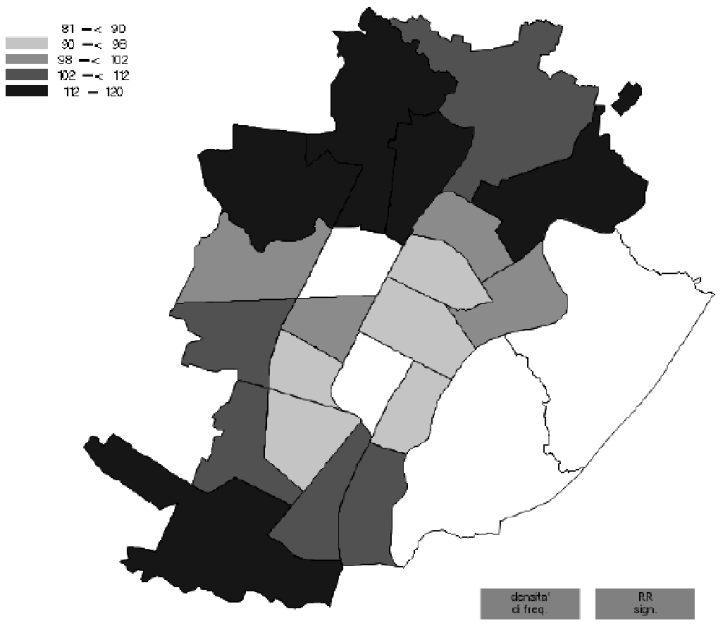

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Fig. 2 – Age and gender-standardized observed-to-expected mortality ratios for Energy Poverty
(excerpt from Fabbisogni e consumi delle famiglie vulnerabili: caratterizzazione del fenomeno e politiche di mitigazione e contrasto. Simone Maggiore, Anna Realini, Marco Borgarello (2020)

In these conditions, it becomes even more evident that the housing comfort (together with the effects related to strategies to increase urban vegetation) has a significant impact on energy expenditure and energy poverty.

The age of buildings, coupled with high energy costs, are among the primary issues to address when tackling the topic of energy poverty that state incentives have failed to resolve adequately. In Italy, various tools have been adopted to combat energy poverty, including support for bill payment (electricity or gas bonuses), energy consultations (to disseminate recommendations on functional consumption behaviours, assist users in identifying additional support measures to which consumers are entitled, and facilitate access to the market for vulnerable customers), as well as incentives or direct interventions for energy efficiency improvements in buildings.

However, incentives for energy efficiency upgrades (such as the Ecobonus) have proven to be somewhat ineffective in combating energy poverty. They require the upfront cost of the intervention to be covered by the property owner or tenant, with only a portion of the cost reimbursed through the incentive. Additionally, many users often live in rented accommodations, which discourages tenants from making investments from which they may not fully benefit. At the same time, property owners are not incentivized to make investments in energy efficiency since they cannot increase rent prices accordingly.

Our priorities are therefore based on finding solutions that can protect this segment of the population in order to increase the energy efficiency of a significant portion of the city.

3 CASE STUDY ANALYSIS

This section should provide a concise and precise description of the case study and the experimental results. Students should reflect on the selected theme by answering a series of questions (e.g. what specific theme was explored? why do you think this theme has relevance in relation to Just Green Transitions? what impact do you think you can expect on the Turin context (social, economic, spatial, environmental, etc.)? what are the expected results)? The different exercises carried out during the Summer School should be synthesized in this section. Figures, tables and supplementary materials can be used to elaborate this section.

3.1 **Thematic Study Selection** *(max 500 words)*

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Table 8. Set of thematic areas for EP assessment.

Level of assessment	Economic dimension	Social dimension	Environmental dimension
Macro	• Competitive energy prices • Energy consumption • Energy dependence • Energy balances • Policy actions	• Socio-economic and demographic household characteristics • Health • Social policy actions	• Energy efficiency • Renewable Energy • Greenhouse gas emissions • Environmental, energy policy actions
Meso	• Competitive energy prices • Energy expenditure • Presence or absence of political actions/initiatives	• Socio-economic and demographic characteristics • Health	• Energy efficiency of technologies used • Renewable fraction • Greenhouse gas emissions
Micro	• Energy access • Energy consumption (expenditure) • Energy prices • Income	• Socio-economic and demographic household characteristics • Habits • Health	• Housing characteristics • Energy efficiency of technologies used • Renewable fraction

The issue of energy poverty is a problem that has been spreading more and more, especially in the post-pandemic period, and has worsened with the conflict in Ukraine. These two particular events have led to an increase in economic disparities due to rising unemployment and economic instability. Furthermore, especially due to the war, there have been increases in energy costs due to the rise in prices of energy resources.

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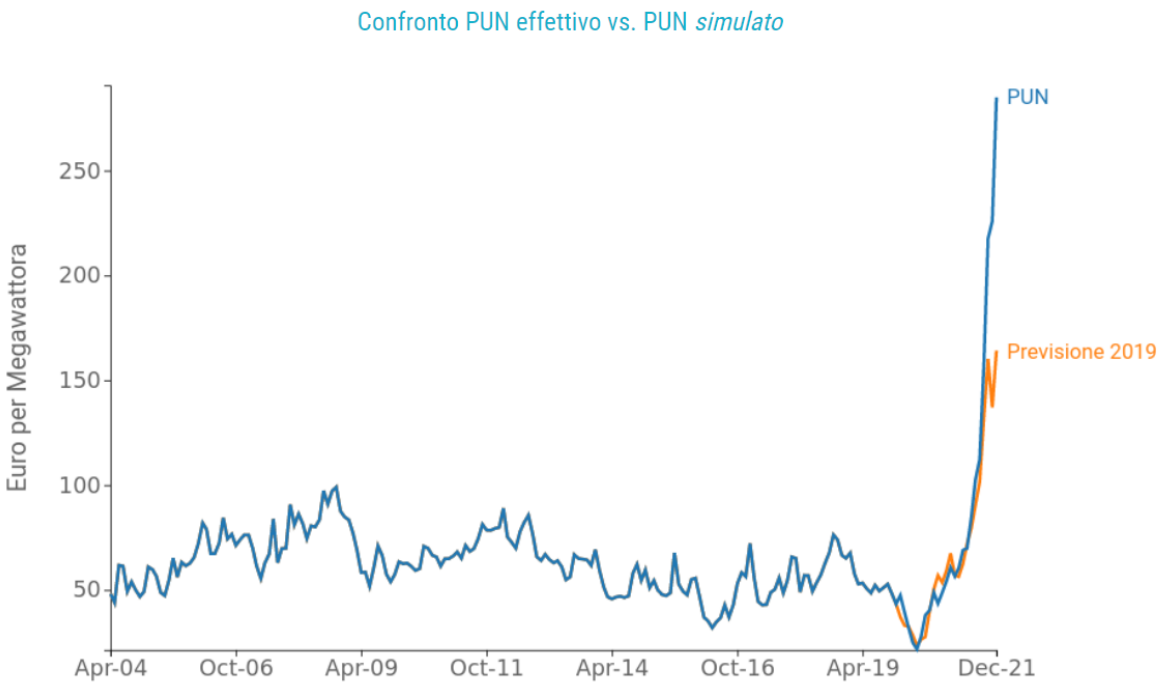

