LUISS

Department of Law

Master of Science in Law, Digital Innovation and Sustainability

Chair: Climate-Neutral and Smart Cities

Social Energy Communities as a Tool to Contrast Energy Poverty: Experimental Projects in Rome and Tilburg

Supervisor:

Prof. Christian Fernando Iaione

Co-Supervisor:

Prof. Claudia Meloni

Candidate: Chiara Scalia

ID Number: 630553

Academic Year 2022/2023

Grazie alla mia famiglia, a Francesco, ai miei amici e a tutti coloro che hanno creduto in me.

Grazie al Prof. Iaione, alla Prof.ssa Meloni e alla Dott.ssa Aquili che mi hanno supportato nella stesura di questa tesi.

Infine, grazie a LDIS ed ai miei compagni di avventura per avermi insegnato l'importanza di "trust the process."

List of Abbreviations and Concept Explanations

Acea: *Azienda Comunale Energia e Ambiente*, Municipal Energy and Environment Company

ACER: European Union Agency for the Cooperation of Energy Regulators

ACT: Alessandrino, Centocelle, Torre Spaccata Co-District developed through the research by LabGov.City and ENEA

ARERA: *Autorità di Regolazione per Energia Reti e Ambiente*, Energy Networks and Environment Regulatory Authority

ASL: *Azienda Sanitaria Locale*, Italian Local Health Agency

CEC: Citizen Energy Community

Commission: European Commission

DNSH: Do Not Significantly Harm principle

DSO: Distributed System Operator. It is an entity responsible for distributing and managing energy from generation sources to final consumers.

EC: Energy Community

EEE: Energy Efficiency Certificate

ENEA: *Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile*, National Agency for New Technologies, Energy and Sustainable Economic Development

EPA: Environmental Protection Agency of the United States

ESCO: Energy Service Company

EU ETS: European Union Emission Trading Systems

EU: European Union

EV: Electric Vehicle

GSE: Gestore Servizi Energetici, Energy Service Operator

IEMD: Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on Common Rules for the Internal Market for Electricity and Amending Directive 2012/27/EU. Also known as Internal Electricity Market Directive (IEMD) or Electricity Directive.

IRL: Investment Readiness Level

LabGov ETS: Rome-based NGO created within the LabGov.City network

LabGov.City: also LabGov, the Laboratory for the Governance of the City as a Commons

Legambiente: Italian Environmental NGO

MASE: *Ministero dell'Ambiente e della Sicurezza Energetica*, Italian Ministry of the Environment and Energy Security

Mezzogiorno: South of Italy

MG: Mini-grid

MISE: *Ministero delle Imprese e del Made in Italy,* Italian Ministry for Business and Made in Italy, formerly Ministry for Economic Development

MS: Member State (of the European Union)

Municipio: administrative subdivision of the municipality of Rome

NDCs: Nationally Determined Contributions

NECP: National Energy and Climate Plan

NGO: Non-Governmental Organization

NRRP: National Recovery and Resilience Plan, *Piano Nazionale di Ripresa e Resilienza* or PNRR

PA: Public Administration

POD: Point of Delivery or point of supply and refers to electricity. Each user is assigned a unique POD code of 14 characters (numbers and letters).

PPCP: Public-private-community partnership

PPP: Public-private partnership

PV system: Photovoltaic system

REC: Renewable energy community

RED II: Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources. Also known as Renewable Energy Directive (RED) II.

RES: Renewable energy sources

Roma Capitale: Municipality of Rome

SHP: Small Hydroelectric Plant

SSA: Sub-Saharan Africa

TRL: Technology Readiness Level

US: United States of America

V2G: Vehicle-to-Grid

List of Technical Abbreviations

DC: Direct current

VDC: The voltage of a direct current (DC) circuit is measured in VDC (Volts Direct Current). Electrical current that only travels in one direction is known as direct current. DC current flows in a continuous direction, in contrast to alternating current (AC), which periodically changes direction.

kW: kilowatt

kWh: kilowatt-hours (one kilowatt of power for one hour)

kWp: kilowatt-peak (maximum capacity for one hour)

MW: megawatt (1 MW = 1000 kW)

GW: gigawatt (1 GW = 1000 MW)

TW: terawatt (1 TW = 1000 GW)

Mtoe: Million or megatons of oil equivalent

NPV: Net present value is the difference between the current value of cash inflows and outflows over a period of time. It is used to analyze the profitability of an investment. It is the result of calculations to find the present value of future streams of payments using a proper discount rate. The formula to calculate NPV is the following:

NPV = $[\text{Cash flow}/(1+i)^t] - \text{initial investment}$

V: Volt. Unit of electrical potential, electrical potential difference (voltage) and electromotive force.

Abstract

The thesis delves into the role of social energy communities as a tool to contrast energy poverty. It makes a comparative regional analysis of bottom-up energy initiatives in the literature review and ultimately focuses on two experimental projects developed in the EU, where the concept of energy community was created, and the legal framework supports their development.

Within the EU, energy communities are addressed in different ways, depending on national implementations of the RED II directive and context-based peculiarities. For example, the Netherlands has a large concentration of energy communities (circa 600), but they do not address the social component of reducing energy poverty. This is exemplified by the fact that there still needs to be a national policy addressing energy poverty.

On the other hand, Italy has implemented a comprehensive policy framework to identify and address energy poverty. Furthermore, Legambiente, an environmental NGO, has founded the Network of Renewable and Social Energy Communities (*Rete delle Comunità Energetiche Rinnovabili e Solidali*), which gathers together energy communities located in vulnerable districts that aim to tackle energy poverty. Nevertheless, the concentration of energy communities is low compared to the EU average.

This work addresses the mismatch between energy community concentration and policies targeting energy poverty by developing two experimental projects. The first is Co-Roma, a Rome-based platform that maps and supports the development of social energy communities. The second is Tilburg JET, a social energy community developed in a vulnerable district in Tilburg, Netherlands, in partnership with the Tilburg Municipality. The challenge, in this case, is enhanced by the Dutch grid congestion, which requires a tailored approach.

Table of Contents

Introduction

Community-led energy initiatives are becoming an essential tool in many areas of the Global North to participate in the energy transition. For example, in Europe, energy communities are a central aspect of the energy transition strategies that set foot as a response to the European Green Deal. It is estimated that by 2050, 264 million European citizens will join the energy market as prosumers and generate 45 percent of the total renewable electricity on the market.[1] Pioneer countries, often enabled by national investments, are Germany (1750 active energy communities in 2020), Denmark (700 in 2020), the Netherlands (500 in 2020, more than 600 in 2023), the United Kingdom (431 in 2020), and Sweden (200 in 2020).[2] In the United States, many states are developing policy frameworks that foster bottom-up renewable energy initiatives.

On the other hand, community-led energy initiatives are still under-explored in many parts of the Global South, particularly in Sub-Saharan Africa. Nevertheless, such initiatives, coupled with solid entrepreneurship and keenness to new technologies, offer the opportunity to co-create a framework to contrast energy poverty.[3]

In Africa, the energy poverty struggle involves billions of people, and it is often exacerbated by rudimentary energy systems. For a large part of the population, there is no access to energy services. Many countries are taking a stance to address the needs of vulnerable communities in being part of the sustainable transition. For instance, in the 2016 Climate Change Act,[4] Kenya created a regulatory framework that provides mechanisms to foster low-carbon development through the Climate Change Fund. Regulatory frameworks are accompanied by NGOs' efforts to engage local communities in the energy transition, such as the case of Power Africa.[5]

Even though energy poverty is acknowledged at the national and international level, difficulties in implementation relate to the low levels of investments in renewable energy. Less than 8 percent of investments in energy transition technologies were made in the Asia-Pacific region in 2021 (excluding China), less than 4 percent in Latin America and the Caribbean, and less than 2 percent in Africa and the Middle East. Since the Paris Agreement was signed in 2015, annual investment in zero-carbon energy has stalled in developing nations outside China. By the end of the 2020s, yearly capital investment in zero-carbon energy in developing countries must grow by more than

[1] Barroco et al. (2020) *Le comunità energetiche in Italia: Una guida per orientare i cittadini nel nuovo mercato dell'energia*. Green Energy Community: EIT Climate-KIC, Agenzia per l'energia e lo sviluppo sostenibile, ENEA, Università di Bologna.
[2] Tarpani, E.; Piselli, C.; Fabiani, C.; Pigliautile, I.; Kingma, E.J.; Pioppi, B.; Pisello, A.L. Energy Communities Implementation in the European Union: Case Studies from Pioneer and Laggard Countries. *Sustainability* **2022**, *14*, 12528. https://doi.org/10.3390/su141912528
[3] Ambole,A.; Koranteng,K.; Njoroge, P.; Luhangala, D.L. A Review of Energy Communities in Sub-Saharan Africa as a Transition Pathway to Energy Democracy. *Sustainability* **2021**, *13*, 2128. https://doi.org/10.3390/su13042128
[4] The Climate Change Act 2016, 10 179 (2016). Kenya.
[5] https://powerafrica.medium.com/engaging-kenyan-communities-in-energy-development-d8b16848e7b4

seven times, to more than $ 1 trillion, to put the world on pace to achieve net-zero emissions by 2050.[6]

Despite being in the front row for the concentration of community-led energy initiatives, some countries of the Global North, for example the United States and the Netherlands, do not acknowledge energy poverty in their legal frameworks. In this case, different from several Global South contexts, energy access is guaranteed, but energy-vulnerable groups cannot afford to use it. This would make energy poverty in the Global North relative and in the Global South, in the cases where the energy infrastructure is lacking, absolute.

In the Netherlands, there is a consistent national investment toward the energy transition, but it is not directed at vulnerable communities. In fact, there is still no national policy that addresses energy poverty, which challenges the possibility of employing a bottom-up approach and implementing local-level policies.[7] This perspective undermines the general efforts to accelerate the energy transition since if the needs of the vulnerable communities are not addressed, they will not be prompted to act sustainably, having more short-term pressing matters to deal with.

In contrast, in Italy, the social aspect of energy communities as a tool to contrast energy poverty is accentuated even though the concentration of energy communities is more limited than in other European countries (35 active, 41 developing, and 24 moving initial steps in 2022). Despite this, many energy communities are developed with a strong social drive and converge in the Network of Renewable and Social Energy Communities (*Rete delle Comunità Energetiche Rinnovabili e Solidali*),[8] founded by Legambiente, an Italian environmental NGO. According to Legambiente, the development of energy communities can lead to savings of up to 25 percent for households, a vital contribution for the more than two million that struggle to secure power continuity, forced to forego energy services such as heating or to use outdated technologies risking their health and safety.[9]

This thesis investigates whether energy communities can be a tool to contrast energy poverty and addresses the mismatch between a consistent energy poverty policy framework coupled with a small concentration of energy communities, such is the case in Italy, and an inconsistent energy poverty policy framework coupled with a large concentration of energy communities.

In the first chapter, the author carries out a literature review of perspectives on energy poverty from the Global North and the Global South. In the second chapter, the author develops the research hypothesis by analyzing the concepts of energy democracy, energy justice, the city as a

6 Aydos, M., Toledano, P., Dietrich Brauch, M., Mehranvar, L., Iliopoulos, T.G. and Sasmal, S., 2022. Scaling Investment in Renewable Energy Generation to Achieve Sustainable Development Goals 7 (Affordable and Clean Energy) and 13 (Climate Action) and the Paris Agreement: Roadblocks and Drivers. *Available at SSRN 4309067*.
7 See Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624. See also Straver, K., Mulder, P., Hesselman, M., Tirado Herrero, S., Middlemiss, L., and Feenstra, M. (2020). *Energy Poverty and the Energy Transition*. TNO.
8 Comunità Rinnovabili (2022) Report by Legambiente. See www.comunirinnovabili.it
9 https://www.legambiente.it/comunicati-stampa/nasce-la-rete-delle-comunita-energetiche-rinnovabili-e-solidali/

commons and governing energy as a commons. The third chapter presents an analysis of case studies of community-led energy initiatives in the Global North and in the Global South. The fourth chapter analyzes the EU policy framework to carry out SDG 7 and combat energy poverty, as well as the renewable energy legal framework, which is relevant for the two experimental projects.

The first experimental project, analyzed in the fifth chapter, is Co-Roma, a Rome-based platform that supports the development of energy communities with a focus on social energy communities located in vulnerable contexts. This tool aims at increasing the concentration of energy communities first in Rome and then to scale up to other Italian cities.

The second experimental project, analyzed in the sixth chapter, is Tilburg JET, a social energy community developed in a vulnerable district in Tilburg, Netherlands, in partnership with the Tilburg Municipality. The challenge is enhanced by the Dutch grid congestion, which requires a tailored approach. In this case, the project aims at developing a pilot social energy community to be scalable in other vulnerable contexts. Eventually, Tilburg could replicate the Co-Roma platform to support the development of other social energy communities. Ultimately, both projects would contribute to the uptake of social energy communities and help contrast energy poverty in the respective countries.

Finally, themes emerging from the thesis are analyzed in the discussion, such as the need for city-specific energy poverty indicators, enabling factors for community-led energy initiatives to thrive, stakeholder engagement strategies, knowledge institutions for capacity building, and sustainable investment strategies.

The thesis has run in parallel to the writing of an academic publication on citizen-led energy production initiatives in coastal cities in the United States, Northern Europe, the Mediterranean area, and the Gulf of Guinea, co-written with Prof. Christian Fernando Iaione and Benedicta Quarcoo from Luiss University, and Dia Porter from Georgetown University. The paper is presented at the Ninth International and Comparative Urban Law Conference (ICULC), held from May 18th to 20th, 2023, at the Ghana Institute of Management and Public Administration in Accra. The conference is sponsored by the Urban Law Center at Fordham Law School and the Ghana Institute of Management and Public Administration (GIMPA). It is co-sponsored by UN-Habitat, the North-West University South African Research Chair in Cities, Law and Environmental Sustainability, and the University of Professional Studies Accra (UPSA).

Finally, the thesis has received the support of the Z-Labs, a co-design laboratory taught by Prof. Paola Belingheri aimed at supporting Master of Science students in writing their thesis, together with a pool of tutors, i.e., Simone Mori, ENEL Director for Europe, for the Scenario Analysis part, Aleardo Furlani, Innova CEO, for the Technology Transfer part, Maria Luigia Ruffo, Project Manager at Stardust, for the Engagement part, and Gaetano de Vito, President of Assoholding, for the Governance part.

1. Literature Review

Energy Poverty

Day, Walker and Simcock define energy poverty in capabilities terms as "an inability to realize essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable alternative means of realizing these capabilities."[10]

The way energy poverty is perceived and conceptualized varies across the world. In the Global North, it entails the inability to economically access energy sources which are nevertheless available at the national level. In many areas of the Global South, instead, it may mean no access to energy sources at all. Therefore, the approach taken in this chapter is diversified. For what concerns the Global South, the analysis focuses on investment initiatives by regional development banks in Asia-Pacific and Sub-Saharan Africa. This is because, even though energy poverty is acknowledged at the national and international level, difficulties in implementation relate to the low levels of investments in renewable energy. For what concerns the Global North, where infrastructure is already present, the analysis delves into policies targeting energy poverty and compares countries with a national framework on energy poverty, such as Italy and the UK, and countries that still do not have a framework in place, such as the Netherlands and the US.

Perspectives from the Global South

In developing countries, billions of people, especially in rural areas, lack access to clean and reliable energy, a problem identified in the Sustainable Development Goals (SDG) and connected to a more comprehensive understanding of improving socio-economic development and well-being.

The poverty rates in the Global South, especially in sub-Saharan Africa and some regions of Asia, are significantly impacted by the lack of access to modern and affordable energy services. Energy enhances living circumstances and creates prospects for revenue production and agricultural and economic output. Malnutrition, poor incomes, and lack of surplus money are often caused by low agricultural and economic output, and lead to a poverty trap. Clean and reliable energy can support job creation, trade, and value-creating activities, which enables vulnerable households to access education and health services, better nutrition, improved housing conditions, which in turn enables them to gradually escape the poverty trap.[11]

---

[10] Day, R., G. Walker, and N. Simcock. 2016. "Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework." Energy Policy 93: 255–264.
Also see Anders Melin, Rosie Day & Kirsten E. H. Jenkins (2021) Energy Justice and the Capability Approach—Introduction to the Special Issue, Journal of Human Development and Capabilities, 22:2, 185-196, DOI: 10.1080/19452829.2021.1909546
[11] Johansson, T. B., Patwardhan, A. P., Nakićenović, N., & Gomez-Echeverri, L. (Eds.). (2012). *Global energy assessment: toward a sustainable future*. Cambridge University Press. Chapter 2. Energy, Poverty, and Development. Convening Lead Authors (CLA):

Nearly 1.3 billion people lacked access to electricity in 2010, while 2.6 billion relied on biomass to power their homes. 95 percent of people without access to electricity reside in Asia and sub-Saharan Africa. Due to population size, Asia has a higher proportion of persons lacking access to energy, although sub-Saharan Africa has a generally lower degree of access. 63 percent of the world's population lives in just ten countries, six of which are in Africa (Nigeria, Ethiopia, the Democratic Republic of the Congo, Tanzania, Kenya, and Uganda), and four in Asia (India, Bangladesh, Pakistan, and Indonesia). The lowest rates of access to electricity are found in Malawi (9 percent), Uganda (9 percent), the Democratic Republic of the Congo (11 percent), Mozambique (11 percent), Myanmar (13 percent), and Afghanistan (15 percent). In Latin America, Haiti's level of 38 percent is much lower than Nicaragua's level of 72 percent, the second-worst situation.

Bangladesh, China, and India are home to half of the world's population who lack access to modern cooking facilities. The percentage increases to 75 percent when Nigeria, the Democratic Republic of the Congo, Pakistan, Indonesia, Vietnam, and the Philippines are included in the equation. Liberia, Zambia, Malawi, Namibia, the Democratic Republic of the Congo, Myanmar, Nepal, and Bhutan have almost no access to modern cooking facilities. The countries with the lowest access rates in Latin America include Nicaragua (3 percent), Honduras (4 percent), and Haiti (5 percent). On the other hand, in northern African and Middle Eastern nations like Iran (100 percent), Jordan (99 percent), and Algeria (98 percent), access is nearly universal.

The inequalities within nations, particularly between urban and rural areas, are not represented by these statistics. Rural areas are home to eight out of ten people who lack access to modern energy services due to geographical constraints and lower population density.[12] The following paragraphs analyze the investment efforts made in the Asia-Pacific region and the sub-Saharan Africa region, illustrating national and international funding mechanisms. These institutional efforts take into consideration the targets set by SDG 7 by 2030 to ensure universal access to modern energy services[13] and to increase the share of renewable energy in the global energy mix.[14]

Asia-Pacific

To accelerate the switch from coal to renewable energy, the Asian Development Bank (ADB) is testing an Energy Transition Mechanism (ETM) throughout Southeast Asia, focusing on coal facilities face-out, scaling up renewable energy alternatives, and ensuring the transition is fair and affordable. They have mobilized funds from donors, private institutional investors, international financial institutions, and other public or private sources to repurpose coal facilities. Carrying out

Stephen Karekezi (AFREPREN/FWD, Kenya) Susan McDade (United Nations Development Programme). Lead Authors (LA): Brenda Boardman (University of Oxford, UK) John Kimani (AFREPREN/FWD, Kenya). Review Editor: Nora Lustig (Tulane University, USA).

12 González-Eguino, M. (2015). Energy poverty: An overview. *Renewable and sustainable energy reviews*, *47*, 377-385.

13 United Nations General Assembly (2015) Sustainable Development Goals. Goal 7: Affordable and Clean Energy. Target 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services. See https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-7

14 United Nations General Assembly (2015) Sustainable Development Goals. Goal 7: Affordable and Clean Energy. Target 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix. See https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-7

feasibility studies in Vietnam, the Philippines, and Indonesia, ADB has discovered the potential of ETM as a carbon reduction model. For example, closing 50 percent of the coal power plants in these three countries over the next 10-15 years would eliminate 200 million tons of CO2 emissions annually.

ADB is working closely with the private sector to increase its involvement in the energy transition through several projects. One is the Asset Regeneration Platform (REGEN), which partners with Temasek, HSBC, and Clifford Capital Holdings to develop green infrastructure throughout Southeast Asia, concentrating first on Vietnam and Indonesia. Another collaboration is with the Climate Innovation and Development Fund and the Bloomberg Family Foundation through the Goldman Sachs Charitable Gift Fund, focusing initially on India and Indonesia.

To foster investment in green infrastructure in Southeast Asia, ADB introduced the ASEAN Catalytic Green Finance Facility, which supports the planning and financing of infrastructure projects for governments, reducing their risk and increasing their appeal to private capital investors. Following the Covid-19 pandemic, ACGF has developed a Green Recovery Plan, catalyzing climate funding from public and private sources and supporting at least 20 high-impact, low-emission sub-projects in the area.

To help nations implement their National Determined Contributions (NDCs), the ADB established a technical assistance platform called NDC Advance, which offers support in transforming NDCs into climate investment plans, raising capital, and creating systems for tracking, measuring, and reporting NDC progress. To enhance community development, ADB has developed the Community Resilience Financing Partnership Facility, which provides funding and technical assistance to advance knowledge and research, aid in planning sizable bankable adaptation projects, and increase the know-how of local institutions and communities.[15]

Sub-Saharan Africa

Among the energy funding sources available in SSA is the Sustainable Energy Fund for Africa (SEFA), which in 2017 supported seven projects in five Member States of the Southern African Development Community (SADC). A significant source of financing is the African Development Bank (AfDB), both through its lending capabilities and in its capacity as the manager of numerous programs dealing with renewable energy, among which SEFA, the African Green Climate Fund, the Green Mini-Grid Market Development Programme, the African Green Bond Fund, and the SEforALL Africa Hub.

For instance, the Green Climate Fund authorized a USD 50 million loan and a USD 2.5 million grant in April 2018 for Zambia's Renewable Energy Finance Framework, which would finance 100 MW of renewable energy projects. With the help of its Green Bond Fund, the AfDB has

[15] https://www.adb.org/news/speeches/smoothing-green-just-energy-transition-asia-pacific-ashok-lavasa

supplemented financing for initiatives like the Dar es Salaam Bus Rapid Transit project, the Xina Solar One CSP project in South Africa, and the Ithezi-Tezhihydro Power Project in Zambia.

AfDB's New Deal on Energy for Africa connects several of these initiatives to provide off-grid energy access to 75 million homes. In this regard, the AfDB announced in January 2018 an investment of USD 30 million in the Facility for Energy Inclusion Off-Grid Energy Access Fund. The African Development Bank also participates in the African Renewable Energy Fund, which develops and finances grid-connected renewable energy projects with a capacity of 5 MW to 50 MW.[16]

An interesting case to take into consideration is Kenya, which has developed the Kenya County Climate Change Fund (CCCF) mechanism, a ground-breaking method of facilitating the flow of climate finance to county governments while also enabling local communities to increase their climate resilience by strengthening public participation in the management and use of funds. It was first tested as the Climate Adaptation Fund in Isiolo and later expanded to Garissa, Kitui, Makueni, and Wajir Counties. The mechanism enhances community participation in the county development planning process and the decision-making process concerning expenditures. According to findings from research on CCCF investments, ward-level adaptation committees foster community involvement and knowledge of implementation processes.[17]

Perspectives from the Global North

In many Global North countries, the concept of energy poverty is often not clearly defined, even though it is common to experience a surge of winter deaths and hospitalizations due to a lack of energy efficiency and affordability of heating. There is some acknowledgment in the debate that different households have different energy requirements or that certain individuals may be more negatively impacted by fuel poverty than others.

The dominating discourse on energy and well-being is based on affordability, frequently emphasizing thermal comfort but mostly does not discuss other energy uses. Concerns about increased mortality and bad health are seen as the predominating effects of energy poverty, while other impacts are under-explored. Some policies, again mostly concerning heating, admit that individuals' demands may vary. However, despite the existence of the term fuel or energy poverty, there is little conceptual connection to a wider understanding of poverty and its manifestations.[18]

The following paragraphs compare countries with a national energy poverty framework and connected investment mechanisms, and countries still lacking a national policy framework that address energy poverty at other levels of governance.

[16] REN21 (2018) SADC Renewable Energy and Energy Efficiency Status Report. Chapter 6.
[17] Crick, F., Hesse, C., Orindi, V., Bonaya, M., & Kiiru, J. (2019). Delivering climate finance at local level to support adaptation: experiences of county climate change funds in Kenya. *Nairobi, Kenya: Ada Consortium.*
[18] Day, R., G. Walker, and N. Simcock. 2016. "Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework." Energy Policy 93: 255–264.

United States

In the US, low-income households spend three times as much of their income on energy (7.2 to 9 percent) compared to non-low-income households (2.3 to 3.1 percent). In the largest cities, low-income households have an energy burden that is twice the median household energy burden.[19] Moreover, African American, Latinx, multifamily and renter households are disproportionately impacted. The Energy Information Administration (EIA) estimates that in 2015, out of a total of 118.2 million homes, 17 million received an energy disconnect/delivery stop notice, and 25 million had to forgo food and medicine to pay energy bills.[20] These are clear examples of energy poverty or insecurity. However, for the US Federal Government, these concepts are not acknowledged in any statutory capacity, and, in particular, they are considered not any different from general poverty.