FIG.... - Compare the actual trend of the PUN price up to December 2021 with the results of the simulation using the estimated model between December 2019 and December 2021 (https://www.pricepedia.it/it/magazine/article/2021/12/22/quale-sara-il-prezzo-dellenergia-elettrica-nel-prossimo-biennio/)

But why is it necessary to address this issue efficiently and quickly? Certainly, energy poverty has first and foremost repercussions on the health and well-being of citizens. In fact, the lack of access to adequate energy supply, such as heating in winter or cooling in summer, can endanger the health and well-being of people. Additionally, energy poverty can hinder the achievement of reducing emissions by 2030 because low-income families do not have enough resources to support the costs required for energy-efficient building upgrades. Moreover, if families have to spend a significant portion of their income to cover high energy bills, they will have fewer resources available for other basic needs and for improving their quality of life.

On Macro level, we would like to work on the Energy consumption at various fields of the society and try to reduce the dependency on fossil fuels on the same. There some graphs below indicating the present scenario of energy consumption and energy resources of Italy.

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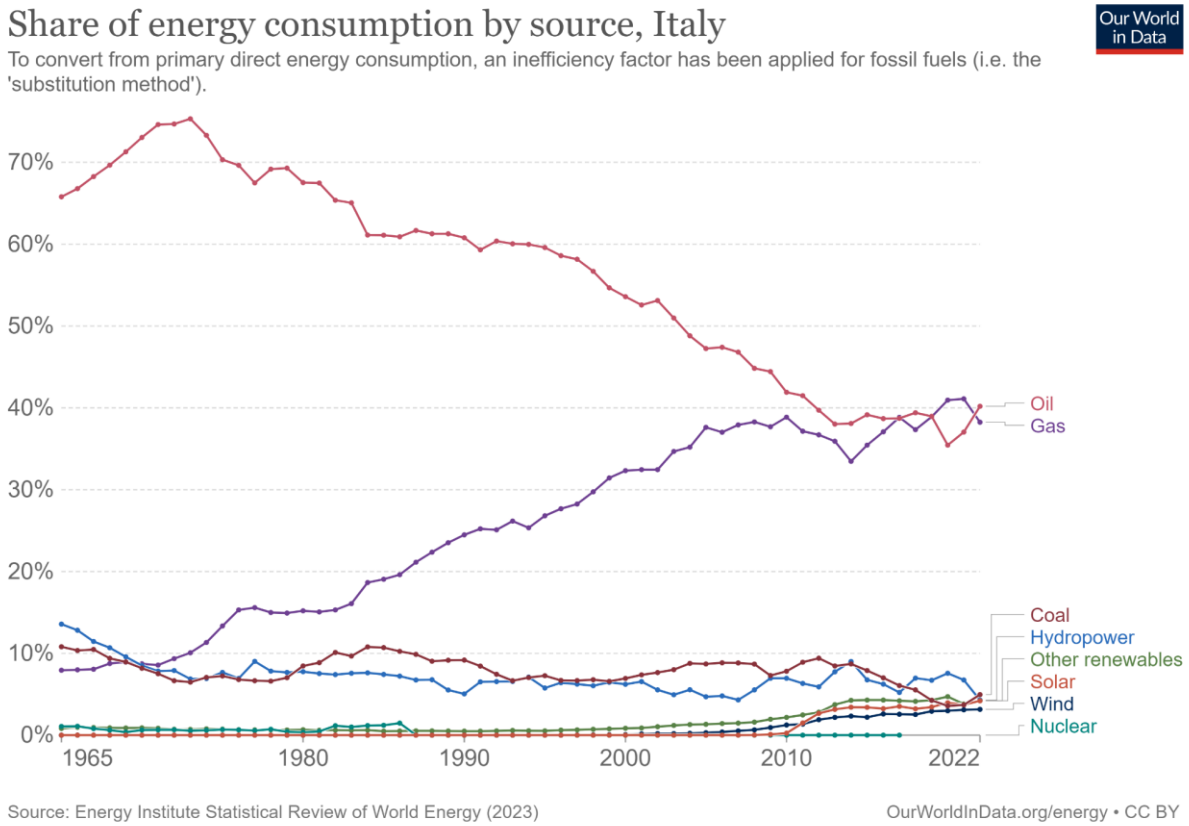
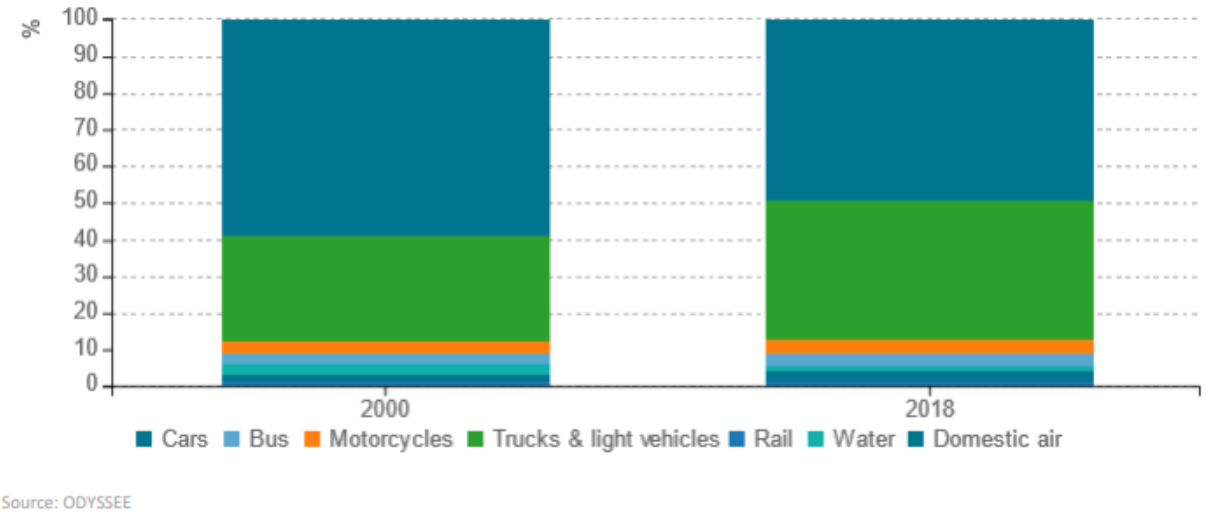


Figure 7: Transport energy consumption by mode



Road transport, passengers and freight, is the main mode of transport with over 90% of transport energy consumption. In 2018 cars accounted for 49% of energy consumption, trucks and light vehicles

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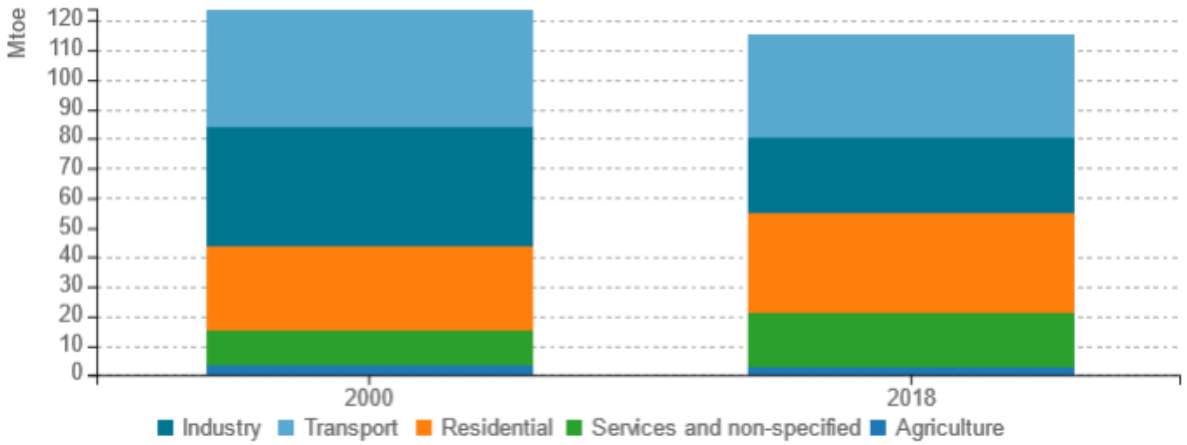
for 38%. The remaining consumption was used by domestic air transport (3%), motorcycles (4%), bus (3%), water (2%) and rail (2%).

Figure 1: Final energy consumption by sector (normal climate)



Source: ODYSSEE

The largest consuming sector was transport sector representing 31% of total final energy consumption with a 1.1 percentage points decrease since 2000. Over the period 2000-2018 residential and services sectors grew by 5.8 and 5.5 percentage points, respectively: the building sector, comprising residential and services sectors, represents 43.5% of total final energy consumption in 2018. Energy consumption in industry kept on decreasing, -37.1% since 2000.

Many progressive countries including EU, are considering to build Energy communities, which can generate clean energy at least to meet its own demand. Energy community initiatives is an initiative brought by EU in 2022, in 3 different projects. The European Parliament has provided funding for 3 different projects that contribute to the dissemination of best practices and provide technical assistance for the development of concrete energy community initiatives across the EU: the Energy Communities Repository, the Rural Energy Community Advisory Hub, and the support service for Citizen-Led Renovation. This initiative is citizen led approach, as the energy use and generation as to be brought into the user conscious.

(Ref: https://energy.ec.europa.eu/topics/markets-and-consumers/energy-communities_en)

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3.2 Spatialisation of Just Green Transition Impacts *(max. 750 words)*

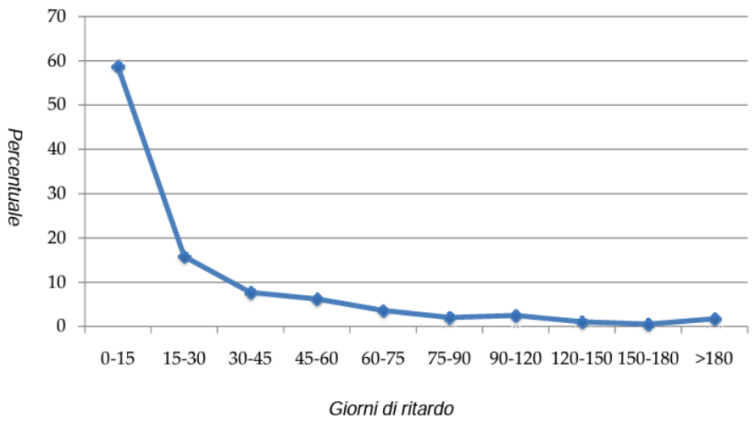
Title: Indicators for measuring energy poverty

Subtitle: indicatori che riflettano la disponibilità, l'accessibilità e l'uso dell'energia da parte delle persone

1. **Energy expenditure of households**
   This indicator measures the amount of money that families or individuals spend on energy bills in relation to the current price of energy. It can be calculated by estimating the average energy consumption compared to the current cost of energy (assuming that in the third quarter of 2023, the energy expenditure is approximately 23,85 c€/kWh [ARERA - Andamento del prezzo dell'energia elettrica per il consumatore domestico tipo in maggior tutela]).
   From the calculation we can assume that the Annual Space Heating Consumption (AHC) in Turin is about 7,324 GWh/year.