Due to the absence of a federal energy poverty recognition, states have implemented energy assistance programs. 51 percent of funding addressing energy burdens comes from utility ratepayer-funded bills and energy efficiency assistance. Despite the absence of federal statutes that acknowledge energy poverty, two federally-funded energy assistance programs were created to combat rising energy costs in response to the 1973 oil crisis. The first is the Low Income Home Energy Assistance Program (LIHEAP), administered by the Department of Health and Human Services (DHHS). The second is the Weatherization Assistance Program (WAP) administered by the Department of Energy (DOE). Still, after fifty years of these programs, one in three households (37 million) is energy poor.[21]

United Kingdom

Starting in the 1980s, worries about the negative effects of underusing energy gained pace in the UK. They were represented through the term fuel poverty, which attracted governmental and civil society lobbying. This issue has historically been driven by worries about the cost of heating, particularly, and the negative impact of cold dwellings on public health.[22] In 2014, there was a peak of winter deaths in the tens of thousands attributed to the poor energy efficiency of the building stock, which makes houses too expensive to heat.[23] Even though the peak has been narrowing

[19] Drehobl, A. & Ross L. *Lifting The High Energy Burden In America's Largest Cities: How Energy Efficiency Can Improve Low Income And Underserved Communities* (American Council for an Energy-Efficient Economy, Energy Efficiency for All, 2016).
Also see Ross, L., Drehobl, A. & Stickles, B. *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency* (American Council for an Energy Efficient Economy, 2018)
[20] US Energy Information Administration (2018) *2015 Residential Energy Consumption Survey (RECS)*
[21] Bednar, D.J., Reames, T.G. Recognition of and response to energy poverty in the United States. *Nat Energy* **5**, 432–439 (2020). https://doi.org/10.1038/s41560-020-0582-0
[22] Day, R., G. Walker, and N. Simcock. 2016. "Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework." Energy Policy 93: 255–264.
[23] See Day, R., G. Walker, and N. Simcock. 2016. "Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework." Energy Policy 93: 255–264.
Also see Office for National Statistics, 2014. Excess Winter Mortality in England and Wales. http://www.ons.gov.uk/ons/rel/subnational-health2/excess-winter-mortality-in-england-and-wales/index.html accessed in 2014.

over time, in 2022, an estimated 13,400 more deaths occurred in the winter period (December to March) compared with the average of the non-winter periods.[24]

A definition of fuel poverty was established in UK policy in 2001 as a household spending more than 10 percent of its income to achieve a satisfactory heating regime. The acknowledgment follows the influential work of Boardman and activist campaigning.[25] English policy labels some homes as susceptible to fuel poverty when at least one family member is elderly, disabled, or very young. For households with elderly and ill individuals in Scotland, a two-degree-C higher living room temperature is prescribed,[26] and across the UK, they get a winter fuel payment.[27] To be classified as fuel-poor, a household must have a relatively energy-inefficient home and stand to be left in relative income poverty due to paying energy bills, assuming they heat their home to the recommended regime.[28]

Although the US and UK have similar policies responding to energy poverty reduction, they differ in that the UK formally recognizes the concept and has more rapid and adaptive responses to fuel poverty exacerbated by the climate crisis. Furthermore, the UK has a requirement to systematically increase household energy efficiency by specific dates, which conveys a sense of a shared national priority for total household wellness and access, achieved through the numerous benefits of energy efficiency. In contrast to the US, the UK provides a national energy poverty identification and plan that includes definitions, reduction targets/objectives, and periodic evaluation.[29]

To conclude, the UK is one of the European countries to promote a consistent energy poverty agenda, as well as an agenda on low carbon communities, with various programs, including the Localism Act of 2011.[30] Scotland pushed very hard on community ownership as part of the benefits that private developers had to offer when developing new renewable projects for local communities. Scotland also promoted direct ownership (more similar to what is today referred to as energy communities) mostly through wind farms to counteract energy poverty and security for islands.[31]

---

[24] See Office for National Statistics, 2022. Winter mortality in England and Wales: 2021 to 2022 (provisional) and 2020 to 2021 (final) https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2021to2022provisionaland2020to2021final

[25] Boardman, B., 1991. From Cold Homes to Affordable Warmth. Belhaven Press, London.

[26] Scottish Executive (2002) *The Scottish Fuel Poverty Statement*. Scottish Executive, Edinburgh.

[27] https://www.gov.uk/winter-fuel-payment/overview

[28] Hills, J., 2011. Fuel Poverty: The Problem and its Measurement. Centre for Analysis of Social Exclusion, London. Also see Day, R., G. Walker, and N. Simcock. 2016. "Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework." Energy Policy 93: 255–264.

[29] Bednar, D.J., Reames, T.G. Recognition of and response to energy poverty in the United States. *Nat Energy* **5**, 432–439 (2020). https://doi.org/10.1038/s41560-020-0582-0

[30] For more information see https://www.legislation.gov.uk/ukpga/2011/20/contents/enacted

[31] Information gathered from interview with Elena de Nictolis.

The Netherlands

In the Netherlands, energy poverty has had limited recognition in national policy, only mentioned in the NECP,[32], despite 8 percent of Dutch households being energy poor.[33] This lack of governmental attention is counterbalanced by local policies that are more sensitive to the needs of vulnerable energy communities and by the EU, which set requirements for reporting energy poverty as part of the energy transition.[34] Nevertheless, a national policy has not yet been put in place, which creates challenges due to the mismatch of local and regional action and the lack of a national framework to access funds and develop activities.[35] From a redistributional perspective, the lack of national attention to energy poverty is concerning since nearly all major decision-making and resource allocation for decarbonization stems from national policy. While decentralization enables context-specific policy interventions, having no centrally defined goals could lead to inconsistency, under-provision of services, or lack of control.[36]

Due to the limited recognition of energy poverty, research is in its early stage. A challenge is that when measuring energy poverty through the European Energy Poverty Observatory (EPOV) indicators, the Netherlands shows a low incidence compared to most EU countries. Yet, disaggregating data reveals that difficulties with heating homes concern up to 16 percent of social housing residents, and up to 7 percent of households in the lowest income deciles experienced arrears.[37] Qualitative research conducted by Woonbond in 2013 and 2019 shows that Dutch energy-poor households face similar challenges to other nations, such as stressful living conditions and owning energy-inefficient appliances. People resort to coping strategies such as heating restricted areas of the house (spatial shrink) or turning the heating only when children are around. Some mention waking up or going to bed several hours later or earlier than usual or restricting visits from family members because their homes are excessively cold, drafty, moldy, and unhealthy. The lived experience research by Woonbond demonstrated the need to offer repeated energy-

[32] NECP (2019) *Integrated National Energy and Climate Plan 2021-2030*. Ministry of Economic Affairs and Climate Policy, Netherlands.
[33] https://www.tno.nl/en/newsroom/insights/2020/11/tackling-energy-poverty-together/
[34] See Governance Regulation on the Energy Union and Climate Action (EU) 2018/1999 and Electricity Directive (EU), 2019/944.
[35] See Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624. See also Straver, K., Mulder, P., Hesselman, M., Tirado Herrero, S., Middlemiss, L., and Feenstra, M. (2020). *Energy Poverty and the Energy Transition*. TNO.
[36] See de Jong, F., and Vonk, G. (2019). Internal coordination of social security in the Netherlands. *Eur. J. Soc. Secur.* 21:2. doi: 10.1177/13882627198 44985
See also Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.
[37] See EPOV (2021). *High Share of Energy Expenditure Income (2M)*. Available online at: https://www.energypoverty.eu/indicator?primaryId=1460andtype=barandfrom=2015andto=2015andcountries=NLanddisaggregation=none
See also See also Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.

saving guidance since families save more when they do so. Understanding a household's intrinsic incentive to save energy is crucial to inspiring it to become long-term conscious of its energy use.[38]

The study *Energiearmoede in Nederland: hoeveel, wie en waar?* (Energy poverty in the Netherlands: how much, who, and where?) shows that energy poverty is prevalent outside the Randstad conurbation, in part of the Zeeland province, and in the country's north, east, and southeast.[39] TNO, an independent research organization, initiated the national energy poverty research program in collaboration with the Dutch government, the Ministries of Economic Affairs and Climate Policy, Social Affairs and the Interior and Royal Relations and the provinces of South Holland and North Holland, and supported by several studies and working sessions that center around the establishment of policies, knowledge acceleration, and increased target group understanding.

TNO, Statistics Netherlands, and Erasmus MC carried out research to identify energy poverty on behalf of the province of Zuid-Holland. It mapped out a strategy to tackle it, which entails a demand-driven program led by the program's local implementers that provide support to energy-poor households.[40] In a 2020 White Paper on Energy Poverty, TNO and partners outline three key recommendations to stimulate the development of an effective energy poverty policy in the context of the energy transition, which are to establish indicators for measuring energy poverty, to develop specific policies targeting energy poverty and to integrate these policies into both social and energy policies.[41]

According to the TNO 2023 Energy Poverty Report, energy poverty is not the same as general poverty. There are non-poor households that struggle to pay energy bills, as well as low-income households that have no problems doing so. It is challenging to come up with a description that is widely accepted for energy-poor families because they are a diverse group of households with different features. However, energy poverty is commonly defined as a condition in which households lack appropriate access to domestic energy resources or spend more than 10 percent of their income on energy bills. Using factors related to energy affordability, housing quality, and the ability to independently make one's home more sustainable, in 2023, CBS started publishing yearly energy poverty data.[42]

Italy

Italy first defined energy poverty in the 2017 National Energy Strategy (*Strategia energetica nazionale* or SEN) as the condition in which access to energy services necessitates a diversion of resources (in terms of expenditure or income) above a normal level. The Italian Observatory for Energy

[38] See Woonbond (2013). Rapportage Woonlasten Onderzoek. Lefier.
Also see Woonbond (2019). Rapportage Meldpunt Energiealarm. Available online at:
https://www.woonbond.nl/sites/woonbond/files/publicaties/Rapportage_Energiealarm.pdf
[39] Mulder, P., Batenburg, A., & Dalla Longa, F. Energiearmoede in Nederland 2022.
[40] https://www.tno.nl/en/sustainable/system-transition/social-innovation/preventing-energy-poverty/
[41] TNO. 2020. *White Paper: Energy Poverty and the Energy Transition: Towards Improved Energy Poverty Monitoring, Measuring And Policy Action.*
[42] TNO. 2023. P10119. *Energy Poverty: A Science and Policy State of Play*. Date: 02 February 2023. Authors: Caroline van Ooij, Anika Batenburg, Nam Chi Nguyen, Koen Straver

Poverty (*Osservatorio Italiano Povertà Energetica* or OIPE) publishes regional estimates of energy poverty, stating that energy poverty in 2021 ranges from a low of 4.6 percent in Marche to a high of 16.7 percent in Calabria. Italian energy poverty averages 8.5 percent.[43]

Further, in 2021 household energy spending increased by about 20 percent compared to the previous year due to the increase in gas and electricity prices. In fact, at the end of 2021, households' average final price of electricity increased by 35 percent compared to the previous year, while the gas price increased by 41 percent. The significant increase in prices resulted in a 0.5 percent increase in energy poverty in Italy, as measured by the indicator of the National Integrated Climate Energy Plan and the Plan for the Ecological Transition. According to this indicator, at the end of 2021, energy poverty affected 2.2 million households, about 125,000 more households than in 2020, accounting for 8.5 percent of total households. There is a much greater incidence of energy poverty in households located in small towns, suburban and peri-urban areas.

In terms of counteracting policies, in 2021, the government intervened to lower final electricity and gas prices, allocating € 5 billion to reduce household bills. In particular, starting in July 2021, general system charges for electricity were eliminated, VAT was reduced, and the electricity and gas bonus instruments were enhanced. The new electricity and gas bonuses differ not only in the higher investment but also in accessibility. From 2021, it is no longer necessary to submit a special application. From the moment one's ISEE (Indicator of Equivalent Economic Situation) is below the prescribed threshold (€ 8,625, raised to 20,000 in the case of large families), a system of data exchange between INPS and ARERA's Integrated Information System (SII) allows for the automatic allocation of bonuses to eligible families.[44]

According to the data released by ARERA, by the end of 2021, € 2.5 million electricity bonuses (0.8 million in 2020) and € 1.5 million gas bonuses (0.5 million in 2020) had been granted, for a total of € 4 million bonuses (1.3 million in 2020) and a total expenditure of € 700 million, more than tripled from the € 211 million in 2020 and expected to grow by the end of 2022 to over €2 billion.[45] Based on recent simulations conducted on a model of Italian households' energy demand, the government's interventions have had a limited effect on curbing the spending of the most vulnerable households. This limited effect seems to be due to the nature of the 2021 universal subsidies, which are targeted at poor households but not specifically at energy-poor ones. The Household Expenditure Survey data indicates a limited overlap between bonus beneficiaries and households in energy poverty, highlighting the need to revisit the bonus instrument.[46]

---

[43] OIPE (2022) La povertà energetica nelle regioni italiane nel 2021. Available at https://oipeosservatorio.it/wp-content/uploads/2022/12/2022_PE_regioni_2021.pdf
[44] OIPE (2022) La povertà energetica nelle regioni italiane nel 2021. Available at https://oipeosservatorio.it/wp-content/uploads/2022/12/2022_PE_regioni_2021.pdf
[45] See https://www.arera.it/allegati/relaz_ann/21/RA21_volume_2.pdf#page=315 and https://www.arera.it/allegati/relaz_ann/21/RA21_volume_2.pdf#page=315
[46] OIPE (2022) La povertà energetica nelle regioni italiane nel 2021. Available at https://oipeosservatorio.it/wp-content/uploads/2022/12/2022_PE_regioni_2021.pdf

2. Research Hypothesis

After having looked at the way energy poverty is perceived and contrasted in the first chapter, the second chapter will explore the research question, supported by the empirical framework developed by LabGov.City, a Luiss-based research unit on urban innovation and sustainable development, and ENEA, the Italian research and innovation agency for energy and the environment. The empirical framework is developed in six reports.[47]

The research question builds on the theories of energy democracy, energy justice, the city as a commons, and governing energy as a commons, which result from the governance of the commons groundbreaking theory developed by the 2009 Nobel Prize Elinor Ostrom.[48] Exploring the multiscale interactions taking place in the systems managing complex resources, Ostrom created a framework promoting the recognition of collective action, co-ownership, and co-management of common resources, i.e., the commons. The commons consist of a community, a resource, and the framework that the community designs to co-create and co-manage the resource.[49]

In finding a general framework to explain the variables that affect the likelihood of self-organization in efforts to achieve a sustainable socio-ecological system (SES), Ostrom explains that in most cases, it is more efficient for users to co-manage the resources rather than having government policies doing so, which often accelerate resource depletion. Ostrom's theory contrasts itself with Garrett Hardin's theory of the tragedy of the commons, which claims that without central control, users of public resources will act in their interest and ultimately deplete them.[50]

[47] See Cannavò, P. et al. (2016) *Protocollo metodologico per la costruzione di quartieri e comunità collaborative urbane (il protocollo co-città).* ENEA. Report RdS/PAR2015/023. Available here.
Also see Cannavò, P. et al. (2017) *Prototipazione di una piattaforma istituzionale e digitale per la creazione di uno smart collaborative district.* ENEA. Report RdS/PAR2016/026. Available here.
Also see Morlino, L. et al. (2018) *Modelli di co-governance urbana, sostenibilità, bancabilità ed eleggibilità finanziaria di imprese civiche o di comunità: il partenariato pubblico-comunità e il partenariato pubblico-privato-comunità.* ENEA. Report RdS/PAR2017/068. Available here.
Also see Iaione, C. et al. (2018) *La cooperativa di quartiere come strumento di cooperazione delle comunità urbane.* ENEA. Report RdS/PAR2018/036. Available here.
Also see Iaione, C. et al. (2021). *La governance per la gestione sostenibile e inclusiva delle comunità energetiche: analisi di pre-fattibilità economico-giuridica.* Report RdS/PTR2020/030.
Also see Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA.
[48] See for example Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, *325*(5939), 419-422.
Also see Ostrom, E. (2010). Beyond markets and states: polycentric governance of complex economic systems. *American economic review*, *100*(3), 641-672.
Also see Ostrom, E. (2017). Polycentric systems for coping with collective action and global environmental change. In *Global Justice* (pp. 423-430). Routledge.
[49] Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354.
[50] Hardin, G. (1968). The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality. *science*, *162*(3859), 1243-1248.

The quintuple helix theory, developed by Carayannis, claims that the co-governance of the commons should be implemented through forms of public-private-community-partnerships involving five types of actors: civic (innovative communities, residents, and users); social innovators; knowledge institutions; public authorities; and sustainable businesses.[51]

Energy Democracy

The notion that energy and democracy go hand in hand has become considerably more popular since the 2010s. The emergence of energy democracy is related to the increased deployment of dispersed and small-scale renewable energy sources. Also, it reflects the increasing importance given to energy governance and climate policy. Energy democracy, a term coined by activists, is now frequently cited by experts and decision-makers, including, for example, EU authorities.

Policymakers and energy companies are pushed to deal with the social components of energy policy to ensure social acceptance of the energy transition. Also, as comparative research has demonstrated, greater public involvement in resource governance and energy policy leads to better governance overall. Literature on energy democracy, most of which has been published since 2017, is highly fragmented, resulting in a lack of a clear definition of energy democracy. Szulecki and Overland highlight three ideal-typical understandings of energy democracy.

The first understanding is "energy democracy as a process," which means reshaping the energy sector through grassroots initiatives and social movements. It is both an ongoing process and a social movement driving the process forward. The critical element is the idea that energy democracy is spreading and cannot be divorced from other social struggles. Hence, energy democracy is an emerging social movement that supports the transition to renewable energy sources by opposing the fossil fuel industry's dominating energy agenda and reclaiming and democratically rebuilding existing energy regimes. Energy democracy is thus described as involving three interconnected but distinct approaches to promoting the change of the energy system toward renewable sources that summarize in resist, reclaim and restructure energy systems.

The second understanding is "energy democracy as an outcome of decarbonization," whereby the energy sector becomes more democratic as we transition to a distributed, renewable energy system. It is the opposite understanding of energy democracy as a process. Here the causal factors are material, understood as a combination of social, technical, and economic aspects. The crucial argument is that the progressive transition to low-carbon and renewable energy sources, which are more intermittent, dispersed, and scalable, should cause changes in how energy systems are organized and catalyze social innovation, creating the framework for energy democracy to thrive.

---

51 Carayannis, E.G., Barth, T.D. and Campbell, D.F., 2012. The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of innovation and entrepreneurship*, *1*, pp.1-12.
Also see https://labgov.city/about-people/#people and the concept note of *Diritto ed Economia delle Comunità Energetiche*, Special Number for the Review *Diritto e Società*, published by LabGov.City in 2023. Concept note available at request.

The third understanding is "energy democracy as a normative goal," defined as an ideal to which communities can aspire and a principle to guide policies and action towards just and democratic energy systems. The goal combines technological shifts with political change informed by democratic ideals. As a result, it emphasizes the politics of energy governance as a means of achieving its democratization, much like the energy as a process understanding. However, it differs dramatically in that it is prescriptive and holds that energy democracy can be separated from social activity and assessed on various criteria.

This work embodies the "energy as a process" perspective since it places local communities at the forefront of the energy transition, focusing in particular on vulnerable groups. Nevertheless, it also embraces "energy democracy as a normative goal," as the author believes that regional, national, and local policymaking is necessary to support effective bottom-up initiatives and processes.[52]

Energy Justice

Energy justice evaluates where injustices emerge, which affected strata of society are ignored and which processes exist to reveal and reduce such injustices. According to Sovacool, there is a need to move towards human-centered exploration of energy developments, promoting the central role of ethics and claiming that energy justice should be a priority, as "how we distribute the benefits and burdens of energy systems is pre-eminently a concern for any society that aspires to be fair."[53] More than just access to energy services, energy justice is concerned with energy policy, production and systems, consumption, energy activism, the political economy of energy and climate change.[54] It applies justice principles to the energy trilemma: security, equity and sustainability.

Energy security assesses a country's ability to stably satisfy present and future energy demands, resist system shocks, and quickly recover from them with the least possible disruption to supply. The efficacy of managing internal and external energy sources, as well as the dependability and resilience of the energy infrastructure, are all covered by this component. Energy equity measures a nation's capacity to offer unrestricted access to a reliable, affordable, and abundant energy for household and commercial usage. The dimension includes basic access to electricity, clean cooking methods, and levels of energy consumption that enable prosperity, as well as affordability of electricity, gas, and fuel. Finally, environmental sustainability of energy systems represents the transition towards renewable energy in order to mitigate climate change impacts. The dimension focuses on air quality, decarbonization, transmission and distribution productivity and efficiency.

Maintaining the three-dimension balance in the rapid digitalization and decentralization of the energy system is challenging. The World Energy Trilemma Index ranks the energy performance of 127 countries on the three dimensions and provides recommendations on policy coherence and

[52] Szulecki, K., & Overland, I. (2020). Energy democracy as a process, an outcome and a goal: A conceptual review. *Energy Research & Social Science*, *69*, 101768.
[53] Sovacool, B.K. (2014) What are we doing here? Analysing 15 years of energy scholarship and proposing a social science research agenda, Energy Res. Soc. Sci. 1 (2014) 1–29. Quote at pg. 15.
[54] Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research & Social Science*, *11*, 174-182.

integrated policy innovation. The Index aims to shed light on a nation's difficulties in resolving the Energy Trilemma and its potential for development in terms of achieving its current and future energy goals. The Index provides information to decision-makers in the policy, energy, and finance sectors. In contrast to historical indexes, which offer information on each country's performance patterns over time, index rankings allow comparisons across nations on each of the three aspects.

The combination of crises and shocks creates a cascade effect that affects energy cost, security, and sustainability challenges across the world. The necessity for balance in the areas of energy security, affordability, and sustainability was reinforced in 2022, a particularly challenging year energy-wise mainly due to the consequences of the Russia-Ukraine conflict. The Trilemma framework provides a starting point for generating insights to help countries comprehend the effects of and monitor the advancement of their energy transitions. The Trilemma dimensions are now showing trajectories that are not aligned with the recent energy crises. However, as nations work to promote a safe, just, and sustainable transition, long-term trends in the data continue to be instructive.[55]

The City as a Commons

Neighborhood and community spaces, services that are functional to local well-being, natural resources, streets, and historical and cultural assets are all defined as urban commons. According to Brett Frischmann, also technological networks, such as collaborative transportation and wireless systems; platforms and micro-grids; and social infrastructure, such as schools, housing, and hospitals, can be understood as urban commons.[56] According to Iaione et al., energy is to be understood as a commons, exemplified by the phenomenon of energy communities.[57]

Iaione and Foster applied the co-governance of the commons to the urban areas to understand how to make cities collaborative and innovation centers.[58] This has led to numerous scholarly publications, including the most recent *Co-Cities: Innovative Transitions toward Just and Self-Sustaining Communities* published by MIT Press.[59] Analyzing more than 500 case studies in 150 cities, they have developed the Co-City Protocol, an index based on five design principles setting up the necessary conditions to rethink the city as a commons.[60]

The five principles are the enabling state, social and economic pooling, urban experimentalism, technological justice, and the quintuple helix. The enabling state refers to public authorities' role as enabling platforms for cooperation with other urban actors. Social and economic pooling involves institutions managed or co-owned by the local communities cooperating with

[55] https://www.worldenergy.org/transition-toolkit/world-energy-trilemma-index
[56] Frischmann, B., Madison, M., & Sanfilippo, M. (Eds.). (2023). *Governing Smart Cities as Knowledge Commons* (Cambridge Studies on Governing Knowledge Commons). Cambridge: Cambridge University Press. doi:10.1017/9781108938532
[57] See for example Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche*. RdS/PTR(2021)/053. ENEA.
[58] Foster, S., Iaione, C. (2019) Ostrom in the City, in Blake Hudson, Jonathan Rosenbloom & Dan Cole, Routledge Handbook on the study of the commons, New York, Routledge.
[59] Foster, S., and Iaione, C. (2022) *Co-cities: Innovative Transitions Toward Just and Self-sustaining Communities*. MIT Press.
[60] For more information see https://labgov.city/co-city-protocol/

collaborative and circular economic systems to create new opportunities and services, particularly in vulnerable contexts. Urban experimentalism is the approach taken to urban processes. Technological justice is the enabling tool of community-wide access to technology and digital infrastructure, which is sometimes managed by the community itself to develop neighborhood services. Finally, the quintuple helix is the framework around which the process of co-governance revolves.[61]

Six stages then characterize the Co-City Protocol. The first is "cheap talking," which consists of organizing informal settings to discuss with key stakeholders (e.g., city users, social innovators, knowledge institutions, non-profit organizations, and SMEs). The second phase is "mapping," which involves fieldwork activities (e.g., interviews, surveys, etc.) conducted based on the information gathered during the previous stage. The third phase is "practicing," in which experimentalism is at its peak, involving co-working sessions with the stakeholders focused on the research objectives and applications.

The fourth phase is "prototyping," which consists of analyzing the outcomes of the previous phases, intending to identify the needs and characteristics of the target territory and verify the conditions for promoting coordinated collaboration between the community and external actors. The fifth phase is "testing," consisting of implementing the developed tools, which will be evaluated both quantitatively and qualitatively to determine whether they meet the needs and objectives identified by the various stakeholders during the process. The sixth phase is "modeling" and will involve the final adoption of the tested and prototyped tools based on the regulatory, administrative, and economic characteristics of the territory under consideration.[62]

Energy communities are an exemplification in the energy field of the institutional design principles and processes underlying the Co-City Protocol. Through energy communities, energy production becomes a common purpose and good for the members of the considered community. The definition of the model and management forms can result from a process of co-governance capable of involving the stakeholders of the quintuple helix to achieve climate and technological justice goals and combat energy poverty and social exclusion.

[61] Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA.

[62] De Nictolis, E. & Iaione, C., The City as a Commons Reloaded: from the Urban Commons to Co-Cities Empirical Evidence on the Bologna Regulation (June 12, 2021). The Cambridge Handbook of Commons Research Innovation.