2. **Arrears on bills**
   Late payment of energy bills can be an indicator of financial difficulties and can help measure energy poverty. It consists in a self-declaration by families of not being able to pay bills in good time in the last 12 months. The Index has been applied to the following case: Municipality of Torino, Electricity, in collaboration with IREN Mercato SpA: about 175.000 households served by the regulated service (Maggior Tutela), for the years 2008-2011;
   (Turin-Index of final user arrears status)

Ritardo (giorni)	Frequenza (%)
0-15	417.453 (58,67)
15-30	112.422 (15,80)
30-45	54.747 (7,69)
45-60	44.601 (6,27)
60-75	25.973 (3,65)
75-90	14.608 (2,05)
90-120	17.787 (2,50)
120-150	7.633 (1,07)
150-180	3.918 (0,55)
>180	12.418 (1,75)



Ritardo	Frequenza (%)
Sì	711.560 (18,19)
No	3.200.466 (81,81)

3. **Number of family members**
   This indicator takes into account the number of people living in a family and can be used to assess the relationship between family size and the amount of energy required to meet its needs. Furthermore, families living in overcrowded spaces may be more susceptible to energy poverty as heating or cooling can be less effective in crowded areas

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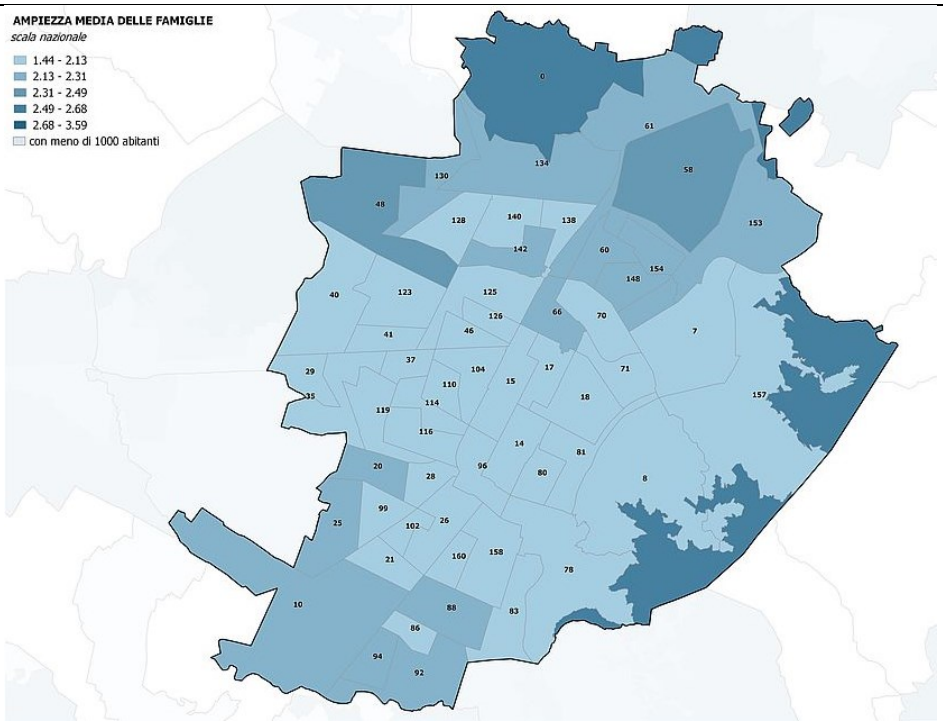

(DATI 2011 PER AREA DI CENSIMENTO, fonte: https://ottomilacensus.istat.it/sottotema/001/001272/4/)

4. **Average incomes per capita (€)**

   This indicator in energy poverty is useful because it helps identify vulnerable families and is therefore valuable in assessing the effectiveness of energy poverty mitigation measures. Additionally, it allows understanding which and how many families would be able to bear the initial financial burden required for potential energy building upgrades.

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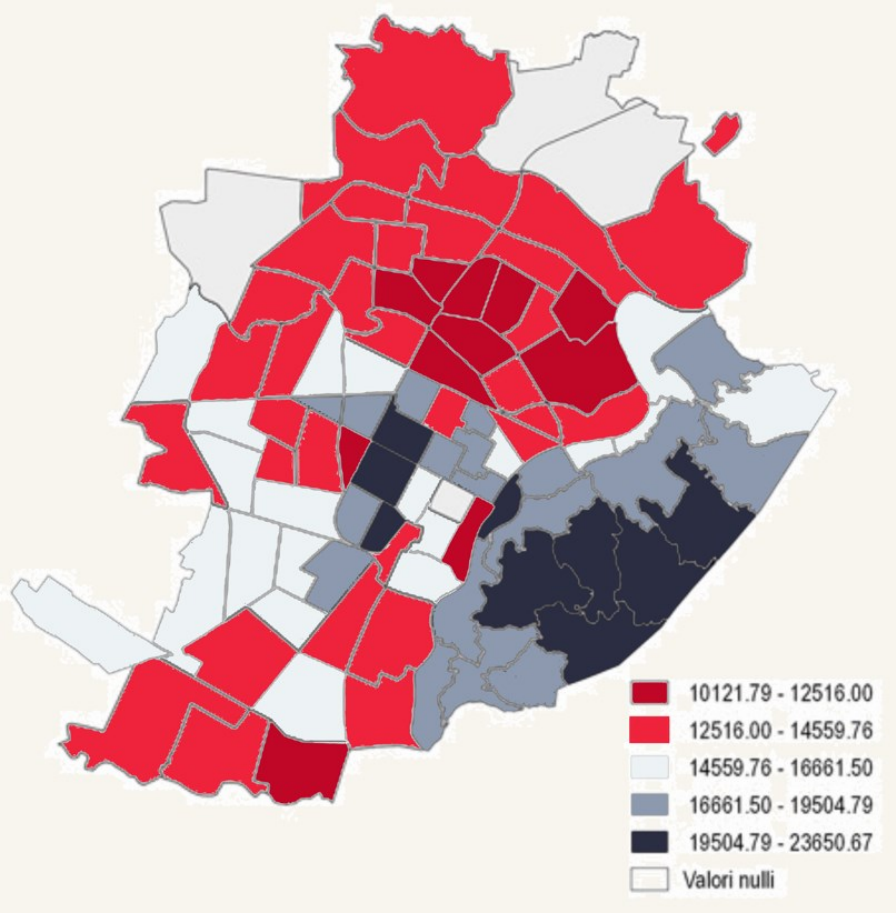

Average incomes per capita (€) [Rapporto Rota 2017]

5. **Period of Residential Building Construction**

The age of residential building construction can significantly influence energy poverty as older buildings are more challenging to maintain a comfortable temperature without high energy costs due to outdated insulation systems. For this reason, those buildings require energy retrofit interventions to achieve higher energy efficiency classes.