Governing Energy as a Commons

The transition to renewable energy is multidimensional. Both social science and engineering are central players in developing future energy systems that are efficient, sustainable, and equitable. The first mainly focus on the end-users and those impacted by energy provision without providing practical solutions. In contrast, the second produce technical solutions that often do not consider the socio-economic effect on those impacted. Therefore, Giotitsas et al. suggest bridging the divide by governing the energy as a commons, claiming that "the commons could provide an umbrella framework for constructing a holistic and sustainable alternative to the current socio-economic configuration which permeates virtually all facets of human activity, i.e., profit-maximizing market relations. The commons may also form a boundary object, a mutual language, to enable collaboration across multiple disciplines in the pursuit of radical solutions."[63]

The framework had already been applied to the theoretical analysis of energy transition, to design climate and energy policies, and to test energy cooperatives as a tool for a commons-oriented governance approach and resource management in the energy production sector. For example, Ferster et al. provide an empirically tested method to enable cooperative behavior among stakeholders to initiate the development of community-led solar projects.[64] Giotitsas et al. add an engineering perspective, incorporating the commons into the design of technological tools and infrastructure. They adopt common-based peer production through open-source services geared towards satisfying community needs rather than financial profit.[65]

Giotitsas et al. envision energy as a commons through microgrids. A microgrid is a local energy production and distribution network that can operate independently when cut off from the main electricity grid. It can supplement user demand spikes and prevent higher energy costs. Microgrids serve a group of nearby users, including households and other building complexes. They are coupled with a battery and powered by PV systems.[66]

The authors build on the theory of the Energy Internet, a framework in which electricity production is treated as a commons resulting in peer-produced energy where all members share generation and storage units. At the same time, demand management is directly related to the users' needs and not mediated by a commodity form or access restriction.[67] They apply the theory to the hardware aspect of the energy system, building on networked microgrids powered by open-source, low-cost, adaptable, socially responsible, and sustainable technology. These microgrids

[63] Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354. Quote at page 3.
[64] Ferster, B. Macht, G.A. Brownson, J.R.S. (2020) Catalyzing community-led solar development by enabling cooperative behavior: Insights from an experimental game in the United States, *Energy Res. Soc. Sci.* **2020**, 63, https://doi.org/10.1016/j.erss.2019.101408
[65] Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354.
[66] https://corporate.enelx.com/en/question-and-answers/what-is-a-microgrid-and-how-does-it-work
[67] Giotitsas, C., Nardelli, P. H., Kostakis, V., & Narayanan, A. (2020). From private to public governance: The case for reconfiguring energy systems as a commons. *Energy Research & Social Science*, *70*, 101737.

connect to each other to share electricity as a commons, with optimized interactions via a communication network infrastructure based on similar principles as the Internet.

Once a microgrid has been formed, a community may use it to supply local needs by combining renewable resources and storage units. Having more generators, the system's redundancy may be increased, enhancing the community services' resilience. Connecting many microgrids may create a more robust energy system for the interconnected energy communities. Communities could trade energy during periods of excess demand. Building on the existing expertise and capacity in the region, the commons would also facilitate capability growth and tool transfer. In turn, this would offer energy solutions and technologies that are sustainable for the local environment.

This strategy would provide communities more control over how to manage their demand-side energy self-management systems and demand-response mechanisms, which prioritize the requirements of the energy community. In the case of energy autarky, the community would establish its decarbonization objectives in accordance with the regional social and environmental context while collaborating with external power grid components to maintain system stability. Giving over control and sensitive personal information to energy utilities is not necessary with this alternate management strategy. To participate in bottom-up coordinated energy self-management, communities can instead rely on open hardware (sensors, thermostats, appliance controllers) and open-source software solutions (interconnected home energy management systems).[68]

Research Question

Building upon the theories of energy democracy, energy justice, the city as a commons, and energy as a commons, the thesis researches whether energy communities can be a tool to contrast energy poverty and aims at addressing the mismatch between a consistent national policy framework on energy poverty coupled with a small concentration of energy communities, such is the case in Italy; and an inconsistent national policy framework on energy poverty coupled with a large concentration of energy communities; such is the case in the Netherlands.

In particular, the author analyzes how vulnerable communities can be enabled to participate in the energy transition and co-govern renewable energy sources as commons. Further, the analysis will explore the possibility of creating a framework to foster the development of social energy communities that could be scalable to different geographic and socio-economic contexts.

As seen in the studies by Giotitsas et al., energy as a commons can be envisioned through microgrids. This is not the only solution possible. It can be a valid solution for certain contexts, especially rural ones, but there are other solutions that better apply to other contexts. The research will also delve into suitable context-based infrastructural solutions for energy communities.[69]

[68] Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354.

[69] Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354.

Methodology

After analyzing the literature in the first chapter and exploring the research hypothesis in the second chapter, the third chapter will explore case studies of energy community initiatives worldwide. After an overview of policies targeting energy poverty in the EU, as well as the renewable energy regulatory framework, the fourth and fifth chapters will delve into the two experimental projects developed by the author in Rome and Tilburg in cooperation with cognitive, technical, and institutional actors. The sixth chapter will entail a discussion on the issues emerged from the research. To answer the research question, the experimental methodology of this thesis includes first-hand interviews, data gathering, and technical support from experts in the field.

In particular, this thesis benefitted from the contribution of:

- Claudia Meloni, architect, and researcher from ENEA who provided information on energy communities and the local token economy – which she developed together with the research team at ENEA – and co-supervised the development of this thesis;
- Giuseppe Chindemi, Ecogena (Acea) CTO, and Guido Sgambati, Energy Efficiency Project Engineer at Ecogena (Acea), who supported the author in the development of a social business plan for to be a framework for energy communities based in Rome;
- Guido La Rose, sustainable strategist at the Tilburg Municipality, and Thijs ten Caten, Master student of Law and Technology at Tilburg University, who provided data and expertise on the territory to implement a targeted social energy community in the vulnerable neighborhood of Abdij- en Torenbuurt;
- Sheila Foster, Professor of Law and Public Policy at Georgetown University, Chiara Pappalardo, Doctor of Juridical Science at Georgetown University, and Elena de Nictolis, Post-Doctoral Global Fellow at New York University, who provided information on the US community-led energy initiatives;
- Aleardo Furlani, Innova CEO, who provided information on sustainable investment strategies for the Global North;
- Simone Mori, ENEL Director for Europe, who provided information on sustainable investment strategies and data for the Global South and insight on the Rome-based energy community business model;
- Edoardo Zanchini, Director of the Climate Office at Roma Capitale, who provided information on the municipality's initiatives in terms of energy communities;
- Simone Benassi, Head of energy communities in Italy at Enel X, who provided information on microgrids and the role of Enel X in the development of energy communities in Italy;
- Mauro Annunziato, former Smart Energy Director at ENEA and currently developing a social energy community in Anguillara, who provided information on the algorithm he developed to assess energy poverty within the social energy community.

Furthermore, the experimental projects developed in this thesis benefit from the co-design methodology applied in two laboratories. The first is the ENGAGE.EU Expedition, a one-week co-design intensive program held in Tilburg in July 2022 in partnership with the Tilburg Municipality, aimed at contributing to creating societal value focusing on innopreneurship and design-thinking to create mission-oriented solutions. The second is the GrInn Lab by LabGov, a five-week co-design program at Luiss University in which students work in partnership with academic and professional stakeholders to produce ideas. The focus was implementing the already existing Co-Roma platform with an enhanced focus on energy community projects. Professor Claudia Meloni taught the course, and the author of this thesis was a lab tutor tasked with supporting students in developing ideas for the platform.

Finally, the author spent a period of time in the Netherlands working for the Tilburg Municipality and interviewing local stakeholders to assess the feasibility of the solution envisioned, among which: Manoe Ruhe, Project Manager of Urban Development at the Tilburg Municipality focusing on the future development of the Abdij- en Torenbuurt district; Robert Kint and Maaike Paulissen Policy Advisors for the Energy Transition at the Tilburg Municipality who provided legal and technical support on the feasibility of the solution envisioned; and Tijs van Gisbergen, Policy Advisor for the Energy Transition at the Tilburg Municipality, which provided knowledge on the policies the municipality is enacting to contrast energy poverty.

3. Case Studies

This chapter analyzes selected case studies of community-led energy initiatives. It starts by analyzing Global North case studies, which have been adopting renewable energy communities as a common tool to advance the energy transition. In Europe, the concept of energy communities is quite linear and fast-growing, while the US has a different and multilateral approach to bottom-up energy initiatives. The analysis proceeds by examining the state of the art in the Global South. It analyzes community-led energy initiatives in two Latin American countries (Brazil and Chile). It proceeds by looking at Sub-Saharan Africa, focusing on policies fostering the development of community-led energy initiatives in Nigeria, the role of the NGO Power Africa for Kenya's deployment of bottom-up energy projects and the role of cross-sector transnational collaborations to effectively co-design energy communities.

Case Studies in the Global North

Energy Communities in Europe

An energy community is a grassroots initiative enabling consumers to produce and share renewable energy, generating and managing cost-effective green energy autonomously, reducing CO2 emissions and energy waste.[70] The number of active energy communities in Europe was over 3,500 in 2020, and it is fast rising.[71] It is estimated that by 2050, 264 million European citizens will join the energy market as prosumers and generate 45 percent of the market's total renewable electricity.[72] Cities will be the main hub for creating energy communities, as they cover 3 percent of the earth's surface but produce 72 percent of all GHG emissions and, by 2050, will host 85 percent of the European population.[73]

Actors in the energy community may households, knowledge institutions, energy companies, businesses, NGOs, and local authorities. Consumers join the energy community and become beneficiaries of the energy service provided by another actor without investing in energy generation and storage units. Energy providers dispense energy-related services such as generation, distribution, storage, and supply, as well as installation, equipment, maintenance, and building refurbishment services. Generation and storage equipment may be located on-site (e.g., rooftop PV system) or nearby (e.g., community-owned wind generators). Prosumers fall in between consumers and energy providers, as they produce their energy and share the surplus with the rest of the community. Initiators are those that set in motion the coordination of the community project. They can be beneficiaries of the energy community or not.

[70] https://www.enelgreenpower.com/countries/europe/Italy/renewable-energy-communities
[71] Gjorgievski, V. Z., Cundeva, S., & Georghiou, G. E. (2021). Social arrangements, technical designs and impacts of energy communities: A review. *Renewable Energy*, *169*, 1138-1156.
[72] https://yeseurope.org/the-potential-of-energy-communities-in-the-new-sharing-economy/
[73] https://knowledge4policy.ec.europa.eu/foresight/topic/continuing-urbanisation/developments-and-forecasts-on-continuing-urbanisation_en

According to EU law, energy communities should be regarded on an equal footing with other players in the energy industry, which increases the probability of generating value. An energy community may enter a market directly or through an energy provider. Individual energy community members should retain their rights and duties (e.g., the right to change suppliers). They should function as a group that behaves as a single unit. Depending on a pre-determined agreement, energy community members can split their expenses and benefits among themselves.[74]

Infrastructure-wise, there are two main schemes. The first is prominent in Northern Europe. It entails developing a microgrid with a single connection point to the national grid, which enables the community to be self-sufficient and exchange energy through a peer-to-peer platform. The second is very prominent for example in Italy, where the State grants incentives for energy produced and shared within the community. In this case, the energy surplus is sold to the national grid, which virtually reallocates it among the energy community members. The principles of energy communities, according to Ambole et al.,[75] are outlined in Table 1.

Operative Principle/Key Characteristic	**Description**
Community involvement and cooperation	A community energy project should provide social, economic, and environmental benefits for its members and the area where it is active. These benefits should be shared fairly amongst members in relation to their participation. In return, members should be willing to take up project leadership roles, as well as engage with diverse stakeholders.
Open and voluntary participation	Membership should be open to all persons in the community as final users who are willing to accept the responsibilities of the endeavor.
Democratic governance	Communities have direct democratic governance based on equal decision-making rights. Projects should be controlled by the members or shareholders who are participating as final users; Outside investors or undertakings participating in the community must not have a controlling position within the board.

[74] Gjorgievski, V. Z., Cundeva, S., & Georghiou, G. E. (2021). Social arrangements, technical designs and impacts of energy communities: A review. *Renewable Energy*, *169*, 1138-1156.
[75] Ambole,A.; Koranteng,K.; Njoroge, P.; Luhangala, D.L. A Review of Energy Communities in Sub-Saharan Africa as a Transition Pathway to Energy Democracy. *Sustainability* **2021**, *13*, 2128. https://doi.org/10.3390/su13042128

Institutional support	Communities need institutional and professional support to initiate and manage energy projects. Professional support can be provided by community energy intermediaries who network communities with relevant stakeholders and resources and provide them with business services. In addition, energy communities need conducive regulatory frameworks that incentivize locals and stakeholders to actively engage in initiating and managing energy projects.
Decentralized renewable energy and innovative technologies	Community energy projects should take advantage of innovative methods and technologies to exploit renewable energy resources sustainably and affordably. Off-grid and micro-grid technologies provide a promising approach.

Table 1: Principles defining energy communities, according to Ambole et al.[76]

Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs) are central components of the energy transition strategies that set foot in Europe as a response to the Agenda 2030, the Paris Agreement, and the European Green Deal, and supported by research and innovation programs such as Horizon Europe and investment endeavors such as the Next Generation EU. As part of the *Clean Energy for All Europeans* package, directive 2018/2001/EU (RED II) introduced the notion of REC, while Directive 2019/944/EU (IEMD) regulated the CECs.

RED II, in Art. 2(16) defines renewable energy communities as a legal entity: "(a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits."[77]

Compared to the REC, the notion of CEC is broader, defined in IEMD Art. 2(11) as a legal entity that: "(a) is based on voluntary and open participation and is effectively controlled by members or

[76] Table adapted from Ambole,A.; Koranteng,K.; Njoroge, P.; Luhangala, D.L. A Review of Energy Communities in Sub-Saharan Africa as a Transition Pathway to Energy Democracy. *Sustainability* **2021**, *13*, 2128. https://doi.org/10.3390/su13042128 **Table 2.** Principles that define and govern energy communities. p. 3
[77] European Parliament. (2018). Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources. *Off. J. Eur. Union*, *5*.

shareholders that are natural persons, local authorities, including municipalities, or small enterprises; (b) has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and (c) may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders."[78]

There are similarities and differences between RECs and CECs. Starting from the similarities, both schemes correspond to a legal entity distinct from their members,[79] differentiating from the collective self-consumption scheme,[80] i.e., a group of at least two renewable self-consumers that generate renewable electricity for their consumption and are located in the same building. Furthermore, both schemes must pursue a value-oriented rather than a profit-oriented purpose, and they must have an open structure allowing the entry and exit of additional members.

Concerning the differences, RECs and CECs differ in terms of membership requirements, as members of RECs can be only individuals, SMEs, and local authorities, while there are no boundaries for CECs. They also differ in the type of energy activities undertaken, as RECs are bound to produce and consume renewable energy sources, while CECs are not. Furthermore, the RECs are autonomous legal entities, which is not required for CECs, and RECs need to develop their own energy infrastructure, which is not required for CECs. Finally, RECs need to have a proximity requirement to the renewable energy generation facility, as seen in Art. 2(16)(a) while CECs do not.[81]

Another similar concept concerns Positive Energy Districts (PEDs), which are defined as "energy-efficient and energy-flexible urban areas or groups of connected buildings which produce net-zero greenhouse gas emissions and actively manage annual local or regional surplus production of renewable energy."[82] They are defined in the SET Plan (*Strategic Energy Technology Plan*) which was first presented to the European Commission in 2007 [COM(2007)723] and updated in the next years[83] with the aim of promoting research and innovation to support the energy transition and the cooperation of EU countries, businesses, research institutes, and the EU Commission in pooling resources and know-how.[84]

---

[78] European Parliament. (2019). Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on Common Rules for the Internal Market for Electricity and Amending Directive 2012/27/EU. *Off. J. Eur. Union*, *158*, 125-199.
[79] The legal entity can take the form of, for example, a non-profit association or a cooperative. The participant members decide the legal form, chosen according to their roles (e.g. companies or households).
[80] Also introduced by the RED II Directive.
[81] Iaione, C. et al. (2021). *La governance per la gestione sostenibile e inclusiva delle comunità energetiche: analisi di pre-fattibilità economico-giuridica*. Report RdS/PTR2020/030. p.17-19.
[82] JPI Urban Europe / SET Plan Action 3.2 (2020). White Paper on PED Reference Framework for Positive Energy Districts and Neighbourhoods. https://jpi-urbaneurope.eu/ped/
[83] In particular, it is important to consider "Communication for an Integrated Strategic Energy Technology Plan" [COM(2015)6317].
[84] European Commission, Directorate-General for Research and Innovation, Joint Research Centre, (2019) *The strategic energy technology (SET) plan*. Publications Office. **https://data.europa.eu/doi/10.2777/04888**

The SET Plan identified ten key actions to accelerate the transformation of the energy system through coordinated or joint investments among European countries. Action #3, which entails creating new technologies and services for smart homes that provide smart solutions to energy consumers, was divided into two actions, one entailing smart solutions for energy consumers and the other entailing smart cities and communities. The "Positive Energy Districts and Neighborhoods for Sustainable Urban Development" program aims to implement the second action by supporting the planning, creation, and replication of 100 Positive Energy Districts by 2025. Twenty member states participate in the program, and JPI Urban Europe coordinates it.[85]

Germany

Germany is the first country in the EU for energy community concentration, with approximately 1750 active ones.[86] It has a large share in renewable electricity generation by private citizens (30.2 percent in 2019), which leads to a large share of the electricity demand (42.1 percent) being covered by renewables.[87] Instead, the share of renewable heating sources is lagging compared to European standards (only 14.7 percent).[88]

The country has had a long history of cooperatives. The Cooperative Law came into force in 1889, covering all kinds of cooperatives, from agricultural to banking. In 2011, the National Office for Energy Cooperatives, part of DGRV (the German Cooperative Confederation), was set up to support the development of energy communities. Currently, the office offers support to comply with RED II, works to disseminate knowledge and best practices, represents communities' interests in federal legislative debates, and supports energy communities in developing business plans and project implementation.

The Office works with 914 RECs with 220,000 members with an overall investment of € 3.3 billion. These RECs have prevented over 3 million tons of CO_2 emissions and have generated 8 TWh of community-owned electricity (2021 estimates), which accounts for 3.5 percent of the total renewable electricity generated in Germany. The type of stakeholders involved are quite diverse, as 95 percent of members are individuals, 4 percent are companies and banks, and 1 percent are farmers.[89]

---

85 See https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en and the concept note of *Diritto ed Economia delle Comunità Energetiche*, Special Number for the Review *Diritto e Società*, published by LabGov.City in 2023. Concept note available at request.

86 Caramizaru, A.; Uihlein, A.(2020) *Energy Communities: An Overview of Energy and Social Innovation*; EUR 30083 EN; Publications Office of the European Union: Luxembourg.

87 See Broska, L.H.; Vögele, S.; Shamon, H.; Wittenberg, I. On the Future(s) of Energy Communities in the German Energy Transition: A Derivation of Transformation Pathways. *Sustainability* **2022**, *14*, 3169. https://doi.org/10.3390/su14063169
Also see AEE. Neue Studie Zeigt: Bürgerenergie Bleibt Zentrale Säule der Energiewende. Available online: https://www.unendlich-viel-energie.de/studie-buergerenergie-bleibt-zentrale-saeule-der-energiewende

88 Dauwe, T.; Young, K.; Jóźwicka, M. *Policies and Measures on Renewable Heating and Cooling in Europe—Eionet Report—ETC/ACM 2018/17*; European Environment Agency: Bilthoven, The Netherlands, 2018.
Also see Broska, L.H.; Vögele, S.; Shamon, H.; Wittenberg, I. On the Future(s) of Energy Communities in the German Energy Transition: A Derivation of Transformation Pathways. *Sustainability* **2022**, *14*, 3169. https://doi.org/10.3390/su14063169

89 https://rural-energy-community-hub.ec.europa.eu/landscape-energy-cooperatives-germany_en

Jühnde

Jühnde is a small municipality in the district of Göttingen, Lower Saxony, known as Germany's first "Bioenergy Village." The bioenergy community transitioned from fossil fuels to renewable, CO2-neutral biomass for both heating and electricity. Since 2004, the community has implemented a 700 kW biogas cogeneration plant and a 550 kW wood chip boiler, which generates 70 percent of the heat power it needs and twice as much electricity as it needs.[90]

The project partners planned the bioenergy system and the district heating grid[91] between 2000 and 2004, submitted applications for approval, and secured investment subsidies. The community established a cooperative in 2004, which was deemed the most suitable legal entity for managing the bioenergy system. A membership fee of at least € 1,500 must be paid to join the cooperative; the exact amount invested determines voting privileges and share of profits. More than 70 percent of the residents participate in the cooperative and have financial stakes in the village's grid connection.

In the Jühnde model, the neighborhood cooperative is the sole operator of the energy system. All residents were previously asked to take part in the planning process. Working groups discussed specific plans for the community's energy future. In the process of switching to renewable energy sources, the community developed a new sense of direction thanks to shared decision-making and problem-solving. As a result, this participative method ensured high compatibility with regional demands and the stakeholder network while establishing local competency and know-how. The Jühnde model has as one of its stated goals the preservation of regional cultural assets and the enhancement of local identity and community life.[92]

The Netherlands

The Netherlands is a pioneer country in the energy community trend, prompted by the investments of the Ministry of Economic Affairs and Climate Policy, and third in Europe in energy community concentration (500 in 2020 and over 600 in 2023), after Germany and Denmark. The existing legal framework does not define energy communities. Still, it does permit recognized citizen groups, such as cooperatives, to establish and own local networks (e.g., microgrids) or renewable energy generation facilities (e.g., PV systems) and to participate in the electricity market following a number of rights and obligations. The Dutch government also encourages the development of local energy initiatives through the Energy Agreement for Sustainable Growth, which sets targets for renewable energy production and consumption.[93]

---

[90] https://www.enelx.com/it/it/storie/2020/05/comunita-energetiche-cosa-sono

[91] District heating uses a system of insulated pipes to distribute heat to buildings. In order to reduce heat losses, heat pumps can use low-temperature waste heat sources (below 45°C) in the district heating grid. For more information see https://www.iea.org/articles/heat-pumps-in-district-heating-and-cooling-systems#

[92] Brohmann, B., Fritsche, U., & Hünecke, K. (2006). Case Study: The Bioenergy Village Jühnde. *Report by Öko-Institute eV for Create Acceptance Work Package*, *2*.

[93] See https://www.government.nl/documents/publications/2013/09/06/energy-agreement-for-sustainable-growth

Almost all energy communities emerged from energy cooperatives. By far, the majority are still experimenting and are part of subsidized EU research projects. Often, these projects are started by enthusiasts with a background in the energy sector who are keen to work on innovative technologies themselves. An energy community can arise either in an urban neighborhood or in a rural community. Energy collectives in cities are often linked to new construction projects. Examples include DE-centrale Loenen (Interreg project), Edona in Heeten (TSE project), Schoonschip (ERA-NET project), and Sterk op Stroom Den Haag (provincial subsidy). In addition, there are many energy cooperatives with plans to develop into an energy community. Still, as these are in various stages of development, it is difficult to estimate exactly how many there are. [94]

There are a few regulations that concern energy communities. The first is the Electricity Act of 1998 or *Elektriciteitswet* which does not consider peer-to-peer energy exchange, precluding the role of prosumers in energy generation. The second is the Experimental Electricity Act (2015-2018) or *Experimenten Elektriciteitswet,* which established rights and obligations for citizen energy communities but was closed in 2018.[95] In 2018, the Energy Transition Act (*wet VET*) amended the 1998 Electricity Act allowing for self-generation by industry and CHP production by industrial firms or joint ventures involving distribution companies.[96]

RED II has not been implemented yet, despite the implementation deadline has already passed. The legislator has included some provisions for implementation but nothing particularly related to energy communities. Thus, the current legislation is only based on the amended 1998 Electricity Act.[97] The government's idea has been to merge electricity, gas, and hydrogen legislation into one law: the Energy Act. In this act, the RED II would be implemented. However, before a law is passed in the Netherlands, it must first be reviewed by an advisory body, the Council of State, which has been skeptical about merging these energy sources into one piece of legislation. What steps the government will take next are still unclear.[98]

The Netherlands has enacted a comprehensive policy for the energy transition. A critical enabler for the development of energy communities has been a financial incentive scheme that includes net metering. The scheme allows produced renewable energy to be crossed out against consumed energy, eliminating the dominant tax component in energy tariffs. Another scheme is the SCE (Subsidy Cooperative Energy production). This financial scheme supports the creation of an energy community without the necessity to implement PV panels on a member's roof as long as

[94] Interview with Thijs ten Caten, Master student of Law and Technology at Tilburg University and researcher under commission from the Tilburg Municipality.
[95] Tarpani, E.; Piselli, C.; Fabiani, C.; Pigliautile, I.; Kingma, E.J.; Pioppi, B.; Pisello, A.L. Energy Communities Implementation in the European Union: Case Studies from Pioneer and Laggard Countries. *Sustainability* **2022**, *14*, 12528. https://doi.org/10.3390/su141912528
[96] https://climate-laws.org/geographies/netherlands/laws/electricity-act-dde0dfd7-d8b9-49bb-9369-29bc5c05c624
[97] Available at https://wetten.overheid.nl/BWBR0009755/2022-10-01
[98] Interview with Thijs ten Caten, Master student of Law and Technology at Tilburg University and researcher under commission from the Tilburg Municipality.

the legal entity invests in renewable energy facilities within the postal code.[99] The Netherlands has a well-developed smart meter grid and smart electricity system, and the communication strategy is tailored to specific contexts, often carried out by municipalities, which effectively enhances citizens' awareness and engagement, also by developing specific platforms that provide guidelines and demonstrate the advantages of energy communities.[100]

Amsterdam

Amsterdam is focused on developing a strong public-private-academic infrastructure for sustainability and innovation R&I. This includes creating the Amsterdam Science Park, which has one of the largest concentrations of research facilities in Europe, gathering together universities, research institutes, and 170 companies. Furthermore, the Amsterdam municipality is also part of the European City Science Initiative (CSI EU), which aims at tackling urban challenges through a structured research-based approach to evidence-informed policy-making. The initiative brings together professionals (i.e., City Science Officers) from different EU cities to collaborate on policies and research.[101]

The Netherlands has a long history of cooperatives, among which are energy cooperatives, and Amsterdam is home to several of them. Schoonschip, an energy community situated in a green residential neighborhood on the city's north side, is a peculiar example. It is an innovative floating residential district with a strong environmental and social drive. More than 140 people live in the community, with 46 residential units on 30 floating plots. Schoonschip started as a bottom-up social community project that, over time, laid the foundations for the effective running of an energy community. The community established workgroups to handle the various facets of the endeavor. The key objectives are to advance clean energy and sustainable living, increase system dependability, participate in the energy transition, foster the local economy, democratize the energy system, and increase community well-being.

The workgroups make sure that the following aspects of the community are managed and preserved: local and sustainable materials that fit within a circular economy, water saving and reuse, energy efficient technologies and smart grid, ecology and biodiversity, local and sustainable food, social community and residents engagement, residents well-being, a consistent legal framework, and collective and transparent financial investment. As a result, the community does not simply share renewable energy but also addresses several other sustainable development goals.

---

99 The postal code and house number uniquely identify a postal address, and a Dutch postal code typically contains eight addresses. As of 2017, there were more than 575,000 postal codes in the Netherlands. For more information, see Rhind, Graham (2017-09-29). *Global Sourcebook of Address Data Management: A Guide to Address Formats and Data in 194 Countries*. Routledge. p. 406. ISBN 978-1-351-93326-1.

100 Tarpani, E.; Piselli, C.; Fabiani, C.; Pigliautile, I.; Kingma, E.J.; Pioppi, B.; Pisello, A.L. Energy Communities Implementation in the European Union: Case Studies from Pioneer and Laggard Countries. *Sustainability* **2022**, *14*, 12528. https://doi.org/10.3390/ su141912528

101 For more information see https://www.uva.nl/en/about-the-uva/organisation/faculties/faculty-of-science/contact-and-location/amsterdam-science-park/amsterdam-science-park.html?cb
Also see https://openresearch.amsterdam/nl/page/43873/european-city-science-initiative-csi-eu and https://joint-research-centre.ec.europa.eu/index_en

Each household is provided with a green roof and a smart heat pump that exchanges heat with the canal water and is insulated using sustainable materials whenever possible. Further, they are equipped with batteries, solar panels (a total of 516), solar water heaters, and heat recovery systems for domestic hot water. There is no connection to the gas infrastructure, and all buildings are wired into the local smart grid to distribute self-produced renewable energy throughout the community. One standard connection to the national electricity grid serves the entire community.

Residents share electric vehicles and bicycles. Some homes have a rainwater collection system. All have separate streams for black and gray wastewater disposal, which is reused in a local bio-refinery station to capture nutrients and generate electricity. Real-time energy flows from and to the houses are displayed on a smart community platform, which illustrates the energy sharing within the community grid network. Each household has access to an overview of the real energy flows and status of their system, which enables them to control their energy performance effectively while considering the overall balance of the community.

The Schoonschip community received an experimental exemption from the legal system, allowing them to develop their private microgrid with a single central grid connection. To do that, the legal entity had to include innovative elements in its design, resulting in the establishment of a few sub-entities: the foundation (established by the board of founders), the cooperative association (established to take on tasks concerning the execution of the project), the owners' association (governing the collective components of the project to secure collaboration from residents), the Pioneer Vessel foundation (a new foundation established by the owners' association to coordinate sustainable initiatives). The community faced numerous challenges during this procedure, notably because the law views houseboats as movable property, which caused years of delay. Nevertheless, the floating community's success enabled the creation of a replicable model.[102]

Italy

Art. 3(2) of the Italian Constitution outlines the ability of all citizens to effectively participate in the country's political, economic, and social organization. Energy communities fall within the scope of active entrepreneurial citizenship and therefore are protected by the legal framework. The Constitution also outlines in art. 43 the possibility of transferring to communities certain enterprises related to essential public services or energy sources and having a preeminent general interest. This provision has been largely unimplemented throughout history, also because Italy has not been keen on community management of goods and services. With the transposition of the EU directives (RED II and IEMD), the role of the communities in the energy sector is starting to be enhanced.

The RED II directive has been transposed in the *Milleproroghe* decree, which in art.42-bis regulates self-consumption from renewable sources and introduces a definition of RECs, restricting the

[102] Tarpani, E.; Piselli, C.; Fabiani, C.; Pigliautile, I.; Kingma, E.J.; Pioppi, B.; Pisello, A.L. Energy Communities Implementation in the European Union: Case Studies from Pioneer and Laggard Countries. *Sustainability* **2022**, *14*, 12528. https://doi.org/10.3390/ su141912528.

parameters defined in art. 21-22 of the directive and applying only to RECs producing renewable energy with a maximum capacity of 200 KW.

The implementation was regulated through the following acts. The first is the ARERA Resolution 318/2020 for regulating economic matters related to renewable electricity shared by self-consumers acting collectively in buildings and blocks or shared in an energy community. The second is the Ministry of Economic Development's implementation decree of September 16, 2020, which set the incentive tariff for the remuneration by the National Energy Service Operator (GSE) of renewable energy self-produced and shared. It provides a 20-year incentive tariff of €100/MWh for collective self-consumption and €110/MWh for energy communities. Followed the ARERA resolution (DMEA/EFR/6/2020) on the technical rules for access to the GSE incentive scheme and the ARERA Memo 86/2021/I/COM for the implementation of the NRRP, in particular Mission 2 related to the sustainable transition, and the Green Deal.

The final transposition of the RED II directive came with Legislative Decree No. 199/2021 (the so-called RED II Decree), which amended the previous regulatory framework. Then, Legislative Decree No. 210/2021 introduced the concept of Citizen Energy Community (CEC). Among the main changes introduced by the RED II Decree is the possibility of building renewable energy plants up to 1 MW and a tariff incentive scheme that changes depending on the plant's capacity. In addition, article 14 of the RED II decree creates the possibility of investing the € 2.2 billion provided for in Mission 2 of the NRRP to support energy communities.[103]

Finally, the December 2022 ARERA resolution (727/2022/R/EEL) adopted the Integrated Text of Decentralized Self-Consumption (*Testo Integrato dell'Autoconsumo Diffuso* or TIAD), which established a regulatory framework for decentralized self-consumption systems, including individual self-consumption and collective self-consumption. TIAD implements the provisions of the Legislative Decrees for the valorization of shared energy (No. 199/2021 and 210/2021). Concerning incentives, the Ministry of Environment and Energy Security will issue a Legislative Decree updating the Ministry of Economic Development decree.[104]

Magliano Alpi

Magliano Alpi is a small rural municipality in the province of Cuneo, Piemonte. The Municipality's energy policy aims to consistently reduce energy consumption in public buildings and produce energy from renewable sources. In April 2020, the City Council decided to join the "Manifesto of Energy Communities for an Active Centrality of the Citizen in the New Energy Market"[105] promoted by the Energy Center of the Polytechnic University of Turin, which focuses attention on the centrality of the citizen-prosumer and of the energy community as a capacity-builder for

[103] Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA. p.14-16

[104] ARERA. Deliberazione 27 dicembre 2022. **727/2022/R/EEL**. Definizione, ai sensi del decreto legislativo 199/21 e del decreto legislativo 210/21, della regolazione dell'autoconsumo diffuso. Approvazione del testo integrato autoconsumo diffuso.

[105] Original title in Italian is: *Manifesto delle Comunità Energetiche per una centralità attiva del Cittadino nel nuovo mercato dell'energia*

aggregation at the local level, to offer services to its members and bring socio-economic benefits to the local community.

In December 2020, the first REC, Energy City Hall, was established. The representative, pending the election of official bodies, is Mayor and Architect Marco Bailo, who intends to establish two more RECs. The Chairman of the Scientific Committee is Engineer Sergio Olivero, an expert in innovative business models for energy transition. As the coordinator and prosumer of the REC, the Municipality of Magliano Alpi has provided a 20-kWp photovoltaic system installed on the roof of the City Hall and connected to the City Hall point of delivery (POD). The REC consists of the library, gym, local schools, and four residents. The system will also be connected to two electric-vehicle (EV) charging stations, which residents can use free of charge.

The municipality, albeit small (2,230 residents), is at the forefront of developing innovative models for revitalizing the territory and bringing citizens environmental, social, and economic benefits. The municipality believes that the REC must become a catalyst for local short supply chains, with solid cognitive and technological added value. The governance involves the municipality, citizens, and SMEs.

The municipality has purchased smart meters, which have been connected to all PODs participating in the REC. Energy City Hall REC has signed a collaboration agreement with socially innovative start-up Energy4Com for the technical-operational management of activities. In parallel with the shared energy calculations that the GSE will provide, the Energy4Com management platform will analyze production and consumption energy flow and manage all energy services. The municipality is also aggregating a Community Operational Group, a cooperative association that creates a short supply chain of technicians, designers, installers, and maintenance workers. The REC is, therefore, the catalyst for this process of aggregating skills in the area, which is essential for creating economic prosperity in the post-pandemic phase.[106]

Bottom-up Energy Initiatives in the US

Many local communities within the United States are enacting bottom-up energy initiatives, and several states are creating policy frameworks to better implement these solutions. The term "energy community" in the US policy landscape is similar to the EU policy on just transition, where the concern is related to areas that have been heavily reliant on fossil fuel for economic prosperity.[107]

The European understanding of energy community could be comparable to the notions of "community solar" and "green power communities." Furthermore, some initiatives, such as the Brooklyn Microgrid, fall in a similar scope to energy communities in the Northern European sense,

[106] Information available on the REC official website https://cermaglianoalpi.it/index.php/chi-siamo/

[107] An exemplary case in Italy is the Sulcis coal basin, a Sardinian territory that, due to its coal mines, has been heavily relying on mining and production facilities for socio-economic development. Information gathered from interview with Elena De Nictolis.

especially in their use of microgrids to enable energy self-consumption and sharing. A close parallel could be drawn with the Schoonschip energy community in the Netherlands.

Community Power Map

A tool available to map renewable energy projects in the US is the Community Power Map. The map has layers that illustrate state regulations and layers that indicate local activity. The indicators encompass community-based renewable energy projects, primarily wind and solar; 100 percent renewable energy or climate pledges made by cities; Utility (Feed-in) Tariffs that offer small power producers a linear route to supplying the electric grid with electricity from distributed renewable energy projects; Municipal Utilities; Communities with active CCAs (Community Choice Aggregations), that have the authority to choose where to purchase their energy thanks to state legislation.

An enabler of citizen energy initiatives concerns city-level utility tariffs. For example, a Feed-in Tariff (FiT) program is being offered by the Los Angeles Department of Water & Power (LADWP) to encourage the growth of renewable energy projects under its jurisdiction. The FiT is open to all technologies compliant with the state's renewable portfolio standard, though LADWP anticipates that photovoltaic (PV) systems will make up most projects. The price will be 0.17 $/kWh, multiplied by the delivery time. As specific MW objectives are achieved, base pricing will gradually decrease.

In Kalona, Iowa, the output of eligible photovoltaic (PV) and small wind systems will be purchased by the Farmers Electric Cooperative's (FEC) Consumer Renewable Energy Sales program for 0.08 $/kWh up to monthly use. A credit of 0.04 $/kWh will be given for any monthly production that exceeds monthly use. The system capacity must be between 500 W and 50 kW. In Merrillville, Indiana, customers that generate power using solar, wind, or biomass are eligible for a feed-in tariff program from Northern Indiana Public Service Co. (NIPSCO). Every current NIPSCO customer is qualified for the program. Facilities must be between 3 kW and 1 MW, insured, and compliant with interconnection requirements. The customer receives payments monthly. Depending on the technology used and the system capacity, payments can reach 0.25 $/kWh.[108]

Community Solar

The US Department of Energy recognizes community solar as "any solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, nonprofits, and other groups. In most cases, customers are benefitting from energy generated by solar panels at an off-site array."[109] Customers can buy or lease a portion of the solar panels and receive an electric bill credit for electricity generated by their share of the community solar system.

108 For more information see https://ilsr.org/community-power-map/
109 Quote from SETO, US Department of Energy. Available at https://www.energy.gov/eere/solar/community-solar-basics

As of 2020, one-third of the states have passed legislation that creates a third-party market for community solar. There is no one-size-fits-all approach, as regulations vary greatly. Usually, community solar customers in states with enabling rules receive two bills: one from the community solar program for their share of solar energy and another from the utility for the share of traditionally generated electricity consumed. Several states want to unify the bills and streamline the process.

The Solar Energy Technologies Office (SETO), part of the US Department of Energy, is advancing community solar with the National Community Solar Partnership, a network of community solar stakeholders striving to increase access to affordable community solar to every American household by 2025. Using peer networks and technical assistance resources, partners set objectives and overcome barriers to enable vulnerable communities to access community solar's benefits. Furthermore, the office provided funding for the Solar in Your Neighborhood Challenge, a reward program that aims to increase vulnerable communities' access to solar energy.[110] The main perks of community solar are to enable customers that cannot install solar panels to benefit from solar energy and for utilities to strategically locate the systems in areas of the grid that can benefit the most.

Green Power Communities

The EPA recognizes Green Power Communities, which were established with the Green Power Partnership in 2001. As of 2021, the agency recognized 122 communities made up of local government, businesses, and households, collectively using more than 8.2 billion kWh of green power annually. The percentage of green power in the total electricity use varies from 5 to 100 percent.[111]

An example is the Libertyville community, which has an annual green power usage of 63,338,000 kWh, established in November 2021. The energy provider is MC Squared Energy Services. To reiterate the commitment, the village established the Sustain Libertyville Commission and adopted the Libertyville Sustainability Plan in 2015, revised in 2018 and 2022. The local administration has partnered with a business, a knowledge institution, and a civil society organization, exemplifying the PPCP. The business partner is SWALCO (Solid Waste Agency of Lake County, IL), which provides special recycling and disposal services and hosts pop-up events and sustainability programs. The partnering knowledge institution is the University of Illinois Extension, which, through the Lake County Master Gardeners, provides horticultural guidance to the residents and offers free educational events, gardening supply sales, clean-up socials, and a free helpline. Finally, the civil society organization is the Community Partners, which connects residents to events and organizations that foster sustainable development.[112]

---

110 SETO, US Department of Energy. Available at https://www.energy.gov/eere/solar/community-solar-basics
111 https://www.epa.gov/greenpower/green-power-communities-list
112 https://www.libertyville.com/1113/Sustainability

Brooklyn Microgrid

The Brooklyn Microgrid (BMG) is an interesting parallel to energy communities in the Netherlands, which are often based on microgrids. It is an energy marketplace for locally-generated solar energy. It enables residential and commercial prosumers to sell solar energy surplus to New York City residents via the digital platform Enerxy. The data platform enables users to transact energy across existing grid infrastructure. The microgrid ecosystem connects prosumer and consumer energy assets. Energy is generated, stored, and transacted locally.

Consumer data, such as that from building management systems, is made available to the Distributed Systems Operator (DSO), which controls energy usage, load balancing, and demand response at agreed-upon rates by using price as a proxy. When an electric vehicle or a charging station, whether public or private, has extra energy, it is made available for sale on the local network. Customers may use a mobile app to set spending limits and receive availability notifications.

The BMG started as a community-driven initiative in April 2016 in Park Slope when two neighbors on President Street took part in the first peer-to-peer energy exchange. BMG was developed by its parent company, LO3 Energy, to rethink the conventional electricity grid paradigm by including the idea of a community energy network wherein residents and business owners in New York may purchase and sell locally produced, renewable energy. The Brooklyn Microgrid seeks to have a good influence on society, the workforce, the neighborhood, and the environment.[113]

[113] Information available on BMG's official website https://www.brooklyn.energy/about

Case Studies in the Global South

Citizen-led Initiatives in Latin America

Latin America is the most urbanized region on the planet, home to five megacities and with 80 percent of the population living in cities. This brings cities to the forefront of energy concerns as population growth and economic development rapidly rise. Cities are taking positive steps to advance clean energy planning. Still, their efforts need to be accelerated in particular through implementing policies and structuring investment to meet the Paris Agreement goals. Energy efficiency measures and renewable power generation are considered the most important opportunities for cities in Latin America to increase living standards and sustainable development.

According to the Inter-American Development Bank (IDB), local governments should take the lead in implementing policies that facilitates energy efficiency, management, and uptake of renewable energy sources. They should engage with partners in the private and public sectors to facilitate investment. Furthermore, municipalities should strive to achieve horizontal and vertical collaboration and tailor clean energy solutions to reflect specific urban needs.

A key point is the implementation of effective stakeholder engagement strategies following a five-step approach, i.e., identification, mapping, prioritization, planning, and engagement. Local governments should foster the dialogue among the stakeholders, placing at the core the local community. They should also re-direct finance away from high-carbon infrastructure to low-carbon projects. Finally, local communities should increase the resilience of their energy systems by reclaiming their collective ownership and develop energy community projects.[114]

SHP Cooperative in Brazil

The Creluz Group is a cooperative in Pinhal, Rio Grande do Sul, operating in 36 municipalities in the north of the state, with 91 employees, and producing energy for more than 22,000 families, which benefits overall 85,000 people. Local authorities initiated the process in 1966 and, together with farmers and businessmen, constituted the cooperative. The membership expansion process immediately began, and the first distribution networks were developed. In the early 1990s, after major difficulties, the cooperative changed its management. Until 1999, Creluz was only an electricity distributor, buying energy from the national grid and reselling it to its members. At that point, it began to concentrate its efforts on producing its own energy, putting its first generation plant into operation at the end of 1999.

In 10 years, Creluz developed six Small Hydroelectric Plants (SHPs) with capacities ranging from 0.27 MW to 1.2 MW, generating a total of 3.9 MW. The cooperative has 4,500 km of transmission lines and is licensed to feed 36 municipalities in an area of 13,000 km^2. Consumers pay their bills

[114] Salmeri et al., (2017) *Developing clean energy solutions in Latin America's major cities: An introduction for subnational energy policy decision-makers*. Carbon Trust & the Inter-American Development Bank (IDB)

according to a tariff set by Creluz, which has reception agencies in every city where it operates. Prices are comparable to those of traditional electric companies, about R$ 0.37 per kWh, with vulnerable consumers receiving up to a 64 percent discount. In addition, more than 600 families are guaranteed free energy through the cooperative's social programs. There are plans for the expansion of the cooperative's activities. Sites have already been identified for ten more SHPs of the same size as the ones that the Cooperative currently operates, and two that could support larger projects of 17 MW and 24 MW.[115]

Community Microgrids in Chile

Avilés et al. analyze community energy projects in Chile that have lowered peak demand fees and developed economies of scale, focusing on grid-connected microgrids (MG) and profitable social business strategies for investors. According to their research, multiple Chilean sites are technically and economically capable of sustaining considerable self-sufficiency based on renewable resources. This is particularly applicable to areas with abundant wind resources outside of the sunlight hours, making solar and wind energy complementing.

The authors find that the community business model is generally more profitable than self-consumption since, due to peak demand fees, the gap between Net Metering and Net Billing systems is significantly diminished in the community situation.[116] They also discover higher levels of profitability and self-sufficiency in rural areas due to the high electricity tariffs that are mostly caused by low population density. Overall, there are encouraging outcomes for adopting green MG technologies even though there are still obstacles to overcome, among which is the absence of clear guidelines for MG-grid connections.

Community MG energy systems can support social equality objectives by giving low-income tenants access to distributed generation (DG). This is consistent with Chile's agenda for equitable policy. The revenue associated with lowering the peak demand charge of the energy bill is a major factor contributing to the positive returns demonstrated in the community scheme. Chile is revisiting tariff structures and considering demand charges for the residential sector, with the goal of giving cost-reflective signals to encourage DG operation and reduce peak electricity supply costs. Thanks to the implementation of several energy policies, the country has the lowest solar energy prices in the world for large-scale generation. This sends a positive signal to small-scale generation, along with the fact that the country is revising its electricity generation bill.[117]

---

[115] Cipolat, C., da Silveira, D. D., Ludke, Q. P., Engelmann, M. P., & Braun, A. B. *Energia limpa, renovável e sustentável: estudo de caso no Grupo Creluz*.

[116] The difference between Net Metering and Net Billing is how members are paid when solar owners export excess energy from their panels to the grid. In general, net billing credits are equal to the wholesale rate, whereas net metering credits are equal to the retail rate of power (what you, as a utility customer, pay for electricity).

[117] Avilés, C., Oliva, S. and Watts, D., 2019. Single-dwelling and community renewable microgrids: Optimal sizing and energy management for new business models. *Applied Energy*, *254*, p.113665.

Bottom-up Energy Initiatives in Sub-Saharan Africa

The fact that more than 60 percent of the 1.11 billion people living in SSA are under 30 raises both development potential and energy demand, which current energy systems cannot meet adequately. Extensive research shows that community-based energy systems may be more effective than centralized systems to enhance energy access.[118] There are still few energy communities in SSA, mostly designed to bridge energy access disparities with underlying issues like poverty reduction and health improvement. However, millions of households in the region are beginning to see energy communities as a mechanism to achieve sustainability and resilience.

Energy in SSA has gotten less attention in the literature than in Europe, despite access difficulties due in part to the developing energy infrastructure. Ambole et al. find that the SSA energy projects either lack or do not have enough elements to be characterized as energy communities. The authors studied 19 community energy initiatives to evaluate the obstacles experienced and propose co-design approaches to effectively develop ECs.

Energy communities provide an innovative take on a socio-technical movement that promotes more democratic and participatory energy systems. In the debate on energy democracy and energy justice, it is frequently argued that voluntary methods, stakeholder engagement, participatory governance, cooperation, and local self-organization should be used to increase community involvement and ownership. For example, Omenge et al. argue in a study focused on Kenya that the success of renewable energy projects depends on active citizen participation and interactive stakeholder involvement that should start with project ideation and continue throughout the entire project life.[119] Muhoza and Johnson add that better integration of user perspective during project design, implementation, and assessment can identify possible shortcomings and obstacles of the energy services and tailor them to the local environment.[120]

According to Ambole et al., among the main reasons why energy communities lag in SSA are inadequate stakeholder engagement and citizen participation. Few countries have energy requirements at the local level, encouraging instead a top-down policy engagement, which has been criticized over time as inadequate for democratic energy policy formulation, design, and implementation. Most top-down strategies fail to effectively involve the local communities, only considering them in validation workshops and interviews after project choices have been made.

118 Rogers, J.; Simmons, E.; Convery, I.; Weatherall, A. Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy* **2008**, *36*, 4217–4226.
119 Omenge, P.M.; Eshiamwata, G.W.; Makindi, S.; Obwoyere, G.O. Public Participation in Environmental Impact Assessment and Its
Substantive Contribution to Environmental Risk Management: Insights from Eia Practitioners and Other Stakeholders in Kenya's Renewable Energy Sub-Sector. *In Energy and Sustainability VIII*; WIT Press: Southampton, UK, 2019; pp. 133–144.
120 Muhoza, C.; Johnson, O.W. Exploring household energy transitions in rural Zambia from the user perspective. *Energy Policy* **2018**, *121*, 25–34.

Other top-down strategies are expert-centered, which means that the communities they are designing for are given little to no input as experts construct energy solutions.[121]

Damien and Frame argue that SSA nations require contextualized community energy initiatives supported by tailored schemes, context-specific know-how, and strong leadership.[122] Research shows that community-managed MGs are a valid tool, in particular for rural areas that fall outside of the main electricity grid. For instance, increased ownership of rural mini-grids has been a key component for broadening the electricity microgrids in Tanzania. Nfah argues that local committees in Cameroon should oversee, run, and maintain installed energy systems and collect funds on a fee-for-service basis to guarantee local stakeholders' profit from the projects.[123]

The following paragraphs aim to draw attention on three aspects. The first is the role of policymaking for the uptake of community-based energy initiatives. The second is the role of NGOs in empowering communities to take a more proactive role in energy self-production. The third is the role of cross-sector collaborations to co-design bottom-up energy solutions.

Nigeria's Policies Fostering Bottom-Up Energy Initiatives

Nigeria operates a fully centralized energy system, primarily using hydropower and thermal power plants, that connects towns and individuals to a single energy source.[124] According to the Nigerian Council for Renewable Energy, power disruptions cost the country 126 billion naira ($ 984.38 million) yearly.[125] The National Energy Policy 2003 has the goal to create energy security through a robust energy supply mix, by diversifying the energy supply and energy carriers.

For the past three decades, the energy market, which is dominated on the supply side by the government-owned PHCN, formerly known as NEPA, has been unable to provide the minimum acceptable standards of electricity's availability, accessibility, and dependability.[126] Nigeria has been implementing policies for the uptake of renewable energy, starting with the Nigeria Renewable Energy Master Plan 2005 and 2012 (NREMP) which offered a legal framework for achieving the goals of maintaining a renewable portfolio standard, establishing, and strengthening regulatory institutions, establishing fiscal and market incentives, incorporating renewable energy into non-energy sector policies, and standardizing renewable energy products.[127]

---

121 Ambole,A.; Koranteng,K.; Njoroge, P.; Luhangala, D.L. A Review of Energy Communities in Sub-Saharan Africa as a Transition Pathway to Energy Democracy. *Sustainability* **2021**, *13*, 2128. https://doi.org/10.3390/su13042128

122 Damien, D.P.A.F. Critical Review of the Malawi Community Energy Model. In Proceedings of the IEEE PES Power Africa Conference, Livingstone, Zambia, 28 June–2 July 2016; pp. 78–82.

123 Nfah, E.M.; Ngundam, J. Identification of stakeholders for sustainable renewable energy applications in Cameroon. *Renew. Sustain. Energy Rev.* **2012**, 16, 4661–4666.

124 Hussaini, I., Onunze, C., Chiroma, A., Muhammas, S., & Ibrahim, S. (2014). *Energy Resources Development in Nigeria: Prospects and Challenges. November.*

125 Council for Renewable Energy (CREN) (2012) Nigeria Electricity Crunch. http://www.reneablenigeria.org

126 Adenikinju, A. F. (2005). Analysis of the cost of infrastructure failures in a developing economy: The case of the electricity sector in Nigeria.

127 Hussaini, I., Onunze, C., Chiroma, A., Muhammas, S., & Ibrahim, S. (2014). *Energy Resources Development in Nigeria: Prospects and Challenges. November.*

The Renewable Electricity Policy Guidelines 2006 was created to guide the government's vision, policies, and objectives to promote renewable sources in the electricity sector. It required the government to increase the country's electricity production from renewable sources to at least five percent of all electricity produced and to a minimum of five TWh.