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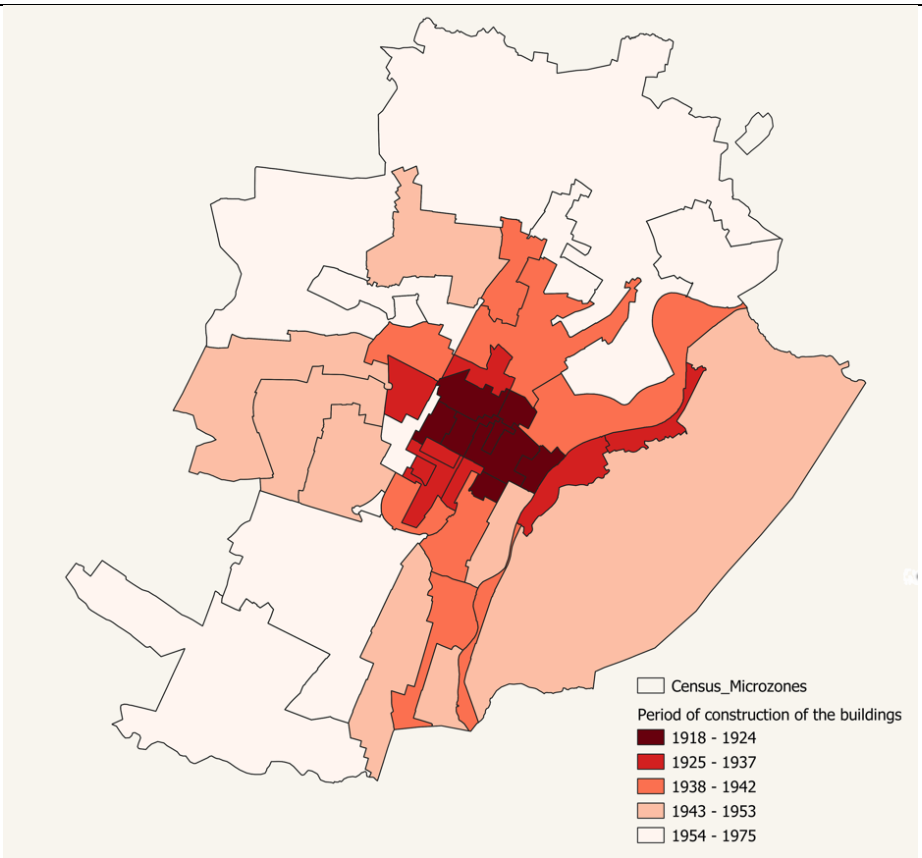

Period of construction of buildings [Geoportale Piemonte]

6. **Age and gender-standardised observed-to-expected mortality ratios for Energy Poverty**

From recent studies conducted by the Epidemiological Observatory of the Local Health Authority (ASL) of Turin 3, the health condition of individuals has been analysed to assess a possible correlation between the onset of certain diseases and the condition of energy poverty. The study has indeed revealed that individuals in conditions of energy poverty (in more disadvantaged socio-economic situations) may have a poorer state of health, increasing the risk of premature mortality due to extreme heat and/or cold. In the city of Turin, this disparity is more pronounced in the most disadvantaged neighbourhoods, resulting in a difference of approximately 4 years in life expectancy compared to, for example, the hillside areas.

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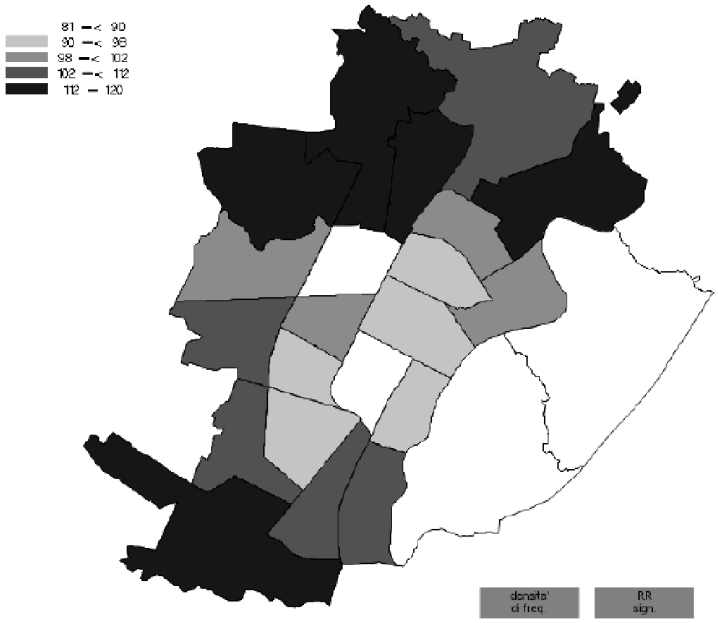

Age and gender-standardized observed-to-expected mortality ratios for Energy Poverty (excerpt from Fabbisogni e consumi delle famiglie vulnerabili: caratterizzazione del fenomeno e politiche di mitigazione e contrasto. Simone Maggiore, Anna Realini, Marco Borgarello (2020)

7. **Energy Performance of residential buildings**

The energy efficiency of a residential building determines how effectively it can maintain a comfortable indoor temperature while minimising energy consumption. High-energy efficiency buildings require less energy for heating, cooling, and lighting, which can help reduce energy bills for occupants, including those from low-income families. Therefore, we can consider residential building energy performance as closely linked to energy poverty. Improving the energy efficiency of homes can help reduce energy costs for low-income families, enhance living conditions, and have positive effects on both financial and health aspects of those affected by energy poverty.