The National Bio-fuels Policy and Incentives 2007 aimed at using agricultural products to grow and support the domestic fuel ethanol industry. A biofuels commission was established and a regulation on biofuels was issued by the Minister of Petroleum Resources. Furthermore, the policy established a research agency for biofuels and funded R&D. Finally, an incentive program for those involved in the biofuels development sub-sector was implemented as part of the policy's contribution to the regulatory environment for renewable energy.

The National Renewable Energy and Efficiency Policy 2015 is Nigeria's first and only coordinated tool to advance the development of renewable energy sources and raise energy efficiency levels. The national grid's accessibility limitations were acknowledged by the policy, which considered renewable energy as the best way to close the gap. To encourage the growth of Nigeria's market for renewable electricity, the government aims at offering guarantees and financial structures. Between 2014 and 2018, the United States Agency for International Development (USAID) and Power Africa funded the Renewable Energy and Energy Efficiency Project (REEEP).

Then there are also State-level regulations. For example, a net metering scheme for rooftop solar project has been launched in Lagos.[128] Other strategies put in place include mini-grid rules that the federal government has developed to handle concerns including tariffs for developers. Only projects with an energy capacity of between 100 KW and 1 MW are subject to the mini-grid regulation. These are constructive actions in the direction of clean energy power production.[129] The Solar Sisters women-led renewable energy NGO establishes women-to-women networks, recruits, trains, and mentors women to achieve "last mile" distribution for solar devices and clean cookstoves. Almost 2,500 business owners in the Solar Sister network offer services to over 350,000 individuals.[130]

Policymaking coupled with entrepreneurial and social drive has sparked a few community-led energy initiatives. Solar-as-a-service-provider has been launched in some parts of Nigeria in July 2022. For example, Ecoligo (a Berlin-based Impact Investment Provider) supports and equips one of Lagos-based manufacturing company TLM Investment Ltd with a 178 kWp solar system. Now, most companies have started implementing solar initiatives as they learn more about its advantages.[131] Another project is the Sharing the Power project introduced by the Rocky Mountain institute (RMI) in collaboration with Nayo Tropical Technology which is providing energy to peri-

128 https://www.linkedin.com/pulse/shared-solar-gardens-possible-nigeria-jonathan-fawumi-kayode/
129 https://www.nigeriaelectricityhub.com/2018/10/09/renewable-energy-and-sprouting-issues/
130 See Solar Sisters (2018). Light. Hope. Opportunity. Available at http://www.cleancooking2015.org/wp-content/uploads/2015/05/SS-Womens-Enterpreneurship-and-economic-empowerment-1.pdf
Also see Manager, C. (2018). *Olasimbo Sojinrin. May.*
131 https://ecoligo.com/en/blog/solar-as-a-service-provider-launches-first-solar-project-in-nigeria/

urban areas. It has been conceptualized as community-centric mini-grids.[132] In this project, co-ownership, inclusive governance, benefit-sharing, safeguarding community investment, gender and social inclusion are highlighted.

The Role of Power Africa in Kenya

Power Africa is a US Government-led partnership to convene resources from the private sector, international development organizations, and governments to increase energy access in SSA.[133] In Kenya, the organization supports the development of 779 MW of electricity generation projects.[134] Power Africa advocates for a community-oriented approach to energy infrastructure development, which can support utilities in building capacity and engaging local communities in the energy transition.

To provide community engagement standards to infrastructure project developers, Power Africa published the *Guide to Community Engagement for Power Projects in Kenya*, which is based on global best practices and their adaptations to the Kenyan context, as well as knowledge and data obtained from civil society organizations, regional administrations, local leaders, and community and religious figures. Power Africa distributed this source as a reference tool to electricity producers, transmission businesses, distribution businesses, and regulators. The guide emphasizes that community consultations are insufficient for meaningful involvement. In fact, all energy project phases must be approached holistically and based on trust and transparency, consent without coercion or intimidation, and fair compensation to affected communities. With Power Africa's support, energy companies evaluate their performance to build institutional and human capacity, including community participation, and develop initiatives that standardize best practices and policies to foster social responsibility in renewable energy production.

Examples of energy projects that center around local communities include the Geothermal Development Company (GDC), which developed a community engagement strategy to reduce project delays and disruptions. Another example is the Kenya Electricity Transmission Company (KETRACO), whom Power Africa supported in completing its Resettlement Policy Framework, which outlines action plans for communities impacted by land acquisition for transmission infrastructure and includes provisions for prompt and fair compensation for resettlement, loss of assets and standards of living. The framework can serve as a policy guide for power transmission projects in East Africa. Finally, Power Africa is guiding, through capacity building, utilities, and other energy sector stakeholders, in developing draft policies on community engagement, land access, revenue allocation, and resettlement compensation to amend Kenya's Energy Act of 2019.[135]

---

132 https://www.esi-africa.com/business-and-markets/sharing-the-power-with-communities-led-mini-grids-to-increase-nigerian-energy-access/
133 https://www.usaid.gov/powerafrica
134 https://www.usaid.gov/powerafrica/kenya
135 https://powerafrica.medium.com/engaging-kenyan-communities-in-energy-development-d8b16848e7b4

Cross-sector Collaborations in Kenya, Uganda, and South Africa

By investigating case studies from Kenya, Uganda, and South Africa, Ambole et al. looked at how cross-sector collaborations can support the co-creation of trans-local energy communities. The authors demonstrate how energy communities are, at first, context-based, driven by their specific energy challenges. However, because of the complexity of energy issues, partnerships with non-local stakeholders are necessary to make the most of resources and skills.

Thus, to create a shared understanding among the local stakeholders, NGOs, policymakers, and academia, the authors explore a transdisciplinary co-design methodology. They created a baseline by gathering information about households and communities via surveys, focus groups, and participatory mapping. They then hosted community discussions, design thinking workshops, and policy seminars for various stakeholders sharing the outputs from the data analysis. The local case studies were then enlarged to a regional scope attaining the trans-local viewpoint. The authors conclude that their co-design endeavor requires a long-term collaborative agenda, best fostered by interdisciplinary academics with a focus on community energy empowerment.[136]

Ambole et al. also state that co-designing the statutory, regulatory, and socio-technical configurations that will support the development of energy communities in various contexts is necessary. In this regard, they suggest that community energy intermediates, such as NGOs and knowledge institutions focused on energy and community engagement, should connect local communities with energy companies and investors who can help them develop and fund energy projects. They can also conduct feasibility studies and offer co-design tools, business services, and policy advice to the community. Finally, intermediaries should support communities with training and foster interaction with decision-makers to ensure that incentive-based regulatory frameworks are developed.[137]

---

[136] Ambole, A.; Musango, J.K.; Buyana, K.; Ogot, M.; Anditi, C.; Mwau, B.; Kovacic, Z.; Smit, S.; Lwasa, S.; Nsangi, G.; et al. Mediating household energy transitions through co-design in urban Kenya, Uganda and South Africa. *Energy Res. Soc. Sci.* **2019**, *55*, 208–217
Also see Njoroge, P.; Ambole, A.; Githira, D.; Outa, G. Steering energy transitions through landscape governance: Case of Mathare informal settlement, Nairobi, Kenya. *Land* **2020**, *9*, 206.
[137] Ambole,A.; Koranteng,K.; Njoroge, P.; Luhangala, D.L. A Review of Energy Communities in Sub-Saharan Africa as a Transition Pathway to Energy Democracy. *Sustainability* **2021**, *13*, 2128. https://doi.org/10.3390/su13042128

4. EU Energy Policy Framework

Inflation Problem in Europe

Concerns about energy security and the inflationary effects of increasing energy prices on the world's economy have substantially increased because of the unprecedented global energy crisis brought on by Russia's invasion of Ukraine. For nearly all administrations, bringing down record-high consumer costs and ensuring dependable supply is a top political and economic priority. Although there are other approaches that nations may take to deal with the present situation, concentrating on energy efficiency measures is the best option to also achieve affordability, supply security, and climate goals.

Depending on the fuel mix, the degree of energy efficiency, the structure of the economy, and government policies like fuel taxes and energy bill assistance methods, energy price inflation differs among nations. Even though the present issue is widespread, it is most felt in Europe, where the decreased energy supply from Russia is putting customers at risk of higher energy costs and supply shortages during the critical heating season.

For the year ending in October 2022, consumer energy price inflation in the European Union soared to 39 percent, with an estimated one-fourth of families experiencing energy poverty. The most vulnerable households are those that frequently reside in older, lower-quality structures, use less energy-efficient appliances, and drive older cars with lower energy performance levels. This not only entails higher energy costs for the home, but also colder, damper, and darker living conditions, all of which increase health concerns.

Additionally, this year has witnessed a notable return to the less expensive traditional biomass, such wood and charcoal, for cooking and heating. Developing and emerging economies are more vulnerable. It is anticipated that 75 million individuals who had just received access to electricity are now unable to pay for it, and 100 million people may have to return to using conventional burners instead of LPG. Women and children are especially at danger since they are the ones who are most exposed to the home air pollution that comes from cooking, which is thought to have caused to 2.5 million preventable deaths this year.[138]

[138] IEA (2022), Energy Efficiency 2022, IEA, Paris https://www.iea.org/reports/energy-efficiency-2022, License: CC BY 4.0

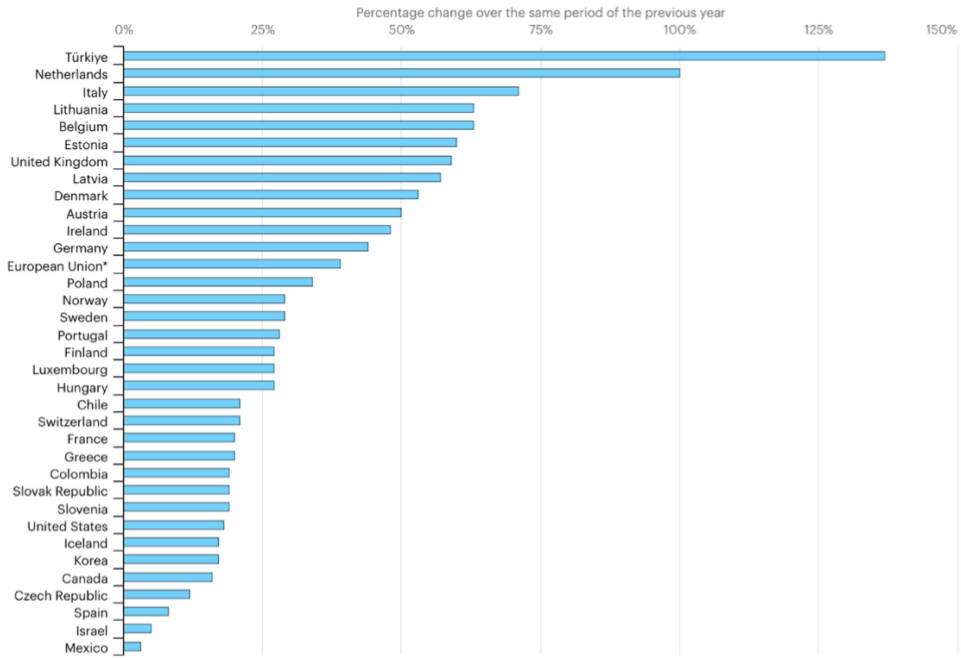

Figure 1: Year-on-year change in energy price inflation, October 2022. [139]

SDG 7 in the EU

SDG 7 monitoring in the EU includes keeping an eye on changes in energy supply, energy demand, and access to cheap energy. Progress has been made over the previous years, particularly in energy usage. The COVID-19 pandemic response efforts, together with the resulting limitations on public life and decreased economic activity, significantly decreased consumption in 2020. As a result, the EU was able to meet its 2020 goals and, based on the development made thus far, including the consequences of the pandemic, seems to be on course to meet its 2030 goal. Progress in the energy supply was aided by the decrease in energy use.

The EU has also met its 2020 goals and wants to boost the proportion of renewable energy in gross final energy consumption to at least 32 percent by 2030 to meet the SDG 7 goal of guaranteeing an affordable, clean, and secure energy system. SDG 7 emphasizes the need of accessible energy for the sake of social justice and equality. Energy is included as one of the necessary services that everyone should have access to in the European Pillar of Social Rights. The difficulty to maintain a comfortable indoor temperature is a survey-based measure used to track EU-wide access to inexpensive energy. Low-income levels combined with high energy costs and inadequate building efficiency requirements are significantly linked to a lack of affordable energy access.

[139] IEA (2022), Energy Efficiency 2022, IEA, Paris https://www.iea.org/reports/energy-efficiency-2022, License: CC BY 4.0

Over the past few years, the EU has made modest improvements toward enhancing access to affordable energy. The percentage of people who could not afford to heat their houses effectively between 2012 and 2019 decreased steadily, reaching 6.9 percent in 2019. However, the share increased once again to 8.2 percent in 2020. The COVID-19 pandemic and a modification to the German EU-SILC survey's methodology are likely to blame for this rise. Due to this modification, the proportion of persons in Germany who cannot afford to appropriately heat their houses increased from 2.5 percent in 2019 to 9 percent in 2020. Only nine other Member States experienced growth between 2019 and 2020, but mostly of less than 1 percentage point. 20 percent below the poverty line reported not being able to effectively heat their homes in 2020, which is an increase of 1.8 percentage points from the previous year. Accordingly, almost a fifth of the EU's poorer citizens experienced energy poverty. In comparison, just 5.8 percent of those with income over the poverty line were unable to afford to effectively heat their houses in 2020, an increase of 1.2 percentage points from the previous year.

Less than 10 percent of the population in 20 Member States reported being unable to heat their houses effectively in 2020. The lowest percentage of people without affordable access to heating were found in Northern and most Western European countries. The highest percentage is in Southern and South-eastern Europe. This distribution can be attributed mostly to insufficient building insulation and energy efficiency, which results in increased heating expenses. Additionally, the typically lower income levels in these areas have an impact on the quality of homes and people's capacity to afford energy. The availability and structure of financial assistance by the national governments is crucial in reducing energy poverty.[140]

EU Commitment to Addressing Energy Poverty

The European Commission claims that energy poverty "results from a combination of low income, high expenditure of disposable income on energy and poor energy efficiency, especially as regards the performance of buildings."[141] In fact, people who live in inefficient buildings are more vulnerable to heatwaves, cold spells, and other effects of climate change. According to an EU-wide poll, 8 percent of EU citizens reported being unable to sufficiently heat their homes in 2020. As a result, energy poverty continues to be a significant problem, and the EU and its members must take immediate action to help vulnerable populations escape it. [142]

Since directive 2009/72/EC, the European Union has been progressively nudging member states to tackle energy poverty. With Regulation 2018/1999/EU, the Directive 2019/944/EU, and the Commission Recommendation 2020/1563/EU, the EU mandates all Member States to develop

140 Eurostat (2022) *SDG 7 - Affordable and clean energy. Ensure access to affordable, reliable, sustainable and modern energy for all*. Data extracted in April 2022. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=SDG_7_-_Affordable_and_clean_energy#Context

141 See European Commission, Covenant of Mayors, Energy Poverty. Available at https://eu-mayors.ec.europa.eu/en/library/energy_poverty

142 See European Commission, Energy Poverty in the EU. Available at https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumer-rights/energy-poverty-eu_en
Also see European Commission, Covenant of Mayors, Energy Poverty. Available at https://eu-mayors.ec.europa.eu/en/library/energy_poverty

national action plans aimed at tackling energy poverty as well as criteria for defining energy poverty and assessing how many households lack the necessary energy services.[143]

Still, it is important to remember that the concept of energy poverty in the EU remains diversified from the one explored in the Global South. It could be characterized as relative rather than absolute, as all European citizens virtually have access to energy services. However, they might lack the economic means to take advantage of them. In some contexts of the Global South, access to energy services is not always guaranteed, leading to absolute energy poverty.

Energy Poverty National Indicators

In current policy objectives and legislative frameworks, the European Commission emphasizes energy poverty as a severe societal problem that must be addressed as soon as possible. A critical step is the diagnosis process, which entails properly identifying the energy poor and monitoring vulnerability levels. To diagnose a potential energy poverty situation, indicators that can consistently and efficiently capture its various characteristics must be used to measure it. A wide range of indicators and approaches can be used to investigate energy poverty.

Data availability and selecting appropriate indicators are becoming increasingly important at the European, national, and local levels. Indeed, the European Commission obliged Member-States in 2019 to assess energy poverty on their territory and estimate the size of the energy-poor population as part of their National Energy and Climate Plans (NECPs). If energy poverty is deemed a serious societal burden, Member States are expected to propose measures and policies to alleviate it.

In the "Energy Poverty National Indicators: Insights for a more effective measuring" report, EPAH focuses on macro-indicators and how they might help Member States and other agency levels with their national strategies and policies, better comprehending the problem and laying the groundwork for planning and implementing energy poverty mitigation measures. EPAH uses 21 indicators for analyzing energy poverty, categorizing them as main if they directly show energy poverty and secondary if they help characterize the factors that lead to a vulnerable situation. These indicators were developed primarily using Eurostat statistics and national Household Budget Survey data to measure energy poverty in all facets across different national settings.[144]

The indicators provide a picture of the EU that is diversified across each of them. The next paragraphs focus the attention on the first two indicators, "arrears on utility bills" and "inability to keep home adequately warm." For "arrears on utility bills" (Fig. 1) it is possible to observe that the EU has a varied percentage of energy poor households, with the highest concentration (above 9.6 percent) in the Eastern-EU countries. Comparing the data to the "inability to keep home

143 See Feenstra M, Middlemiss L, Hesselman M, Straver K, and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. Doi 10.3389/frsc.2021.645624.

144 Thema, J., & Vondung, F. (2020). *EPOV Indicator Dashboard: Methodology Guidebook*. Energy Poverty Observatory. European Commission.

adequately warm" (Fig. 2), it seems that the situation worsens in some countries such as Italy, the Netherlands, Belgium, Portugal, Romania, and Germany, but it is better in Croatia and Hungary.

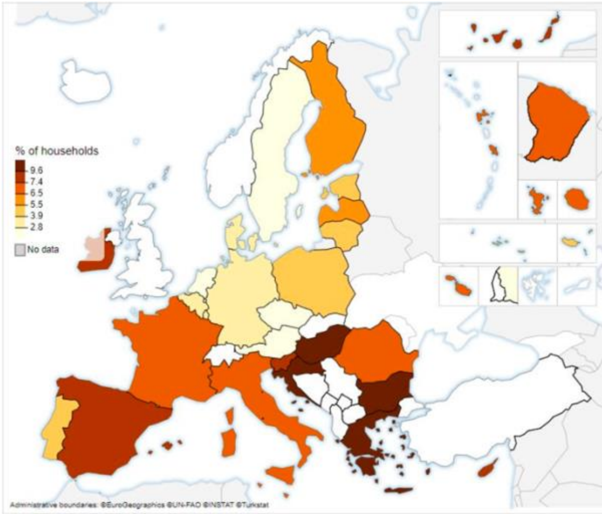

Figure 2: Map of the arrears on utility bills from 2021.

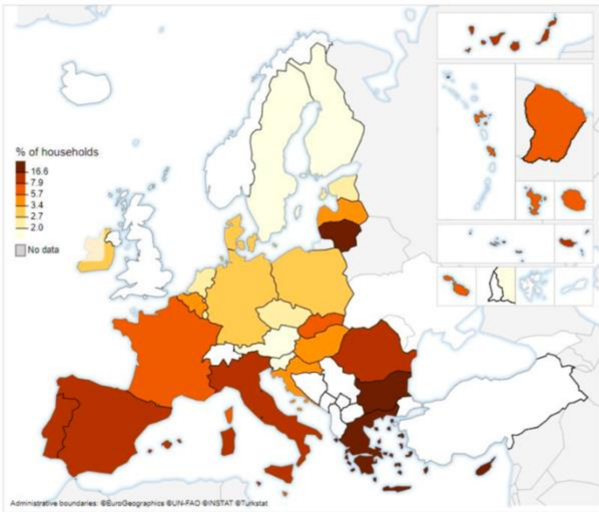

Figure 3: Map of Inability to keep home adequately warm indicator in 2021.[145]

Tackling Energy Poverty at the Local Level

The EU Energy Poverty Advisory Hub (EPAH) has been investigating and collecting information and experience on this problem at the subnational and local levels. The project has already created an ATLAS that includes over 200 European initiatives and projects tackling energy poverty at the local level in their various stages of diagnosis, planning, implementation, and effect assessment.

[145] Figures 2-3 from Energy Poverty Advisory Hub (2022) *Energy Poverty National Indicators: Insights for a more effective measuring*. European Commission.
Source: EPAH (2022). Energy Poverty Indicators Dashboard. Directorate-General for Energy. European Commission. Available at: https://energy-poverty.ec.europa.eu/observing-energy-poverty/national-indicators_en

The paper "Tackling energy poverty through local actions – Inspiring cases from across Europe" identified 24 cases covering various activities to inspire local governments in their actions. The EPAH also published the report "Bringing Energy Poverty Research into Local Practice – Exploring Subnational Scale Analysis," which is a review of research articles focusing on local assessment and indicators of energy poverty in various geographical contexts to gather information for local governments to set up energy poverty diagnosis processes.

In parallel, the Covenant of Mayors on Climate and Energy in Europe (CoM) has introduced the energy poverty pillar, reaffirming municipalities' commitment to addressing energy poverty to guarantee a just transition. The CoM advises and assists local governments in reducing energy poverty, preferably in conjunction with existing climate action programs. The CoM, in collaboration with EPAH and the Joint Research Center (JRC), has suggested a framework based on a collection of indicators combining different macro-areas to assess energy poverty.[146] Case studies include a multi-stakeholder partnership to eradicate energy poverty, in Zagreb, Croatia, fighting energy poverty through a network of committed actors, in Les Mureaux, France, and through deep renovation of buildings, in Porto, Portugal. Finally, there is a project on improving living standards and reducing energy poverty in Newcastle Upon Tyne, United Kingdom.[147]

Social Climate Fund

The European Commission proposes expanding carbon pricing to the building and transport sectors as part of the revisions to the EU ETS included in the *Fit for 55* legislative package. Instead of the current ETS, a new, independent emissions trading system will be used to cover emissions from these industries. The Commission suggests establishing the Social Climate Fund to address any social effects that this new system may have. The Fund's main objectives are to finance temporary direct income support for vulnerable households and support measures and investments that reduce emissions in road transport and building sectors to reduce costs for vulnerable households and enterprises.

According to the Commission, the draft Fund should "provide funding to Member States to support measures and investments in the increased energy efficiency of buildings, decarbonization of heating and cooling of buildings, including the integration of energy from renewable sources, and granting improved access to zero- and low-emission mobility and transport. These measures and investments must mainly benefit vulnerable households, micro-enterprises, or transport users."[148]

146 CoM (2022). *Reporting Guidelines on Energy Poverty*. Support and Library. Covenant of Mayors for Climate & Energy - Europe.
147 See European Commission, Covenant of Mayors, Energy Poverty. Available at https://eu-mayors.ec.europa.eu/en/library/energy_poverty
148 https://climate.ec.europa.eu/eu-action/european-green-deal/delivering-european-green-deal/social-climate-fund_en

Clean Energy for All Europeans Package

In 2019, the Commission adopted the *Clean Energy for All Europeans package,* supporting the decarbonization of the EU's energy system in line with the European Green Deal objectives. The package made a significant step forward in implementing the 2015 Energy Union Strategy (COM/2015/080), which aimed at creating an energy union that provides EU households and businesses with secure, sustainable, competitive, and affordable energy. The package consists of eight laws, described below, making a clear contribution toward the EU's long-term strategy of achieving carbon neutrality by 2050.[149]

1. Governance Regulation

Regulation on the Governance of the Energy Union and Climate Action (2018/1999/EU) established that each EU country is required to draw up National Energy and Climate Plans (NECPs) for 2021-30, which will outline how EU countries will achieve their targets on the five dimensions of the energy union strategy.[150] The first dimension entails diversifying Europe's energy sources and ensuring energy security through cooperation between the Member States. The second dimension entails a fully integrated energy market enabling the free flow of energy through adequate infrastructure. The third concerns improving energy efficiency, which will reduce dependence on energy imports and drive growth. The fourth concerns climate action and decarbonizing the economy, following the commitments of the Paris Agreement. The fifth dimension is research and innovation supporting breakthroughs in low-carbon and clean energy technologies.[151]

2. Renewable Energy Directive (RED)

The first version of the Renewable Energy Directive was introduced in 2009 (2009/28/EC). Since then, the deployment of renewables has been steadily growing, reaching 22 percent in 2020, placing the EU in a leading position globally.[152] The revised Renewable Energy Directive or RED II (2018/2001/EU) entered into force in December 2018, as part of the *Clean energy for all Europeans package*. The directive sets a new, legally-binding aim of at least 32 percent of renewables in the energy mix by 2030, with a provision for a potential modification to a higher level by 2023.

The directive introduces new measures for several economic sectors where progress has been slower. One example is transportation, where the Commission has set a target of at least a 14 percent increase in renewables by 2030. Finally, the Directive encourages citizens to actively

[149] https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en
[150] https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en
[151] https://energy.ec.europa.eu/topics/energy-strategy/energy-union_en
[152] European Commission, Directorate-General for Energy, Hørman, M., Georgiev, I., Wessel, R., et al. (2022) *EU's global leadership in renewables : final synthesis report : July 2021*. Publications Office of the European Union. **https://data.europa.eu/doi/10.2833/523799**

participate in the energy transition by forming renewable energy communities or self-consuming renewable energy.[153]

3. Energy Efficiency Directive (EED)

In July 2021, the Commission put forward a proposal for a recast directive on energy efficiency (COM/2021/558) as part of the *Delivering on the European Green Deal package*, raising the level of ambition of the EU energy efficiency target and making it binding for countries to collectively ensure an additional energy consumption reduction of 9 percent by 2030 compared to the 2020 Reference Scenario. This corresponds to the 39 percent target for primary energy consumption and 36 percent for final energy consumption, making overall energy consumption by 2030 no more than 1023 million tons of oil equivalent Mtoe of primary energy and 787 Mtoe of final energy.[154] As explained by Eurostat, "Primary energy consumption measures total domestic energy demand, while final energy consumption refers to what end users actually consume. The difference relates mainly to what the energy sector needs itself and to transformation and distribution losses."[155]

In response to the gas dependency on Russia, in the 2022 REPowerEU Plan, the Commission proposed raising the energy efficiency target to 13 percent (compared to the 2020 Reference Scenario), making overall consumption of 750 Mtoe in the final and 980 Mtoe in primary energy. In art. 8, the recast proposal doubles the annual energy savings obligation (1.5 percent of final energy consumption from 2024 to 2030, up from the current level of 0.8 percent). The proposal also requires the public sector to reduce annual energy consumption by 1.7 percent across a wide range of activities such as buildings, transport, water, and street lighting. MS is also required to renovate every year at least 3 percent of the total floor area of the buildings owned by the public administration.

The directive also stresses alleviating energy poverty, prioritizing energy efficiency measures for vulnerable communities, empowering consumers through awareness raising, information provision, and improved requirements to lift barriers relevant to split incentives between tenants and owners. Under the Social Climate Fund, the revenues from the ETS extension to buildings and transport will be used to offset adverse distributional consequences. Finally, under the energy savings duty (art. 8), each EU nation will be required to allocate a share of energy savings to vulnerable consumers.[156]

[153] https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en
[154] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en
[155] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210128-1/
[156] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

4. Energy Performance of Building Directive

To decarbonize the building stock (approximately 36 percent of all CO_2 emissions), along with the Energy Efficiency Directive (originally 2012/27/EU), the Commission produced the *Energy Performance of Buildings Directive* or EPBD (2010/31/EU),[157] which was revised in 2018 (2018/844/EU).[158] The European Parliament has recently proposed an additional revision of the directive, which would set 2028 as a deadline for all new buildings to be zero-emission and equipped with solar technologies where feasible, and 2026 for all public buildings, which will have to achieve class E by 2027 and class D by 2030. Moreover, residential buildings undergoing renovation would have until 2032 to implement solar panels and would need to achieve at least energy performance class E by 2030 and class D by 2033. Member states will have to put in place cost-neutral renovation schemes and prioritize deep renovation and targeted grants to vulnerable households.[159]

5-6. Electricity Directive and Electricity Regulation

By 2030, the share of power generated by renewable energy sources will increase from 25 to over 50 percent. When there is no wind or sun, power must still be generated and distributed appropriately. To support renewable energy sources and draw investment in resources like energy storage that may offset fluctuating energy supply, markets must be strengthened and offer the appropriate incentives to encourage consumers to help maintain the stability of the power system. The *Clean Energy for All Europeans package* includes four pieces of legislation addressing these issues and further adjusting EU market regulations to the new market realities.[160]

The *Directive on common rules for the internal market for Electricity* (2019/944/EU), also referred to as Internal Electricity Market Directive (IEMD), replaced the Electricity Directive (2009/72/EC) and the *Regulation on the internal market for electricity* (2019/943/EU) replaced the Electricity Regulation (EC/714/2009) placing the consumers at the core of the clean energy transition enabling their active participation and putting in place a strong consumer protection framework. Society will gain more from international trade and competitiveness if electricity can flow freely to where it is most needed, which will drive the investments required to decarbonize the European energy system while ensuring supply security. By giving more flexibility to accommodate an expanding percentage of renewable energy in the grid, the new regulations help the EU achieve its aim of being the global leader in energy generation from renewable energy sources.[161]

157 https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF
158 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=EN
159 https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-energy-performance-of-buildings-directive
160 https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en
161 https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

7. Risk Preparedness Regulation

The *Regulation on risk preparedness in the Electricity sector* (2019/941/EU) requires Member States to draw up plans for how to deal with potential electricity crises and put the appropriate tools in place to prevent, prepare and manage the situations. Member States must identify all potential national and regional electricity crisis scenarios using standard techniques before creating risk preparedness strategies. Above all, this preparation calls for solidarity-based cooperation and coordination between EU member states and their neighboring nations. Additionally, it creates a new structure for the Electricity Coordination Group to monitor supply security risks in a more organized manner.[162]

8. ACER

The Agency for the Cooperation of Energy Regulators (ACER)'s original role was coordinator, advisor, and monitoring figure. Under the new market design, Regulation 2019/942/EU transforms it into an agency for the cooperation of national energy regulators. Additional competences are granted in areas where fragmented national decisions of cross-border relevance are likely to lead to problems for the internal energy market.[163]

162 https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en
163 https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

5. Rome Experimental Project

The Rome Experimental Project results from ten years of theoretical and applied research by LabGov.City and ENEA. LabGov.City is an international network of theoretical, empirical, and applied research developing methods, policies, and projects focused on collaborative commons management. It is co-directed by Professor Christian Iaione from Luiss Guido Carli University and Professor Sheila Foster from Georgetown University. The labs developed under the LabGov framework are active in four universities: Luiss University in Rome, Georgetown University in Washington DC, the University of Hong Kong, and the Universidad Latina de Costa Rica in San José. LabGov also collaborates with several other knowledge institutions worldwide and has created a global network of Co-Cities, aimed at developing urban collaborative innovation that makes cities more equitable and sustainable.

ENEA is the National Agency for New Technologies, Energy, and Sustainable Economic Development, a public research and innovation entity focused on applied research, technology transfer, and scientific support to PAs, businesses, and citizens. It is institutionally bound to the Ministry of the Environment and Energy Security. Since 2015, LabGov has supported ENEA in developing several applied research projects adapting the multidisciplinary approach of co-governance of the commons to energy services and investigating the dimensions of energy communities.[164]

The Italian Perspective on Energy Transition

Mission 2 of the NRRP (Green Revolution and Ecological Transition) focuses on renewable energy, hydrogen, and sustainable mobility, to which are devolved € 18.22 billion, and to energy efficiency and requalification of buildings, to which are devolved € 29.55 billion. The mission will benefit from an investment of € 69.80 billion, the highest among all the missions. The mission includes three of the Next Generation EU flagship programs identified by the European Commission in the 2021 Annual Sustainable Growth Strategy, which are *Power Up* (renewable energy and green hydrogen), *Renovate* (energy efficiency of buildings), *Recharge and Refuel* (development of sustainable mobility through electricity distribution networks).

Within the sustainable agriculture project line, the plan aims to develop agri-solar parks to increase the sector's sustainability and energy efficiency and enable decentralized energy production systems. The 2026 goal is to have a total PV coverage of 13,250 m^2 with a total productivity of 1.300-1.400 GWh, which marks an increase in PV production of 5 percent compared to the 24,000 GWh baseline. The mission is particularly oriented on developing the Mezzogiorno (south of the country) and minor islands, transforming them into 100 percent sustainable territories and

[164] See the concept note of *Diritto ed Economia delle Comunità Energetiche*, Special Number for the Review *Diritto e Società*, published by LabGov.City in 2023. Concept note available at request.

attracting further sustainable investment, and supporting the development of environmental and economic zones.

The second component of the mission deals with the production and distribution of renewable energy, providing the infrastructure for their full integration into the electricity grid. It is conceived as one of the most important parts of the NRRP as it has the strategic role of achieving the sustainable development goals highlighted in the EU's objectives in the *Fit for 55* package. The project line will also significantly reduce air pollution, as 3.3 percent of the Italian population lives in areas that exceed the EU cap for air pollution (due to particulate matter and nitrogen oxides). The component provides for reformed measures, among which is a simplification of the authorization procedures for renewable installation and the definition of a new legal framework to support renewable production by extending the scope of eligibility of the current support schemes. Furthermore, the plan envisions national programs on air pollution control with a related monitoring system.

The investment action includes funding (senior/junior loans and/or credit enhancement) for grid parity systems, support for the development of floating and offshore wind photovoltaic projects, onshore projects carried out on sites owned by the PA or with low land consumption or combined with storage technologies (parity between cost of self-produced electricity with a photovoltaic system and cost per kilowatt hour of energy produced from traditional sources). To support the NECP target for 2025, the targets for 2026 are represented by an increase of 4.5-5 GW in installed renewable capacity. The design and installation of 100 MW floating solar systems in a region with high radiation levels will be combined with wind power plants to increase overall energy production. Investment is also targeted at supporting the growth of industrial sectors linked to the production of technologies for generating electricity from renewable energy sources, focusing on PV and wind power. Regarding PV, the objective is to increase national production from 200 MW/year to 2 GW/year in 2025 and increase to 3 GW/year in the following years.

Additionally, the investment entails installing thermal storage systems to separate the thermal and electrical flows of the CCGT (Combined Cycle Gas Turbines) systems, allowing for the temporary displacement of electricity production while ensuring a continuous and secure supply to industrial complexes. These steps follow the EU's decarbonization plan. They will help achieve the NECP's goals of raising the renewable energy share in Italy's energy mix to 55.4 percent by 2030 and achieving a storage capacity of 3 GW by 2025. Significant physical infrastructure and grid digitalization are anticipated to boost the integration of renewable energies into the electricity distribution network. The investment also supports municipal projects that are in line with the NECP, chosen in accordance with EU regulation on the basis of consistency and contribution to the NECP's objectives, as well as for local impact.[165] Furthermore, the plan devolves € 2.2 million to small municipalities for the development of renewable energy facilities with a production capacity of at least 2 GW.

---

165 Next Generation Italy (2021) *National Recovery and Resilience Plan.* Approved by the Council of Ministers on 12 January 2021. Ministry of Economics and Finance, Rome.

The third component of the mission deals with energy efficiency and restoration, as buildings generate more than a third of total consumption. Two design lines make up the component. The first is implementing a program to increase the efficiency and security of the legacy of public buildings, focusing on schools, public housing, municipalities, and judicial towns. The second is a temporary incentive for introducing energy requalification and anti-seismic measures concerning private property through a tax reduction equal to 110 percent of the costs incurred for the linked interventions.[166]

Energy Governance in Italy

The National Plan for Energy and the Climate (*Piano Nazionale Integrato per l'Energia e il Clima* or PNIEC) sets the parameters of the energy transition in Italy, identifying multi-level governance that enhances the role of the ministries involved in the sustainable transition, the regions, municipalities, and ARERA, supported by knowledge institutions and industry associations. The PNIEC advocates for greater involvement of citizens and the simplification and standardization of authorization procedures related to new installations and revamping of existing ones.[167]

The Italian Parliament has transposed the EU legal framework on energy communities at the national level. Then, some agencies develop policy frameworks according to their competencies, i.e., ARERA is concerned with the energy distribution grid, and MASE with incentives for energy communities. Art. 5 of the Constitution recognizes and promotes local autonomies in accordance with the subsidiary principle. Therefore, regions and municipalities play a fundamental role in energy governance.

Concerning regions, a parallel could be drawn between Lazio, Emilia Romagna, and Piemonte. The Piemonte region is one in which renewable energy communities (REC) thrive the most also due to the mountainous territory, which offers different renewable energy sources. The region supports the development of RECs by monitoring the progress of projects, creating a regional network, sharing information and project results, and organizing dissemination and communication events. Furthermore, the region interacts with institutional stakeholders, i.e., ARERA, GSE, MISE, and energy distributors, to create enabling conditions for the development of RECs. Finally, the region already passed a regional law in 2018 (n. 12 of 3 August 2018) to promote the development of RECs, which was implemented through the Regional Council

166 Next Generation Italy (2021) *National Recovery and Resilience Plan.* Approved by the Council of Ministers on 12 January 2021. Ministry of Economics and Finance, Rome.
167 See Ministero dello Sviluppo Economico, Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Ministero delle Infrastrutture e dei Trasporti (2018) *Piano Nazionale Integrato per l'Energia e il Clima.*
For a deeper understanding also see Ministero dell'Ambiente e della Sicurezza Energetica (2022) *Piano per la Transizione Ecologica.* Also see Camera dei Deputati (2021) *Governance europea e nazionale su energia e clima*. Published on 16 December 2021. Camera dei Deputati Servizio Studi XVIII Legislatura, Rome.

Resolution No. 18-8520 of 8 March 2019 and four pilot projects (Municipality of Scalenghe, Susa Valley Mountain Union, Municipality of Ostana, Maira Valley Mountain Union).[168]

With Regional Council Resolution No. 2151 of December 5, 2022, the Emilia-Romagna Region intends to incentivize the establishment of Renewable Energy Communities (RECs), consistent with Regional Law 5/2022, through the granting of economic contributions that help cover the costs of preparing feasibility studies and establishing them. In addition to the environmental benefits, RECs can generate social and economic benefits, especially through the involvement of vulnerable households, and combat energy poverty.[169]

The Lazio region has published a call for funding technical and economic feasibility studies to develop RECs with a total investment of € 1 million. For each application, support ranges from a minimum of € 6,000 to a maximum of € 13,000. The development of RECs is already the subject of the 'Less Pollution, More Savings' awareness campaign. It is part of the energy policy directions of the 2021 - 2027 Unified Planning, the Regional Energy Plan – PER, and the Region's Ecological Transition Plan (ETP). According to the regional plan, the development of RECs makes achieving socio-economic and environmental goals possible by encouraging the spread of RES and creating models of inclusion and collaboration to combat energy poverty.[170]

Rome

This section provides an example of local-level energy governance focusing in particular on energy communities. Rome is one of the 100 cities selected by the EU Commission to become climate neutral by 2030 and draft a Climate City Contract. The Climate Office is tasked with implementing the necessary measures to achieve climate neutrality. The office's role is two-fold: support access to credit to develop energy community projects, especially for vulnerable communities, and make the public building stock available to the needs of energy community projects. In particular, the Intersectoral Working Group Energy Communities and Solar Installations support the development of energy communities and the installation of solar systems in the municipal territory in collaboration with the *Municipi*, the Metropolitan City, and Areti, which manages the electrical distribution network in Rome. Areti has created a map of primary substations (*cabine primarie*) to support the development of new energy community projects.[171]

Roma Capitale has agreed to finance 15 social RECs, one for each Municipio, with the PV systems implemented on school rooftops because they represent a cultural hub in which the local community tends to recognize itself. The schools will self-consume and be part of the social RECs at the same time. Resources will also be invested in implementing social projects for the

168 See https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2023-02/comunita_energetiche_slide_feb2023.pdf
Also see https://www.regione.piemonte.it/web/temi/sviluppo/sviluppo-energetico-sostenibile/comunita-energetiche-rinnovabili-piemonte
169 https://fesr.regione.emilia-romagna.it/opportunita/2022/sostegno-allo-sviluppo-di-comunita-energetiche-rinnovabili
170 https://www.regione.lazio.it/notizie/Comunita-energetiche-rinnovabili-al-via-oggi-domande-bando
171 The map is available here https://www.deepl.com/translator#it/en/cabina%20primaria

community. The Department of Infrastructure Development and Urban Maintenance will coordinate the implementation of the RECs with the selected *Municipio*. Roma Capitale initiates the development of the energy communities but does manage any of them. It will be responsible for selecting entities that will handle technical, economic, and communication aspects.

Furthermore, the city will later sponsor the development of RECs centered around 300 schools through the Institutional Development Contract, where the installation of solar systems is already planned. The Administration will also simplify solar installation procedures by creating agreements with the banking system to facilitate access to credit for households that want to be part of energy communities, starting with vulnerable neighborhoods.

Finally, the municipality will make its public roofing assets available for projects promoted by families and third-sector associations. This includes 1,200 school buildings and hundreds of social housing, libraries, museums, and markets.[172] Roma Capitale has also signed a Memorandum of Understanding with the GSE to make the public building stock sustainable (i.e., self-sufficient), starting from schools by 2030. The investment is made by municipal resources, the incentive tools managed by the GSE, such as the *Conto Termico,* and private operators involved through energy supply tenders.[173]

Incentive Framework

A central issue in developing an energy community is access to financial resources. It has been observed in several countries that the development of an EC is not always linear and bottom-up financing (e.g., crowdfunding) is often insufficient, which translates into the fact that communities rarely own the energy facilities. To face the issue, in Italy, multiple incentive and investment schemes have emerged that fall under three categories.

The first is public financing. In this line of action, EC projects, which undoubtedly retain a high degree of risk, are financed by public incentives. At the national level, there are several types of direct support, such as the incentive package introduced by the MISE Decree No. 285 of 16/09/2020, the ARERA resolutions 318/2020/R/eel and 573/2022/R/eel. In particular, access to incentives is constrained by some variables. The first is the cap to total power generation for each REC, which amounts to 5 GW. The second is the capacity of each energy facility, which equals 1 MW. Furthermore, the energy facilities have to be built and start working after the publication of the decree, and they need to comply with the DNSH principle.

The GSE gives the incentive for a period of 20 years and amounts to 110 €/MWh on the energy immitted in the grid and shared (MISE decree 16/09/20220). Furthermore, there is a fee dispensed for the return of minor system costs resulting from sharing, identified by ARERA with 9 €/MWh. Therefore, the total is 119 €/MWh for the GSE incentive, to which is added a zonal component. In the central regions (Lazio, Marche, Tuscany, Umbria, and Abruzzo), the correction factor is 4

[172] https://www.comune.roma.it/web/it/notizia.page?contentId=NWS993312
[173] https://www.comune.roma.it/web/it/notizia.page?contentId=NWS1010051

€/MWh. In the northern regions (Emilia-Romagna, Friuli-Venezia Giulia, Liguria, Lombardy, Piedmont, Trentino-Alto Adige, Valle d'Aosta, and Veneto), the correction factor is 10 €/MWh. The correction factors are justified by solar exposure, which is lower in the north than in the central and southern regions. Despite so, the incentive scheme seems not to account for the socio-economic gap between the north and the south of the country, which can be widened by the lack of zonal incentives in the south, as even before the implementation of the zonal component, the majority of energy communities were developed in northern regions.

Furthermore, energy communities can benefit from regional and EU fundings, in particular the European Structural and Investment Funds (ESI Funds) geared toward small-scale renewable energy projects, the InvestEU scheme and the EIB investment facility, as well as the Just Transition Fund (JTF) of the European Green Deal (COM/2019/640 final). Finally, it is worth mentioning the NRRP, which allocates more than € 2.2 billion to developing ECs.

Beyond GSE incentives, PAs can indirectly support EC projects by bearing part or the total activation costs. This could be done by establishing PPCPs, in which, for example, the public actor provides in free concession a public unused building roof to install the solar panels, therefore acting as a prosumer.

Secondly, investment can be financed privately through loans provided by financial institutions. In this case, particular attention should be given to ethical banks (art. 111-bis *Testo Unico Bancario*). Another investment tool concerns the Energy Efficiency Certificates (EEE), also called white certificates, which are negotiable securities certifying the achievement of energy savings in energy end uses through energy efficiency enhancement interventions and projects. The objective of this system was initially to nudge electricity and gas distributors with more than 50,000 customers to save predetermined amounts of energy every year. Currently, the EEE system allows voluntary access also to other entities, including ESCOs, public and private entities that have adopted an Energy Management System, or that have appointed an EGE (Expert in Energy Management). To obtain the incentive, entities must submit specific projects to the Energy Services Manager for approval. The white certificate will be issued only after a monitoring period, through which the actual energy savings resulting from the intervention will be assessed.

The last category is community financing, which offers two primary investment schemes. The first is the cooperative model, based on self-funding by the members. The second is crowdfunding, in which the future EC accesses financing through campaigns promoted on crowdfunding platforms, similar to an early-stage startup.[174]

[174] Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA.

The Network of Renewable and Social Energy Communities

Italy sets a clear example of how it is possible to use renewable energy communities to contrast energy poverty. The environmental NGO Legambiente has created the Network of Renewable and Social Energy Communities (*Rete delle Comunità Energetiche Rinnovabili e Solidali*) to foster community-led energy initiatives that tackle energy poverty. The network seeks to enable vulnerable areas to implement social innovation processes that trigger a change in the local community and bring about environmental and social justice. The network believes mitigation and adaptation actions need to center around citizens' participation and the role of non-profit organizations, PAs, and SMEs. There are currently 59 members within the network.[175]

The first social energy community was set in East Naples (*Comunità energetica e solidale di Napoli Est*), in the vulnerable neighborhood of San Giovanni a Teduccio. It required an investment of about € 100,000. It was financed by Fondazione con il Sud, promoted by Legambiente, and by the local community, particularly the Famiglia di Maria foundation, which works to support 40 vulnerable households included in the energy community. The community co-owns a 53-kW PV system built on the roof of the foundation, with a productivity of about 65,000 kWh. It is estimated to be able to generate savings, in terms of less electricity consumed by all REC members, of about € 300,000 in 25 years.[176] The REC sparked the development of a renewed community identity. The approach is context-based, but the general framework can be applied to other vulnerable territories in accordance with specific needs.

Social RECs can be a key lever for the energy transition and social justice. The goal of the Network is not only to stimulate the emergence of new models but also to make the communities themselves the core of a bottom-up social energy revolution. The first small municipality to become part of the network is Ferla, in the Siracusa province of Sicily, with a population of 2.300. In partnership with the municipality and the Catania University, the citizens created "Common Light – mettiamo insieme le nostre energie," an energy community powered by a 20-kW PV system provided by the municipality, which is the only prosumer.

These are just examples of a wider trend setting foot in Italy. According to Legambiente, it is possible to install renewable energy community facilities for a total production capacity of 17 GW by 2030, equal to about 30 percent of the energy sector decarbonization targets set by the National Integrated Energy and Climate Plan (PNIEC). The system can support the creation of more than 19,000 jobs in the renewable energy facility sector alone, generating an added value of € 2.2 billion along the entire supply chain, an increase in tax revenue, net of deductions, of € 1.1 billion from

[175] See https://www.comunirinnovabili.it/manifesto-c-e-r-s/
Also see https://www.comunirinnovabili.it/la-rete-delle-comunita-energetiche-rinnovabili-e-sostenibili/
[176] https://www.comunirinnovabili.it/comunita-energetica-e-solidale-di-napoli-est/

the companies involved in the construction and maintenance of plants, VAT (for owned plants) and royalties. All with savings in CO_2 emissions estimated at 47.1 million tons by 2030.[177]

Co-Roma Platform

In 2015, LabGov ETS[178] and ENEA published the *Methodological protocol for building collaborative neighborhoods and communities (Co-City Protocol),* which documents the first phase of fieldwork focused on developing a methodology for co-governance of the district to strengthen the capacity of citizens and stakeholders to participate in decision-making and take initiatives for energy and social sustainability. In particular, LabGov ETS conducted an experiment in the Centocelle district to generate the methodological protocol for developing an Urban Smart Collaborative District (or Co-District) in the city of Rome, which became known as Co-Roma. The scope of the activity was to foster community empowerment and self-organization, enabling the community to adopt a bottom-up approach to trigger collaborative urban regeneration processes. The objective is pursued through educational processes (on energy, sustainability, and soft skills), organizational processes (co-governance, co-design, and living labs), and ICT technologies.[179]

The follow-up was *Prototyping an institutional and digital platform for the creation of a smart, collaborative district* (2016) which documented the first phase of the implementation of Co-Roma. The development of the Co-District was widened to the neighboring areas of Centocelle Park, i.e., Centocelle, Don Bosco (particularly the Torre Spaccata area), and Alessandrino (ACT). LabGov ETS carried out activities aimed at the first prototyping of a digital platform that would support the development of the Co-District. The assumption is that to realize a smart and just city, it is necessary to identify neighborhoods in which local communities are most inclined to co-govern with other urban actors the processes of digital, technological, and infrastructural transformation of the city and the subsequent aggregation of these neighborhoods into a network of which the Co-District would become the institutional unit of government.[180]

In 2017, in *Models of urban co-governance, sustainability, bankability, and financial eligibility of Civic or community enterprises: the public-community Partnership and the public-private-community Partnership,* LabGov ETS and ENEA continued the activities of technical support and organization of workshops and fieldwork within the co-district. This enabled greater awareness of the community's social capital and self-organizing capacity, which in December 2017 was formally established as a community cooperative (CooperACTiva). LabGov ETS then carried out a continuous engagement activity to

[177] See https://www.comunirinnovabili.it/manifesto-c-e-r-s/
Also see https://www.comunirinnovabili.it/la-rete-delle-comunita-energetiche-rinnovabili-e-sostenibili/

[178] The name of the Association is "LABoratorio per la GOVernance dei beni comuni - LabGov Ente del terzo settore" or in abbreviated form "LabGov ETS."

[179] Cannavò, P. et al. (2016) *Protocollo metodologico per la costruzione di quartieri e comunità collaborative urbane (il protocollo co-città).* ENEA. Report RdS/PAR2015/023. Available here.

[180] Cannavò, P. et al. (2017) *Prototipazione di una piattaforma istituzionale e digitale per la creazione di uno smart collaborative district.* ENEA. Report RdS/PAR2016/026. Available here.

include other city users and relevant stakeholders of the co-district to foster the incubation of the first community enterprise in Rome.