Energy Performance of residential buildings in Turin

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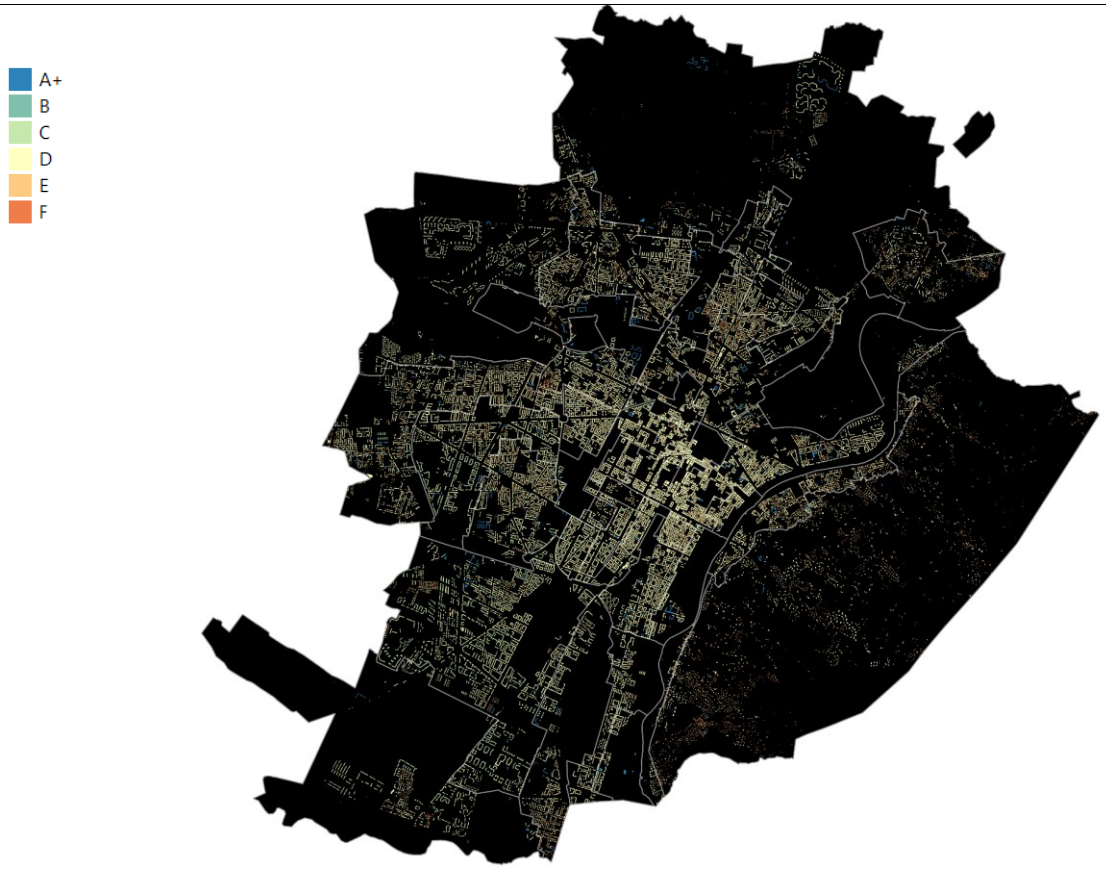

From the calculations carried out to determine the energy class of each residential building in the city of Turin, it is evident that the majority of them fall into energy class D. Energy class D can be considered a moderate classification in terms of energy efficiency for a building; however, it also indicates that the building is less energy-efficient compared to higher classes. A better energy class, such as A or B, represents a building that is much more energy-efficient, with lower energy consumption and associated costs. Buildings in energy class D may require a significant amount of energy for heating, cooling, and lighting, which can result in higher energy bills for occupants. Therefore, these buildings would benefit from energy retrofitting to improve their performance and move to higher energy classes. Such types of interventions could lead to energy savings ranging from 15% to 30% per year, resulting in cost savings on energy bills as well. Below, you can see an example of calculations for microzones 7 and 22 (Vanchiglia and Michelotti) of the types of interventions that are more suitable based on the year of construction of the building and the results obtained with the application of energy retrofit measures.From the table, can you infer which intervention is more cost-effective in terms of energy saved per year based on the building's construction year and number of floors. This can be applied in all buildings in Turin.

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Year of construction	Intervention	Saved energy [Kwh/year]	Saved energy [%]	Intervention for best energy saving
< 1919	Walls insulation		/	Roof insulation
	Roof insulation	13.675.838	24%	
	Inferior slab insulation	5.128.439	9%	
	Windows and shutters	9.687.052	17%	
1919 - 1945	Walls insulation		/	Roof insulation
	Roof insulation	41.363.755	26%	
	Inferior slab insulation	12.727.309	8%	
	Windows and shutters	27.045.532	17%	
1946 - 1960	Walls insulation		/	Roof insulation
	Roof insulation	20.441.082	17%	
	Inferior slab insulation	4.809.666	4%	
	Windows and shutters	18.036.249	15%	
1961 - 1970	Walls insulation	21.743.163	29%	Walls insulation
	Roof insulation	12.745.992	17%	
	Inferior slab insulation	3.748.821	5%	
	Windows and shutters	14.995.285	20%	
1971 - 1980	Walls insulation	5.217.716	26%	Walls insulation
	Roof insulation	2.809.540	14%	
	Inferior slab insulation	2.006.814	10%	
	Windows and shutters	5.017.035	25%	
1981 - 1990	Walls insulation	2.124.977	30%	Walls insulation
	Roof insulation	991.656	14%	
	Inferior slab insulation	566.661	8%	
	Windows and shutters	1.487.484	21%	
1991 - 2005	Walls insulation	5.169.425	34%	Walls insulation
	Roof insulation	1.520.419	10%	
	Inferior slab insulation	760.210	5%	
	Windows and shutters	1.824.503	12%	

From an overlap of these indicators, it was possible to generate a map of neighbourhoods most susceptible to energy poverty according to our set of indicators that may influence it. Below is a scale map from red to green, where red indicates that the neighbourhood is at risk of energy poverty and green signifies that it is not affected. The white circles represent neighbourhoods with more outdated residential buildings based on the year of construction.

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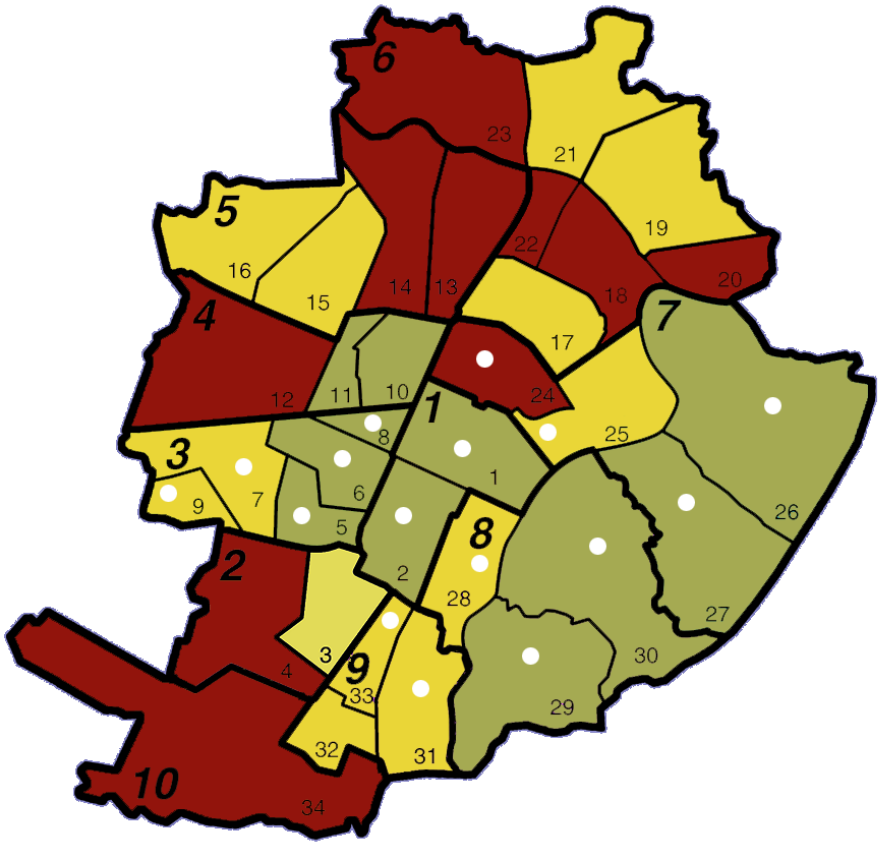

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3.3 Cost-Benefit Analyses to measure Just Green Transitions *(max. 750 words)*

CBA analysis

From all the indicators we have chosen the indicator of the "Energy performance of residential buildings" in Turin, and the intervention for energy poverty will be the retrofitting of old buildings.

COSTS

1- Retrofitting costs (calculate the expenses involved in retrofitting old buildings, including insulation, upgrading heating systems, installing energy-efficient windows, etc).

2- Maintenance costs (estimate ongoing maintenance expenses after retrofitting)

3- Administrative Costs (consider costs related to obtaining permits, legal fees, and project management).

BENEFITS

1- Energy Savings (retrofitting buildings to improve energy performance can result in reduced energy consumption for heating, cooling, and lighting, leading to direct cost savings on energy bills for residents).

2- Health improvements (enhances insulation and improved indoor environment resulting from retrofitting can positively impact residents' health by reducing exposure to extreme temperatures and improving indoor air quality).

3- Environmental Impacts (lower energy consumption means reduced carbon emission and environmental impact, contributing to a more sustainable urban environment).

Calculation of CBA

Assumption:

1- Retrofitting cost for a building in Turin: €100,000

2- Annual energy savings after retrofitting: 20% of reduction in energy consumption, estimated at €10,000

3- Maintenance costs post-retrofitting: €2,000

4- Administrative costs: €5,000

Benefit calculation:

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Annual Benefit = Energy Savings – Maintenance cost annual benefit = €10,000 - €2,000 = €8 000

Cost calculation:

Total Cost = Retrofitting Costs + Administrative Costs = €100,000 + €5,000 = €105,000

CBA

1- Net Benefit per Year: €8,000

2- Initial Investment: €105,000

3- Payback on Period: Approximately 13.13 years (105,000/8,000)

4- Return on Investment (ROI): 7.6% annually (8,000/105,000 * 100)

Based on these results, retrofitting the building yields positive net benefits over time. Although the initial investment is substantial, the yearly energy savings offset ongoing maintenance costs, resulting in a positive ROI and payback period of around 13 years.

3.4 **Land-Based financing for Climate Solutions** *(max. 750 words)*

Energy Efficiency Retrofits:

Our project begins with the implementation of an Energy Efficiency Retrofits program targeting 500 residential units within Mirafiori Sud. The objective is to achieve a substantial 20% reduction in energy consumption. Assuming an annual energy bill of €1 million for these units, this retrofit could result in significant cost savings, amounting to approximately €200,000 annually. The retrofit involves upgrading existing buildings with energy-efficient technologies, thereby not only reducing utility costs for residents but also contributing to the broader environmental sustainability goals.

Green Spaces and Urban Planning:

Simultaneously, our initiative includes the development of green spaces and urban planning strategies. A prime example is the creation of a new 10,000 square meter park within Mirafiori Sud. Beyond the immediate aesthetic improvements and recreational benefits, these green spaces contribute to the overall well-being of the community. Studies have shown that access to green areas can positively influence property values. While

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quantifying this impact precisely is challenging, a conservative estimate suggests a potential increase in the overall land value by several million euros. Integrating urban planning strategies ensures that these green spaces are thoughtfully incorporated into the community fabric, promoting a sustainable and vibrant neighborhood.

In tandem with these transformative measures, the application of Betterment Charges becomes a crucial financial mechanism. Betterment Charges, set at a modest 2% of property value, serve as a funding source generated directly from property owners. In our example, this equates to an additional annual revenue of €400,000. These funds can be earmarked for financing vital infrastructure improvements, such as upgraded utilities, roads, and community facilities. The implementation of Betterment Charges not only ensures the active participation of the local population but also establishes a sustainable funding model for the continued development and improvement of Mirafiori Sud.

In summary, this integrated approach seeks to create a holistic urban environment in Mirafiori Sud, addressing both energy efficiency and community development while actively engaging and benefiting the local residents.

Links/References

- UN-Habitat (2016): LEVERAGING LAND: LAND-BASED FINANCE FOR LOCAL GOVERNMENTS-A READER, GLTN

http://geoportale.comune.torino.it/web/governo-del-territorio/piano-regolatore-generale

3.5 Just Green Transition: between carbon-neutrality and re-industrailisation *(max. 750 words)*

Title: Just Green Transition: between carbon-neutrality and (re)industrialisation

Exercise: Rethinking industrial cities in the green transition: the case of Skellefteå

Operative steps

- The establishment of manufacturing facilities focused on renewable energy components is key in pursuing reindustrialization within a just green transition. These initiatives not only contribute to a sustainable energy ecosystem but also create opportunities for job growth and economic revitalization. Investing in plants manufacturing renewable energy components like solar panels, wind turbines and energy storage systems promotes expansion of the green energy sector and drives technological innovation. By localizing production, countries can reduce import dependence and boost domestic renewable energy infrastructure. Simultaneously, establishing recycling facilities concentrating on reclaiming valuable materials from end-of-life renewable energy products supports a circular economy. These recycling initiatives reduce waste, conserve resources and minimize environmental impact from manufacturing. Additionally, supporting the energy retrofitting industry for buildings complements these efforts by fostering job creation and enhancing energy efficiency, aligning with broader goals of a sustainable reindustrialization process.
- Creating manufacturing plants geared toward renewable energy components is foundational in transitioning to a greener industrial landscape. These facilities drive technological advances and enable mass production of renewable energy technologies, making them more accessible and cost-effective. Investments in solar panel manufacturing plants, wind turbine factories and

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energy storage system production facilities spur innovation while generating significant manufacturing jobs. Skilled workers in engineering, production, logistics and maintenance are essential for efficiently operating these plants. Furthermore, strategically locating these manufacturing facilities in regions with high potential for renewable energy deployment like areas with ample sunlight or strong wind resources allows countries to maximize renewable energy generation while also fostering local economic development.