One of the characterizing elements was the emphasis placed on civic innovation challenges, i.e., actions aimed at bringing out the entrepreneurial nature of the citizens, as in urban co-governance, civic innovators are the key actors for a transition from co-governance of individual urban commons to co-governance of co-district platforms and infrastructures. Workshop participants were accompanied in project activities and participation in calls for proposals. The monitoring and field activities confirmed the hypothesis that cultural heritage is the entry point to leverage to experiment with co-governance at the neighborhood level.[181]

LabGov ETS also supported the community in obtaining recognition by the Council of Europe as a Faro Heritage Community, which is defined as "a heritage community consisting of a group of people who value specific aspects of cultural heritage and who wish, within the framework of public action, to sustain and transmit them to future generations."[182] LabGov ETS's research activities have been subject to constant dissemination and outreach, which include mapping civic innovators in the co-district in a section of the Co-Roma platform, writing posts on the LabGov website and on the social media pages, organizing activities including external stakeholders, and presenting Co-Roma in academic conferences, public fora and through scientific publications.[183]

In 2018, LabGov ETS and ENEA published *Neighborhood Cooperative as a tool for urban community cooperation*, a working package based on the Co-City Protocol. The main goal was to assist civic entrepreneurs in defining a social business model for CooperACTiva. The work was structured into two branches of activities. One is the legal, economic, and policy theoretical research and qualitative analysis of at least three community enterprises/cooperatives to generate an evaluation matrix including criteria for measuring and evaluating the outputs, outcomes, and socio-economic impacts produced. The second is producing a benchmark analysis of existing community enterprises/cooperatives, and the first test of the community enterprise/cooperative evaluation tool. These activities were carried out in parallel with technical assistance in the development phase of the social business model through ad hoc meetings with consultants and workshops.[184]

In 2020, LabGov ETS and ENEA worked on *Governance for sustainable and inclusive management of energy communities: economic-legal prefeasibility analysis*, a report aimed at providing guidelines for the definition of Local Energy Communities (LEC) and supporting sustainable and inclusive development of territories, defining governance models, based on legal and economic feasibility. For this reason, the report elaborates on a co-design model, providing the local communities with

[181] Morlino, L. et al. (2018) *Modelli di co-governance urbana, sostenibilità, bancabilità ed eleggibilità finanziaria di imprese civiche o di comunità: il partenariato pubblico-comunità e il partenariato pubblico-privato-comunità.* ENEA. Report RdS/PAR2017/068. Available here.
[182] See Faro Convention on the Value of Cultural Heritage for Society, 2005, art.2
Also see Morlino, L. et al. (2018) *Modelli di co-governance urbana, sostenibilità, bancabilità ed eleggibilità finanziaria di imprese civiche o di comunità: il partenariato pubblico-comunità e il partenariato pubblico-privato-comunità.* ENEA. Available here.
[183] Morlino, L. et al. (2018) *Modelli di co-governance urbana, sostenibilità, bancabilità ed eleggibilità finanziaria di imprese civiche o di comunità: il partenariato pubblico-comunità e il partenariato pubblico-privato-comunità.* ENEA. Report RdS/PAR2017/068. Available here.
[184] Iaione, C. et al. (2018) *La cooperativa di quartiere come strumento di cooperazione delle comunità urbane.* Report RdS/PAR2018/036. Available here.

the know-how to develop and manage new projects and test the identified solutions in synergy with the stakeholders involved.

The report also delves into the legal pre-feasibility model, which, based on the results obtained in the co-design phase, takes into consideration the public policy framework and the organizational forms deemed most suitable; the legal framework on crypto-assets to verify the legal qualification of an energy token; the legal framework of smart-contracts highlighting possible benefits and critical issues; and the related cybersecurity issues. The ultimate goal is to define a community governance model best suited to the stakeholders' needs, distinguishing three alternative models: centralized, mixed, and decentralized. The proposed models not only take into consideration existing legislation and regulations but also local characteristics.[185]

In 2021, LabGov ETS and ENEA worked on *Experimental prototyping of the legal-economic model of energy communities*, a report proposing an energy community model based on the sharing of energy and social services and customized to context-specific variables according to four dimensions: territorial, subjective, economic, and legal. The empirical analysis shows that the most prevalent legal model is the non-profit organization, often supported by public funding and private ownership models. The non-profit model implies business models focused only on energy production and exchange. It better suits the purposes of an energy community, pursuing environmental, economic, and social benefits rather than financial profits (e.g., associations or social enterprises). In contrast, the debate is open on whether a benefit corporation is permissible by pursuing profit and social purposes as its main purposes. Another suitable legal entity is the cooperative organization.

The study found an educational gap between initiative promoters and members of the non-profit. Also, smaller-scale interventions in which strong community involvement is present adopt the cooperative model, characterized by a lower dependence on public funding and public ownership schemes. Finally, the study outlines the Local Token Economy (LTE) experimental model, which aims to create a peer-to-peer virtual microgrid model based on blockchain technology, enabling reciprocity of exchanges between prosumers and local consumers in the social as well as energy sphere.[186]

A core objective of the 2021 report is to support CooperACTiva in developing an energy community in the Co-District. The analysis found that the legal entity of the neighborhood cooperative is suitable for the EC project and that the area requires targeted action on the subjective dimension since several community members show little energy literacy. This gap is to be filled through capacity building supported by facilitators. CooperACTiva has included in its founding charter the aim to develop a REC, which will be the first pilot project to be developed

---

[185] Iaione, C. et al. (2021). *La governance per la gestione sostenibile e inclusiva delle comunità energetiche: analisi di pre-fattibilità economico-giuridica*. Report RdS/PTR2020/030. ENEA.
[186] Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* Report RdS/PTR(2021)/053. ENEA.
For more information, see the concept note of *Diritto ed Economia delle Comunità Energetiche*, Special Number for the Review *Diritto e Società*, published by LabGov.City in 2023. Concept note available at request.

under the Co-Roma framework. The experience with the ACT Co-District offers the opportunity to define a multi-scalar energy community network system that could extend from single-point experimentation into district experimentation, relying on the social and collaborative infrastructure sustained by the community, the facilitators, and the co-managed services and consolidating the collaborative and polycentric governance at the neighborhood level.[187]

Development of the Co-Roma Platform

Co-Roma is an open and responsible urban platform. It is a tool that has been tested for almost ten years for what concerns co-governance and the development of the commons. Over the years, it has focused on different aspects. The current focus is on energy communities, a trend that could further implement co-ownership and co-management in vulnerable districts.

Co-Roma will participate in the acceleration process of the House of Emerging Technologies, the Municipality of Rome's innovation hub, and will access funds from the NRRP Urban Integrated Plans. It will also be a central pillar of the project developed by Luiss University for Rome's Expo 2030 candidacy. The ultimate goal is to transfer Co-Roma to a public entity to become an effective tool to serve the local community. At the moment, the main sections of the platform are a collaboration tool, a fundraising tool, an e-commerce tool, a mapping tool, an impact measurement tool, and a matching and closing tool. The development of the future platform is focused on seven sections.

- "Mapping" entails widening the scope of innovation tracking on the territory. At the moment, the platform offers a mapping of common goods. To this end, a questionnaire has been issued to be filled out voluntarily by platform members. The current goal is to map sustainable, innovative bottom-up ideas and projects on the territory, focusing in particular on energy community projects, which are a key exemplification of commons in the energy sector.
- "Coordination & Networking" entails proposing ideas for a new energy community project or taking part in one already proposed on the platform. It is a tool enabling users to feel part of the community and share online and offline spaces to cooperate and realize innovative ideas.
- "Fundraising" entails the possibility of contributing financially to initiatives launched by other users through crowdfunding and other types of financing tools.
- The collaborative platform becomes the enabling tool for the "Local Token Economy," a local exchange economy in a circular system, by connecting the energy community with the local economy. The local economy is based on tokens exchanged for goods and services. The tool is managed by the community, which can designate a dedicated manager. Positive energy behaviors and efficiency will be rewarded with tokens that can be exchanged for goods and services within the community. It involves the use of blockchain in the token exchange and validation.
- The "Matching & Closing" section supports the energy community projects with the legal, technical, and economic tools necessary to establish the legal entity at the core of the energy

[187] Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA.

community. It involves using blockchain to validate smart contracts that are transparent and accessible to the community.

- "Impact Measurement" particularly focuses on seven dimensions: territorial, environmental, socio-economic, health, technological, institutional, and collaborative.
- The platform's governance assumes relevance for an integrated approach (both vertical and horizontal) to sustainable innovation in the territory. The platform aims to develop an open governance, including public shareholders, private entities, and citizens.

The GrInn Lab Experience

The GrInn Lab is an Interdisciplinary Urban Clinic directed at the pre-incubation of sustainable innovation. The transitions that currently characterize cities, involving climate change and digital transformation, increasingly require an ecosystem approach to innovation. The GrInn Lab addresses current challenges by working on the new frontiers of digital and technological innovation, introducing new governance and management tools based on the engagement and cooperation of five urban actors: public, private, social, knowledge institutions and city-users.

The added value of the GrInn Lab is its experimentalism. Not only the Lab represents an interdisciplinary education pathway (entrepreneurial, political, legal, technological) but also generates projects and best practices that contribute to the realization of the university's societal mission of carrying out activities for the development of social and cultural commons. The GrInn Lab enables students interested in innovation and sustainability to carry out tangible projects, incubate innovative tools and solutions, and work in teams like real startups.

Co-Roma has been the focus of the GrInn Lab in 2023. The students were divided into teams according to each of the seven areas of work and were tasked with developing ideas to better implement the platform. The class was taught by Prof. Claudia Meloni from ENEA and supported by several public and private stakeholders, such as Acea, Roma Capitale, Zètema, and Biblioteche di Roma.

Business Models for Sustainability

Transitioning from the traditional energy production to the prosumer production value chain, energy communities have redesigned value creation in the energy sector, making room for a variety of new business models focused on sustainability. These represent an opportunity for the co-creation of value among different stakeholders and the active involvement of energy citizens, i.e., those that take part in the energy transition in the technological and political arenas. Business models for sustainability transcend the mere economic dimension to reflect the social and territorial ones.

From this perspective, value creation is no longer perceived as a linear and unidirectional process. Rather, value is co-created by suppliers of goods and services together with consumers, and it involves services that go beyond the production and supply of electricity by investing revenues obtained from efficiency improvements in the energy value chain in further activities that benefit the territory, the local community and society at large.

A focal point concerning business models for sustainability is how the community generates value for itself and how value is distributed among stakeholders. Several energy communities are taking up additional services, which may include energy distribution (through the management of local and smart grids), a range of ancillary services (energy upgrading services, consumption monitoring, auditing, and financial services), micro-mobility services (i.e., carpooling and car sharing), and additional activities (consulting, communication, and awareness campaigns).[188]

Technical Support from Acea

To enhance the TRL and IRL of the project and to bridge the divide between social and technical skills to govern energy as a commons, the author sought technical support from Acea, an Italian multiutility operative in the management and development of networks and services in the energy sector and with a strong competence in energy communities. The ESCO supported the author in gaining the technical knowledge required to draft a proper social business plan for the pilot project of the ACT energy community. The Excel adaptation of the business plan is available as Annex B.

Social Business Plan

The business plan seeks to support vulnerable households in joining the energy community by shifting the financial burden through a rent-a-roof scheme, with funding provided by community stakeholders. Instead of paying high upfront costs, households rent their roof to a Community Energy Fund, which pays rent to the houseowner, as well as for equipment and installation. In exchange, the Fund can use the roof to install the PV system. Surplus energy is sold to the grid. Households will start investing in the energy community once they perceive the economic benefits of the energy bill reduction.

The business plan assumes that users will consume, on average, 75 percent of the renewable energy produced. It assumes that the size of the renewable energy facility is 1 MW, the maximum acceptable by the legislation, with a total surface of 7000 m^2. It also assumes that the annual producibility of the facility is 1400 kWh/kWp with an annual loss of 0.5 percent. It assumes that installing a PV system on one roof costs 900 €/kWp with an annual maintenance cost of 15 €/kW. Furthermore, according to a reasonable estimation, the rent of the roof (without asbestos abatement activities) is 12,000 per year. The model assumes that the price of the kWh injected in the national grid is 0.15 €/kWh, and the Net Present Value (NPV) rate is 5 percent. Therefore, with an initial investment of € 900,000, the expected return time is three years. The NPV is € 2,372,433.82.

[188] Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA.

ENEA Digital Tools for Energy Communities

It is important to connect the platform to existing open-source tools, such as the LEC platform and the RECON economic simulator, developed by ENEA.[189]

LEC Platform

The Local Energy Communities (LEC) platform fosters the development of energy communities, providing users with a range of services and methodologies that enhance value creation for the community. It is targeted at citizens, businesses, and energy operators. The platform provides four kinds of services: energy consumption monitoring; nudging users to adopt positive energy behavior; creating a local economy based on blockchain and tokens; and providing the energy operator with a dashboard for service management and user interaction.

The platform uses sensor data and energy consumption information from energy operators to identify the user's energy profile and provide suggestions for adopting more energy-efficient behaviors. This enables the second service, which identifies users' virtuous behaviors and, by responding to requests from the grid as needed, encourages the reduction or reshaping of energy consumption. The goal is to activate a demand/response process that makes users dynamic, smart, and aware energy consumers. By monitoring consumption and enhancing virtuous behavior, the platform enables the creation of a local economy based on users' active participation in the community's energy needs and their sharing of locally available resources. The community managers have a dedicated dashboard on the platform, enabling them to identify interventions to improve the community's energy and social performance. The platform uses blockchain and methodologies such as LTE that enable the integration of environmental, social, and economic aspects within the community.[190]

RECON Economic Simulator

RECON is a free tool for the energy, economic, and financial evaluation of RECs. With this tool, ENEA intends to support PAs and other stakeholders in making informed decisions based on the current regulatory framework and to encourage citizens' active participation in the energy market. To obtain an evaluation, data about housing clusters, energy consumption, characteristics of the PV system, and incentive schemes are to be uploaded. Then the algorithm provides an evaluation of the self-consumption and energy sharing. Finally, it provides an estimation of the benefits of the creation of the REC.[191]

---

[189] Other available tools are DHOMUS for household consumption and SMART SIM, which compares the user's consumption, costs, and impact on the environment with the local average. For more information on DHOMUS, see https://dhomus.smartenergycommunity.enea.it/
For more information on SMART SIM, see https://www.smarthome.enea.it/smartsim/login
[190] https://sue.enea.it/product/cittadini-attivi-e-comunita-intelligenti/social-urban-network/
[191] For more information on RECON see https://recon.smartenergycommunity.enea.it/

6. Tilburg Experimental Project

The Dutch Perspective on Energy Transition

The Dutch energy transition is centered around phasing out natural gas and substituting it with less carbon-intensive heating alternatives, e.g., district heating and electricity. The commitment to decarbonization is shaped under the influence of the UN climate negotiations and EU climate law, but also through bottom-up efforts. The most famous example is *Urgenda Foundation vs. The State of the Netherlands*, in which civil society Urgenda Foundation and a group of 900 Dutch citizens sued the state to reduce GHG emissions more aggressively and successfully obtained from The Hague District Court the requirement for the Dutch government to reduce emissions by at least 25 percent (compared to 1990) by 2020 to protect the future generations against the imminent danger caused by climate change.[192]

Another example is the societal unrest that arose in response to the earthquake damages across the northern province of Groningen due to the prolonged natural gas extraction in the region. The province presents Europe's largest natural gas field and was the main heating and cooking source for 72 percent of Dutch households in 2016.[193] After the blocking of new extraction permits to the concession holders (Exxon Mobile and Shell) resulting from lawsuits against the government by citizens, interest groups, and local governments, the national government conceded to phase out natural gas extraction from the Groningen field by 2022.[194]

Due to the dismissal of the Groningen field, the Netherlands became an importer of natural gas for the first time in 2018, but the transition to electricity is expected to drop prices. In 2020, the Netherlands reported the EU's lowest electricity price per kWh. Between 2010 and 2020, electricity prices decreased by 19 percent while they increased on average by 23 percent in the EU.[195] Instead, the price of natural gas went up by 46 percent in the same period, and in 2020 Dutch consumers paid the most expensive natural gas in the EU after Portugal.[196] The government has announced that taxes on natural gas consumption for households will be raised over the coming years while those on electricity will be lowered. Finally, there are significant concerns regarding the household

---

192 https://elaw.org/nl.urgenda.15
193 Data retrieved in 2016.
See Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.
Also see CBS (2018). *Energieverbruik van Particuliere Huishoudens*. Available online at: https://www.cbs.nl/nl-nl/achtergrond/2018/14/energieverbruik-van-particuliere-huishoudens
194 See Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.
Also see Rijksoverheid (2020). *Definitief Einde Gaswinning Groningen Wettelijk Geregeld*. Available online at: https://www.rijksoverheid.nl/actueel/nieuws/2020/11/24/ definitief- einde- gaswinning- groningen- wettelijk- geregeld (accessed April 22, 2021).
195 See Eurostat (2021). *Electricity Prices for Household Consumers - Bi-annual Data (from 2007 Onwards) [nrg_pc_204]*. Available online at: https://ec.europa.eu/eurostat/web/products-datasets/-/nrg_pc_204
Also see Feenstra M, Middlemiss L, Hesselman M, Straver K, and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. Doi 10.3389/frsc.2021.645624.
196 Eurostat (2021). *Gas Prices for Household Consumers - Bi-annual Data (from 2007 Onwards) [nrg_pc_202]*. Available online at: https://ec.europa.eu/eurostat/web/products-datasets/-/nrg_pc_202

energy mix and the costs of the heating transition in the longer future. For heating, cooking, and hot water, households currently use mostly natural gas (86 percent compared with 14 percent of electricity). Most residential structures have poor energy efficiency, with 61 percent having a C to G energy efficiency rating.[197]

Energy Governance in the Netherlands

The Dutch governance landscape is characterized by multi-level governance (EU, national, provincial, regional, and municipal). The Dutch decarbonization policy framework is based on the Coalition Agreement of 2017. The energy transition ambitions of the government are rooted in the Energy Agreement of 2013, the Climate Agreement of 2019, and the Climate Act of 2019. The government committed to transitioning 1.5 million households (out of the 7.5 million total) from natural gas to a lower-impact source by 2030, which will involve considerable infrastructural housing interventions, such as installing new heating systems and retrofit measures in residential buildings or the construction of district heating networks.[198]

Some of the 12 provinces have adopted regional energy poverty agendas, i.e., the provinces of Utrecht, Zuid-Holland, and the three Northern provinces of Groningen, Friesland, and Drenthe. For example, Utrecht has allocated € 8.9 million for the just energy transition, financing projects for energy-poor households. For each of the 35 regions, a Regional Energy Structure (RES) makes decisions on the decarbonization path according to the specific renewable energy production targets for electricity, heat, and infrastructure. Local and provincial governments work with businesses, utilities, and residents to develop regional options for decarbonizing their area. The RES also develops neighborhood-based collaborative Heating Transitions Visions.[199]

Finally, the 355 municipalities retain the greatest executive and decision-making power in the implementation of the energy transition, especially in developing Heating Transition Visions and setting the pace for neighborhood-based solutions. Some explicitly refer to preventing energy poverty as an integral transition concern. Their primary role is part of a wider decentralization movement started in 2010 through the Participation Law, in which municipalities gained extensive implementation responsibilities for social service provision and poverty alleviation. However, local

[197] See Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624. Also see Schellekens, J., Oei, A., and Haffner, R. (2019). *De Financiële Gevolgen van de Warmtetransitie. Een Onderzoek Naar de Investeringsuitdaging, Effecten op Energie-Betaalbaarheid en het Potentieel van (nieuwe) financieringsvormen*. Ecorys.
Also see PBL (2018). "Meten met twee maten," in *Een Studie Naar de Betaalbaarheid van de Energierekening van Huishoudens*, eds M. Middelkoop, S. Van Polen, R. Holtkamp, and F. Bonnerman (Den Haag).

[198] See Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624. Also see NECP (2019) *Integrated National Energy and Climate Plan 2021-2030*. Ministry of Economic Affairs and Climate Policy, Netherlands.

[199] See Feenstra M, Middlemiss L, Hesselman M, Straver K, and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. Doi: 10.3389/frsc.2021.645624.

government efforts are hindered by the absence of a national framework for energy poverty, lacking a clear mandate and adequate resources. [200]

A number of municipalities are formulating policies, action plans, and regional agreements for the just energy transition. For instance, the municipality of Arnhem is developing a three-year € 1 million energy poverty program that will help at least 2,500 energy-poor homes. Following prior *ad hoc* allocations of € 140,000 and € 400,000 in 2019-2021, the Groningen City Council additionally set aside € 230,000 per year to reduce energy poverty in 2021-2024. The national government has provided a € 2 million subsidy to implement small energy efficiency improvements in households which does not target energy-poor households. Nevertheless, the municipality has used it as a tool to contrast energy poverty.[201] Finally, the city is launching a Just Transition Fund to work on decarbonization projects with a focus on energy poverty.[202]

National Incentive Framework

There are currently more than 600 energy communities in the Netherlands. Most originated in the *Postcoderoos* scheme, which offered a financial incentive to consumers to jointly produce energy by reducing the tax rate on the energy bill to zero with a cap on self-consumption of up to 10,000 kWh per year. It was conditional on participants living in the same postal code. In April 2021, the reduced tariff for collective generation scheme was replaced by the SCE, which is applicable to cooperatives or buildings' Owners Associations. Compared to *Postcoderoos*, the new subsidy scheme seems to be mainly intended to give participants more certainty that the investments in renewable generation installation (mainly PV systems) can be recovered.

A small group of projects was developed under the Decree on Experiments in Decentralized Renewable Electricity Generation (*Experimenten AMvB*), in force from 2015 to 2019. As the *Experimenten AMvB* was intended to facilitate pilot projects, the number and duration of projects was limited. Initially, the scheme's duration was four years and after a negative opinion from the Council of State, the government decided not to extend it in December 2020.

The SCE grant scheme aims to generate renewable energy, particularly focusing on wind, solar, and hydropower. It enables energy communities to benefit from renewable energy without developing facilities but only by investing in nearby generation plants. The conditions are the following: (1) before applying, the applicant must not have entered into irreversible financial

---

200 See Dijkhof, T. (2014). The Dutch Social Support Act in the shadow of the decentralization dream. *J. Soc. Welfare Fam. Law* 36, 276–294. doi: 10.1080/09649069.2014.933590
Also see ENGAGER (2019). *Workshop Summary Amsterdam 30-31 October 2019. Making the Most of Qualitative Evidence for Energy Poverty Mitigation: A Research Agenda and Call for Action*. Available online at: http://www.engager-energy.net/wp-content/uploads/2020/01/Amsterdam.pdf
Also see Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.
201 Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.
202 See European Commission (2023) Speech by Commissioner Elisa Ferreira at the Just Transition Fund launch event - Groningen, The Netherlands. 20 February 2023. Available at https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_23_1276

commitments towards the generation plant(s), (2) the legal entity must be an energy cooperative or an Owners' Association,[203] (3) the applicant must own the generation plant, but financial leasing is also allowed.[204]

It happens that cooperatives or owners' associations apply for SCE subsidy on the basis of, for example, ownership or financial lease of part of a solar farm. In this case, a cooperative or owners' association should be able to demonstrate ownership. For example, if a certain number of solar panels within a solar farm are under their ownership, a right of superficies should be established on the panels. The reason for this is that the ownership would otherwise pass to the landowner by operation of law after a certain period under Dutch law. If a right of superficies is established on the relevant land, a lease or use agreement will suffice.[205]

At the national level, there is the ISDE subsidy for insulation and heat pumps. The amount granted is 15 percent when only one measure is implemented and 30 percent for two or more measures. Loans are awarded through the *Nationaal Warmtefonds*, which entails roughly three kinds. The first is the standard target group, i.e., households, and the percentage differs based on duration, loan amount, and other variables. The second is the zero-percent loan for households with an aggregate income of up to € 48.625. Finally, there is a special type of mortgage for low-income households that participate in a district-oriented project organized by the municipality. This type of loan is rather complex as it is considered a subsidy unless the household income increases over time, in which case it becomes a loan to be paid.[206]

ENGAGE.EU

The ENGAGE.EU European University is a network of leading European universities in business, economics, and social sciences fostering economic capability and social development. The network introduced the concept of "innopreneurship," which merges entrepreneurship, innovation, and intrapreneurship to serve society at large.[207] It developed a methodology for virtual, physical, and phygital innopreneurial spaces promoting open processes which facilitate the cooperation of diverse stakeholders in developing innovative and sustainable ideas.

The approach is in line with the EU policy frameworks on responsible research and innovation, open science, and citizen science, and places communities, public, private, social, and civic actors at the center of a multi-stakeholder network in which knowledge institutions serve as the pivot and provide spaces and tools enabling actors to co-create. The methodology demonstrates that the

[203] When you buy an apartment in the Netherlands, you automatically join a *Vereniging van Eigenaren* (VvE), or Owners' Association, granting you shared ownership of the building.
[204] https://www.rvo.nl/subsidies-financiering/sce/algemene-voorwaarden
[205] Interview with Thijs ten Caten, Master student of Law and Technology at Tilburg University and researcher under commission from the Tilburg Municipality.
[206] Information provided by Guido La Rose, sustainable strategist from the Climate Office at the Tilburg Municipality.
[207] See https://www.engageuniversity.eu/2021/06/17/engage-eu-innopreneurial-mindset/ and https://www.engageuniversity.eu/2021/11/22/engage-eu-innopreneurship-literacy-concept/

co-governance of innovation and the quintuple helix approach are intrinsically connected with the EU innovation approach.

The framework determines the dimensions of the open and collaborative innopreneurial spaces – scope, mode, stakeholders, and governance – and how they guide the activities developed within the spaces. A focus in made on the Engage Labs (e.g., X-Labs and Z-Labs, implemented at Luiss University), which support teams of university students in developing an innovative startup idea in collaboration with external stakeholders. The Proof of Concept that comes from the Labs will be assessed before the process is continued. The Preliminary Assessment seeks to best equip innovators with know-how. It determines if the projects are suitable for pre-incubation or whether they are prepared to directly enter the market.[208]

The innopreneurship cycle builds on Carayannis' quintuple helix[209] and the Co-City framework.[210] The procedure ensures that an innovative idea is developed using an experimentalist approach and that local communities and other social stakeholders participate in the various stages. As a result, the spaces attempt to reduce the gap between academic research and local needs.[211]

Tilburg Challenge

The Tilburg experimental project was first ideated during the ENGAGE.EU Expedition held in July 2022 in Tilburg. The Expedition program was the first of its kind and gathered students from the universities of the network to participate in three challenges launched by partners of the Tilburg University ENGAGE.EU Lab on Climate and Energy Transition, among which the Tilburg Municipality.

The theme was the just energy transition. The threat of climate change requires solutions that are not only technological but also social, economic, financial, legal, political, and psychological. Citizens lack strong incentives to modify their behavior. Current legislation is often in contrast with bottom-up initiatives. Coordination and cooperation among government, business, and civil society is lacking. Costs are frequently borne by those not benefitting from the change, and the business case for a sustainable transition is not always clear-cut.