- Concurrently, establishing recycling facilities specialized in handling end-of-life renewable energy products addresses sustainability concerns in the green energy sector. As the lifespan of renewable energy components ends, recycling facilities play a critical role in reclaiming valuable materials like silicon from solar panels or rare earth elements from wind turbines. Through advanced recycling techniques, these materials can be extracted and reused in manufacturing new renewable energy components, reducing reliance on raw materials and minimizing environmental degradation. Additionally, creating recycling facilities generates employment opportunities in waste management, material recovery and technological innovation. Investing in research and development within these recycling facilities fosters advancement of efficient recycling technologies, promoting a closed-loop system where materials are continually repurposed and reused.

- Complementing these efforts, the energy retrofitting industry for buildings amplifies job creation while significantly enhancing energy efficiency. Retrofitting existing buildings with energy-efficient systems, insulation and smart technologies not only reduces energy consumption but also stimulates employment across various sectors. Skilled workers like construction professionals, electricians, HVAC technicians and energy auditors are crucial for executing these retrofitting projects. As demand grows for energy-efficient buildings, this industry not only generates immediate job opportunities but also stimulates production of energy-efficient materials and technologies. Government support through incentives, subsidies and regulations further accelerates growth of the energy retrofitting sector, encouraging building owners and developers to invest in sustainable upgrades.

- Integrating these initiatives—establishing manufacturing facilities for renewable energy components, recycling facilities for end-of-life products and supporting the energy retrofitting industry—creates a comprehensive framework for a just green transition. It not only promotes sustainable industrial growth but also fosters job creation across diverse skillsets from manufacturing and engineering to recycling and construction. Additionally, these efforts contribute to reducing greenhouse gas emissions, conserving resources and developing a circular economy model. By aligning economic development with environmental sustainability, reindustrialization in a just green transition phase can pave the way for a more resilient, equitable and environmentally conscious industrial landscape. As governments, industries and communities collaborate to realize these initiatives, they lay the foundation for a brighter, more sustainable future.

4 POLICY ADVICE AND RECOMMENDATIONS

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This section should provide a concise and precise description of the list of policy recommendations and policy advice that the team has identified to support Just Green Transitions implementation in Turin and prevent possible side effects. Figures, diagrams, tables, and supplementary materials can be used to clarify/better explain the recommendations made.

Main Challenges

(*Describe what are the main challenges your topic has in terms of social, economic and environmental dimension*)

- Achieve the Energy Equity - accessibility and affordability to the carbon neutral energy
- Retro-fitting options made accessible to all the residential building to reduce the energy consumption at the building level
- Energy providers have to find new clean ways to produce the energy
- Bring the Energy Community initiative of the European Union into force in the town: A Citizen led approach to Energy Actions
- Improve the quality of life by implementing the better green infrastructure to reduce the dependency on the mechanical devices for the comfort at home.
-

General Objective

(*Please define the main objective of your proposal by motivating it throughly*)

- To achieve energy equity and affordability through diversifying the energy resources with the available technology or by partnering with the global leaders in the respective field.

Specific Objectives

(*Please define the specific objectives through which the challenges identified could be addressed*)

- Addressing the issues at different levels of society I.e., Micro, Meso, and Macro levels.

Strategies

(*Please identify a list of strategies that can effectively address the challenges that emerged by identifying different development trajectories or opportunities to restructure the current development path*)

- Understand the energy consumption of the energy at the building level - to reduce the consumption by retro-fitting
- Understand the socio-economic dynamics of the area of study
- Understanding the clean energy resources could be used to reduce the dependency on fossil fuels.
- Understanding the economic dynamics of the energy production from the clean energy resources.
- Addressing the green infrastructure issue at the local level for the better solutions.
- Forging the partnership to better use of the available clean energy resources.
-

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Actions

(*Please associate with each strategy a number of actions you think can support the current transition of the city of Turin. The list of actions has to be coherent with the topic selected*)

- Increasing the possibility of deducting the cost of the project (even up to 100%), with limits on the cost of the intervention and in relation to the level of poverty.
- If this reinforcement of the incentive is deemed insufficient, measures may be adopted to grant incentives to private or institutional entities. An interesting mechanism has been implemented by the United Kingdom (Energy Company Obligation), in which subsidies are provided to energy providers obligated to carry out energy-efficient measures on residential buildings used by vulnerable users (with annual targets for reducing consumption and reducing energy bills). The cost of the intervention is advanced by the provider and shared among users of the electric and gas services.
- Introducing measures for transferring the tax credit to consortia of credit institutions that commit to offering individuals in poverty low-interest rates.
- Promoting and Building Energy Communities - Funded by EU
- Improve the Green Infrastructure of the city to reduce the Urban Heat Island and the flooding risks.

5 REFERENCES

(https://www.aerb.gov.in/english/regulatory-facilities/nuclear-power-plants)

.(https://www.gov.uk/government/publications/powering-up-britain#:~:text=We%20will%20move%20towards%20energy,will%20play%20in%20that%20transition)

(https://sustainabilitymag.com/net-zero/top-10-nations-that-are-leading-the-renewable-energy-charge-countries-emissions)

(https://www.whitehouse.gov/briefing-room/statements-releases/2022/12/13/fact-sheet-u-s-africa-partnership-in-supporting-conservation-climate-adaptation-and-a-just-energy-transition/)

Rapporto Rota, 2017

G. Melis, E. Di Gangi, M. Ellena, N. Zengarini, G. Ricciardi, P. Mercogliano, G. Costa, Urban Heat Island effect and social vulnerability in Turin: Prioritising climate change mitigation action with an equity perspective, Science Talks, Volume 8 (2023)

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(Fabbisogni e consumi delle famiglie vulnerabili: caratterizzazione del fenomeno e politiche di mitigazione e contrasto. Simone Maggiore, Anna Realini, Marco Borgarello (2020)

excerpt from Fabbisogni e consumi delle famiglie vulnerabili: caratterizzazione del fenomeno e politiche di mitigazione e contrasto. Simone Maggiore, Anna Realini, Marco Borgarello (2020)

https://www.pricepedia.it/it/magazine/article/2021/12/22/quale-sara-il-prezzo-dellenergia-elettrica-nel-prossimo-biennio/

https://turinschool.eu/turin-index

https://ottomilacensus.istat.it/sottotema/001/001272/4/

Geoportale Piemonte

ARERA - Andamento del prezzo dell'energia elettrica per il consumatore domestico tipo in maggior tutela

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