The question analyzed was how local governments can motivate citizens, corporations, and social partners to actively participate in the energy transition. These stakeholders are all part of the solution to help municipalities achieve their key goals. The ultimate goal for the city of Tilburg is to achieve climate neutrality in 2045. To do this, households must be made more energy-efficient and switch to using sustainable electricity and heating sources. The municipality offers several

208 ENGAGE.EU European University (2020) *D87 Innopreneurial spaces*. Project co-funded by the Erasmus+ Programme of the European Union.
209 Carayannis, E.G., Barth, T.D. and Campbell, D.F. (2012) The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of innovation and Entrepreneurship*, *1*, pp.1-12.
210 Foster, S., and Iaione, C. (2022) *Co-cities: Innovative Transitions Toward Just and Self-sustaining Communities*. MIT Press.
211 ENGAGE.EU European University (2020) *D87 Innopreneurial spaces*. Project co-funded by the Erasmus+ Programme of the European Union.

incentives for citizens and businesses to help them behave more sustainably, but a large part of the population is still unwilling to participate.[212]

Tilburg is the second-largest city in the province of North Brabant after Eindhoven, and seventh-largest in the country. The municipality is very ethnically diverse. Of the total population (222,601 on 1 July 2021), 23.3 percent (47,964) are of foreign descent. The main countries of origin are Turkey, with a population of 8,106 (3.7 percent), Morocco with a population of 6,100 (2.8 percent), Indonesia with a population of 5,077 (2.1 percent), the Dutch Caribbean, with a population of 4,333 (2.3 percent), Suriname with a population of 3,315 (1.6 percent), Somalia with a population of 1,159 (0.8 percent), and other countries making up 15.9 percent of the remaining foreign population (20,811 people).[213]

The city has an industrial past, with the main business opportunities in the textile and logistics sectors. In the past, the city was famous for its wool industry. Since the 1960s, the government has made several steps to diversify, as the industry was declining. Due to the relatively high percentage of working-class households, the average income level is lower than the national average. Yusuf Çelik, Alderman for Housing, Neighborhoods, and Integration at the Tilburg Municipality, claims that, with the rise in gas prices, a significant portion of the households can barely make ends meet, which decreases the interest in the sustainable transition, as short-term financial survival is the immediate concern. However, Tilburg's sustainable development is one of the municipalities' foremost priorities, which has taken upon itself to support households in the energy transition. To achieve this, it works together with three local housing companies. The target groups are citizens living in energy poverty, including tenants living in rented properties (about 35,000 households out of the total 100,000) and houseowners.

The local government has enacted a neighborhood-oriented approach in which local officers adopt a door-to-door communication strategy informing vulnerable citizens about the benefits of making their homes energy efficient and self-sustaining and the incentive framework. Although this strategy is tailored to diverse neighborhoods, the communication barrier remains, especially for foreign residents who do not speak Dutch. Therefore, the question posed in the challenge is: what is the best way for the municipality to reach citizens and build enough trust for them to become part of the energy transition by making their houses more sustainable, energy-efficient, and powered by renewable energy? Can this be an opportunity to improve not only their houses but even (where necessary) life circumstances by merging the climate and social needs? Should the local government bear the burden alone, or should it partner with other stakeholders or completely leave the endeavor to other stakeholders?[214]

The proposed solution explored below was developed by five students from Luiss University and the University of Mannheim with diverse backgrounds, i.e., two of the students majored in

---

212 https://www.engageuniversity.eu/engage-eu-expedition/

213 Bevolkingsontwikkeling; regio per maand [Population growth; regions per month]. CBS Statline (in Dutch). CBS. 1 January 2021.

214 Information gathered from the speech by Yusuf Çelik, Alderman for Housing, Neighborhoods, and Integration at the Tilburg Municipality, to the ENGAGE.EU students held at Tilburg University on July 11th, 2022.

Economics and Finance, one in Business Psychology, one in German Law, and one in Law, Digital Innovation, and Sustainability. The Tilburg Municipality has decided to support the project and explore further developments. The designated district for the implementation of the project is Abdij- en Torenbuurt.

National Grid Congestion

A further challenge that calls for alternative solutions is the grid congestion that is at the moment present in the Netherlands. Liander, a major gas and electricity supplier, has published a map of the congested areas.[215] Liander is working with the grid operator Tenne on a call to select innovative projects for grid congestion management. Furthermore, the Authority for Consumers and Markets (ACM) decided in May 2022 to change the grid code to expand the share of renewables in the energy mix.[216] There are roughly three reasons for the current grid congestion in the Netherlands:

(1) Population growth, wealth growth, and further digitalization have enabled users to consume increasingly more energy in the Netherlands.

(2) The electricity grid is built on delivery from a power plant to the user. With increasing electricity feed-in ("the other way round"), a problem arises. A common metaphor is the following: the power grid is one-way. Because electricity is now also going in the other direction, a traffic jam is created on the grid. This is not particularly problematic if it happens occasionally, but it happens too much in some areas.

(3) Electrical grid axes are based on central generation. Cables at power plants are thick, and cables in sparsely populated areas are thin. However, renewable energy generation (solar farms, wind turbines, etc.) is particularly interesting in sparsely populated areas because of the available space.[217]

Local Incentive Framework to Tackle Energy Poverty

The Tilburg municipality embraces TNO's definition of energy poverty as low income households that spend at least 10% of their income on energy bills and/or have a low house quality.[218] The measures taken by the municipality concerning energy poverty are two-fold: (1) via income support to provide short-term relief, and (2) via assistance with energy savings to achieve a long-term effect. The Municipality is spending € 1,719,000 of the Climate Fund (*Klimaatfonds*) for the implementation of the Energy Poverty Action Plan 2023-24, which will provide additional

215 Availability capacity by Area. Published by Lander on their official website. Available at https://www.liander.nl/grootzakelijk/transportschaarste/beschikbaarheid-capaciteit
216 https://www.pv-magazine.com/2023/01/24/grid-congestion-continues-to-increase-in-netherlands/
217 Interview with Thijs ten Caten, Master student of Law and Technology at Tilburg University and researcher under commission from the Tilburg Municipality.
218 Information from interview with Tijs van Gisbergen, Policy Advisor for the Energy Transition at Tilburg Municipality.

subsidies to access insulation measures, and establish a "white goods scheme" whereby energy-consuming appliances can be exchanged for energy-efficient ones.

Support is targeted to each type of household (social housing, private rentals, and homeowners). The approach to the social housing stock is done in close cooperation with the Tilburg housing corporations. The approach for homeowner falls under the program *An de slag met je huis* in which the Municipality collaborates with the five Tilburg energy cooperatives. For the private rentals target group the Municipality is currently investigating the possibilities for further support.

The Municipality received funds from the central government to address energy poverty. Of those funds, €5.1 million remains. The central government also provides funds for insulation under the National Insulation Program. For Tilburg, € 2.1 million has been reserved, which is insufficient to implement the action plan.

Consequently, the Municipality is requesting a contribution from the Climate Fund of € 1,719,000. This is a reservation because there is a large margin of uncertainty. For example, it is not known how much use will be made of the subsidy for insulation and white goods. There is also a chance of additional resources flowing from the State. It has been announced that the budget for the National Insulation Program will be increased and that additional funds will be allocated for energy fixers. If costs are lower than expected or if there are additional funds, then the reservation in the Climate Fund will be reduced.

The Municipality is now making decisions on the Climate Fund reservation, subject to a positive council decision, so that it can start tendering for various projects. This is necessary because the national funds for energy poverty, with which we cover part of the costs, must be spent by the end of 2024.[219]

Income Support	
State funds energy allowance 2023 tranche 1	€9.800.000,-
Remainder Tilburg Support Fund 2022	€100.000,-
Financial framework subsistence security, track b	€170.000,-
Energy Savings	
Residual government funding for energy poverty[1]	€5.118.000,-
National insulation program[2]	€2.140.000,-
Climate Fund	€1.719.000,-
Total	€19.047.000,-

Table 2: Coverage plan for energy poverty

[219] Tilburg Municipality (2023) Energy Poverty Action Plan, Administrative Decision of May 16, 2023 – 42.

Climate investment fund reserve		
Balance at 31-12-2026	€37.194.000	
For the purpose of implementation Program (New Policy Budget 2023)	€4.476.000	
On behalf of Sun on Your Roof	€2.735.000	
Freely disposable		€29.983.000

Table 3: Overview of Climate Fund expenditures [220]

The municipality is providing subsidies for insulation measures on top of the national ISDE subsidy. They are considering three categories. The starting point is for buildings to have energy labels D, E, F, or G (or comparable when there is no energy label registered). The municipality offers a 100 percent subsidy for households with low income and low savings, up to € 6.000. It also offers a 20 percent subsidy for households with a maximum property value of € 339.000 (average in Tilburg), up to € 1.650. Finally, it offers a 10 percent subsidy for households with a maximum property value of € 429.300 (national boundary for National Mortgage Guarantee), up to € 1.150.[221]

Tilburg JET

The proposed solution seeks to enable all Tilburg city users to participate in the energy transition by establishing a social energy community named Tilburg JET (Just Energy Transition). Members benefit from the energy community according to the shares of Energy Bonds they acquire by participating in costs of the renewable energy facility. The process is itinerant, which means that bonds can be sold to other stakeholders throughout the process, and everyone can gain progressively more participation and revenue in the venture.

Abdij- en Torenbuurt

The designated district for the implementation of the energy community, or self-sustaining neighborhood, is Abdij- en Torenbuurt, located in the central-south side of Tilburg, in proximity to Tilburg University. The district is part of the Kenniskwartier quarter, and it is composed by two

[220] Fig. 3-4 (translated from Dutch to English) from Tilburg Municipality (2023) Energy Poverty Action Plan, Administrative Decision of May 16, 2023 – 42.
[221] Information provided by Tijs van Gisbergen, Policy Advisor for the Energy Transition at the Tilburg Municipality.

neighborhoods: Torenbuurt and Abdijbuurt, located at the south border of the railway track. Fig. 3 shows a graphical representation of the quarter.

Figure 4: Graphical representation of Kenniskwartier [222]

78% of the 731 dwellings are owned by a rental corporation, while only 11% are privately owned. 57% of dwellings are multi-family.[223] The average house value is € 144,000. Houses were mainly built between 1946 and 1964. They are mainly apartments owned by the rent corporation (400) and there is a roughly equal number of single-family households that are privately-owned (123) and rent corporation-owned (128).

The average income per inhabitant is € 15,800. Concerning distribution of income, 76.3% of the household are lower class, 21% are middle class, and 2.7% are upper class. The total population is of 1,580 and it is quite young. In fact, 300 are under 15, 300 between 15 and 25, 530 between 25 and 45, 305 between 45 and 65, and 145 are over 65. Of the 885 total private households, 525 are single, 130 do not have children and 235 have children. The average household size is 1.8. Concerning facilities, in the district there are four schools, one store, one commercial building, two healthcare centers, and one church.

Concerning energy consumption, the main heating system is an individual central heating system for 96% of households, while 3% connect to district heating without gas consumption. There are 576 households which are energy labeled. As shown in the figure below, most are class B or lower.[224]

---

222 Figure from the Tilburg Municipality official website, available at https://www.tilburg.nl/fileadmin/files/Gemeente/Gebiedsontwikkeling/kenniskwartier/Samenvatting_Gebiedsperspectief-Kenniskwartier.pdf

223 Data and figures are available at https://allcharts.info/the-netherlands/neighbourhood-abdij-en-torenbuurt-tilburg/#info_population

224 Data and figures are available at https://wijkpaspoort.vng.nl/?admin=BU08553702

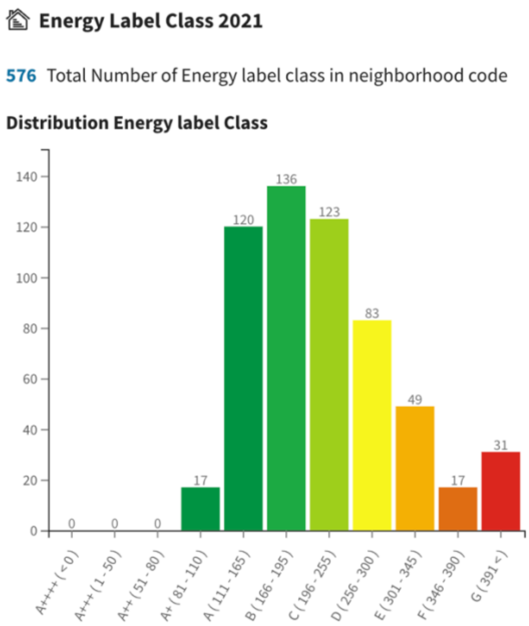

Figure 5: Energy Label Class 2021 in Abdij- en Torenbuurt [225]

In June 2023, the rent corporation Tiwos, second-largest in Tilburg, finances 77 single-family households in Torenbuurt to become energy efficient, including insulation and energy-saving pumps. Residents will not pay an increase in rent but will pay only for the optional addition of solar panels. Tiwos has a strong social drive, as they provide affordable rent for 7,500 households to low-income tenants.[226]

Governance Model

The energy community is co-owned and co-managed by citizens, public, private, knowledge institutions, social and environmental organizations, and local media entities, following the co-governance model of the quintuple helix. The local stakeholders involved are:

Citizens of diverse backgrounds: Wealthier citizens can invest in the energy community by becoming prosumers and purchasing Energy Bonds. Vulnerable citizens can engage in the energy community by initial investment or by renting their space to an Energy Community Fund to be used as part of the renewable energy system[227] and starting to invest once they acquire the economic benefits of the energy community in the energy bill reduction.

[225] Figure available at https://wijkpaspoort.vng.nl/?admin=BU08553702
[226] For more information see Tiwos' LinkedIn post available at https://www.linkedin.com/feed/update/urn:li:activity:7067043954956849152/
And their official website at www.tiwos.nl
[227] In this case most likely implementing solar panels on their roofs, if either solar or solar-wind hybrid is the preferred option for renewable energy source. See the section on "Renewable Energy System."

Public institutions: The municipality of Tilburg will join the energy community as a seed capital provider via the Climate Fund, which is not targeted at private citizens but at associations and foundations, two of the possible legal entities for energy communities.[228] The municipality could also provide for space to install the renewable energy system, following the model of the municipality of Rome.

Private institutions: First of all, the energy community seeks to include the local utility company Exenis, as renewable energy infrastructure provider and facilitator. The energy community seeks to include multiple local SMEs, especially those operating in sectors with high energy consumption, that would benefit from energy expense reduction. It is important to seek investment from financial institutions focused on sustainable finance, such as Triodos Bank, which could make the endeavor part of their green investment portfolio. Other possible investors could be corporations seeking an opportunity to enrichen their ESG profile and comply with international corporate social responsibility standards. SMEs and corporations could also provide space to install the renewable energy system.

Knowledge institutions: On the one side, the Academic Collaborative Center Climate & Energy at Tilburg University will provide support and information regarding the governance model, monitor, and evaluate the process. On the other side, local schools will address the energy transition and energy saving concerns turning the children into young ambassadors.

Social Housing corporations: The local housing corporation Tiwos will engage in door-to-door interactions with citizens, as they have already done so far, in particular, to reach vulnerable groups and ensure that they take part in the energy transition. They will also be a point of contact for members of the energy community willing to become ambassadors and provide training.

Distributed Energy System

To not overload the national grid, the community needs to become self-sustaining. The thesis analyzes two viable options, a microgrid and a community battery.

Microgrid

A viable solution could be to implement a microgrid energy system. Using a system of underground or overhead cables, the microgrid powers end users with the renewable energy produced by the community's renewable energy system. Similarly to the main electricity grid, the microgrid connects distributed energy sources like generators and renewable resources (like solar panels or wind turbines) and batteries to nearby end users. The microgrid acts independently from the main power grid, with only a central connection to it. It is supported by a software system that adjusts the resources and production as needed, as well as the hardware necessary to distribute the energy it self-produces.

[228] For more information see https://www.tilburg.nl/inwoners/subsidies/regeling-klimaatfonds/

The main benefits of such a system include savings on electricity costs and minimizing the use of power from the grid. Furthermore, the community can create additional sources of income by providing ancillary services to the national grid if permitted by the legal framework. The community and stakeholders can drastically cut CO2 emissions and target several SDGs. The energy community can be certified as self-sustaining, which, especially for the private stakeholders involved, can be useful for corporate social and environmental responsibility reports. Finally, the microgrid's advanced management system permits to optimize energy costs.[229]

The main disadvantage of the microgrid system is that a consistent amount of hardware and software technologies need to be implemented, which can be costly, as well as legally and infrastructurally challenging. This downside is reduced in the community battery case.

Community Battery

Community batteries represent an opportunity to change the traditional grid networks, as they can create mini independent networks distinct from the main grid. In general this is particularly appropriate for remote and small communities and in light of extreme events caused by climate change. In the Tilburg case, the solution would be helpful in easing the weight on the overloaded national grid. Community batteries are owned and operated by a power network.[230] In the case of Tilburg JET, the battery could be owned by the utility company Enexis Netbeheer, a Dutch grid operator that provides energy distribution in the northern, eastern, and southern Netherlands.[231]

The main advantage of the community battery is that there is no need of installing a larger cable to deal with peak demand issues, which also helps with voltage and capacity issues due to solar panels concentrations. The battery works "like Dropbox except for electricity." Sizes range from 100 kW (size of a fridge) to 1 MW (size of a shipping container) and each household is offered a certain amount of storage for surplus energy generated during the day.[232]

The community battery solution is already present in the Netherlands. For example, the Rijsenhout community has installed a 128kWh-capacity battery system connected via a low-voltage network to 35 household PV systems. The system avoids an investment of € 25,000 in grid reinforcement and stabilizing grid power by up to 20V.[233]

The battery could be placed in a Mobility Hub, which is already a plan for the future development of the Torenbuurt neighborhood. The hub could be a multi-floor parking lot, providing sharing mobility solutions and a venue for EVs to charge their batteries. Furthermore, Japanese EVs

229 https://corporate.enelx.com/en/question-and-answers/what-is-a-microgrid-and-how-does-it-work
230 https://communitydirectors.com.au/help-sheets/community-batteries-101
231 For more information see https://www.enexisgroep.nl/investor-relations/publicaties-presentaties/#halfjaarberichten-&-jaarverslagen
232 https://www.theguardian.com/environment/2021/apr/05/community-batteries-what-are-they-and-how-could-they-help-australian-energy-consumers
233 See https://www.deingenieur.nl/artikel/communal-battery-for-solar-power-in-rijsenhout and https://blogs.worldbank.org/energy/neighborhood-battery-system-conserving-energy-and-reducing-emissions-netherlands

already have implemented the possibility to discharge their batteries, which could be useful if the vehicles were parked for a long period of time and there was the need for backup energy.

Renewable Energy Source

There are three main applicable solutions concerning the renewable energy source employed: solar power, wind power, and solar-wind hybrid.

Solar Power

The first solution concerns having some energy communities members become prosumers and install solar panels on their roofs. There are a few problems related to this method. The first is that solar energy is produced only during daylight hours, which would mean that an additional intermittent energy source is needed to power the batteries, most likely a fossil fuel such as diesel. The second problem is that Tilburg does not have enough irradiation days to optimize energy production. A possible financial strategy in this case involves the rent-a-roof scheme described in Chapter 5.[234]

Wind Power

The second solution entails wind power. The Netherlands depends on wind energy to achieve its decarbonization goals. The Government has decided to build more onshore wind turbines. 2,525 onshore wind turbines were operating as of the end of 2015, producing a combined 3,000 megawatts (MW) of power. This is around 5% of what the Netherlands needs overall. The goal was 6,000 MW onshore wind capacity by 2020, as set in the Energy Agreement for Sustainable Growth, which entails a capacity increase of more than 3,000 MW. The Netherlands requires between 1,000 and 1,500 additional onshore wind turbines since an average wind turbine has a capacity of 2 to 3 MW. The Wind Energy Action Plan introduced extra measures to achieve the target among which fast-track procedures for installing wind farms and better communication to overcome citizens' resistance.[235]

There are existing cases of community-owned wind turbines in the Netherlands, such as Volksmolen, a turbine on the Windfarm Zijpe financed by the local community, which has produced 125.000 kWh in 5 months. The project was financed by the local community from the towns of Burgerbrug, Schoorl, Bergen, Groet, Petten, Koedijk and Warmenhuizen in the province of North Holland, by purchasing "Windshares." In exchange, the members receive a 15-year governmental incentive that exempts them from the energy tax on electricity, while ensuring access to affordable, locally produced green energy at a low cost.[236]

234 For more information see section on Social Business Plan.
235 For more information see Government of the Netherlands, *Wind Energy on Land.* Available at https://www.government.nl/topics/renewable-energy/wind-energy-on-land
236 For more information see https://windenergysolutions.nl/blog/the-success-of-a-community-owned-windturbine-in-the-netherlands/

On the north side of Tilburg (Noord Tilburg), there is the Wind Farm Spinderwind, completed in 2019, which consists of four turbines provided by Nordex with a hub height of 91 m and a rotor diameter of 117 m. The rated power per turbine is 3.6 MW, and the total capacity is 14.4 MW. Like Volksmolen, Spinderwind enables users to purchase energy bonds and benefit from the energy produced, regardless of their location. This could be a viable scheme if wind power was designated the best solution.

Another option could be to create a microgrid network consisting of a miniature wind farm, a battery unit, a large consumer area, and a connection to the power system. The advantage of this solution is that it is much more efficient than solar power, taking into consideration wind production rates in the Netherlands. The disadvantage is that the solution is more costly than solar.

Solar-Wind Hybrid Power

The third solution is solar-wind hybrid power, which entails implementing a small turbine and a PV system. The intermittent nature of wind power brings several benefits, among which an increase in the quantity of renewable energy available, as the turbine can be used both to charge the energy storage unit's batteries providing additional electricity, decreasing the amount of backup power needed from a diesel generator, and reducing the load placed on energy storage, which will result in an extension of battery life.

Concerning the microgrid option, the Advanced DC-Bus Hybrid System is the most common system, in which the wind turbine provides direct current (DC) power for loads and batteries (typically 48 VDC).[237] Through separate charge regulators, the wind and solar systems are connected to a DC-bus (a large conductor that distributes the voltage). The batteries also connect into this DC-bus along with the DC loads and the inverter/charger. Such connections can be made between various systems with or without a centralized control system. The batteries are charged by both the wind and solar systems. However, a backup diesel generator comes into play if the batteries are only around 20 percent charged. Realistically, the backup is used 5 percent of the time.

Small wind turbines are frequently used for community microgrids, especially in rural energy projects in developing countries where electrification of services and households needs to be fast and affordable. These hybrid solar-wind microgrid systems have shown to reduce the quantity of diesel fuel needed by between 70 and 90 percent.[238]

Insulation Renovation

A primary concern is the buildings' insulation renovation, making them energy efficient. The municipality is investing in building insulation with a 100 percent subsidy in the case of vulnerable

[237] The voltage of a direct current (DC) circuit is measured in VDC (Volts Direct Current). Electrical current that only travels in one direction is known as direct current. DC current flows in a continuous direction, in contrast to alternating current (AC), which periodically changes direction.

[238] For more information see https://www.veckta.com/2020/10/20/small-wind-turbines-for-microgrids/

communities. In the case of rented households, the landlords could reinvest the rent directly in the household upgrading, as they are nudged to make the residential properties energy efficient due to the Energy Performance of Buildings Directive. The tenants do not have upfront costs but profit from lower energy bills, as the building is more energy efficient. Thanks to the lower energy costs, the household tenants can decide to purchase bonds from the Energy Community Fund.

Engagement Strategy

Multi-purpose Mobility Hub

The Multi-purpose Mobility Hub could be developed in the Torenbuurt neighborhood, in the 30-meter safety zone by the railway track. Other than serving as the venue for the implementation of the community battery, the Mobility Hub could also function as a gathering place for the community. In fact, the hub could be a multi-layer parking spot with a multipurpose rooftop that could host sporting and recreational facilities, food, drinks, and music venues, and showcase contemporary art installations. The scope, functionalities and design of the hub should be co-created by the members of the community, which then should be able to become co-owners and co-managers. This could be a positive way to engage the community and create jobs opportunities.

Communication Strategy

In addition to the already existing door-to-door campaign, which is time- and cost-intensive, the project seeks to create the figure of Green AmbassaDoors, citizens from the heart of the community who experienced similar issues (e.g., financial concerns, linguistic barriers) as prospective energy community members. They can be members of the community with time available (retired, students, unemployed, part-time workers, persons on parental leave).[239] They can be helpful in delivering the message as language and cultural barriers also result in trust issues towards the municipality. Ideally, Green AmbassaDoors should be of different age groups so that online and offline communication can be both tailored. For example, 60+ residents may benefit more from a in-person visit rather than a reel or TikTok, which could instead be a suitable strategy for the Z-Generation.

The main tasks of the Green AmbassaDoors are the following: (a) Being a contact person for questions about the renewable energy system and house insulation; (b) Visiting households who are not yet participating in the energy community, i.e., answering questions, explaining the bond and ownership structure, explaining the need of insulating the house before placing PV modules, framing the Energy Bonds as a future passive additional income, highlighting that the capital comes from the community and will flow back into it; (c) Being an intermediary between the citizens, the local government, and other stakeholders.

239 https://tilburg.incijfers.nl/dashboard/arbeidsdeelname and https://tilburg.incijfers.nl/dashboard/werk-en-inkomen

Local media personalities ("local heroes") shall be included in a outreach campaign and advocate for the energy transition, which will directly benefit their public image and convince more people to participate in the energy community. Examples of local heroes are Guus Meeuwis (Singer); Leo Alkemade (Comedian); Soccer Club Willem II and its players; Hockey club Tilburg Trappers and its players.

Finally, the energy communities can attract members and investors through a yearly Energy Festival, conducted on different scales, from an event for a single street, a whole neighborhood, or the whole municipality of Tilburg. While engaging elements like concerts, rallies, or presentations attract the public, the Green AmbassaDoors and the municipality staff can use the event to demonstrate their involvement, build trust and inform about different concepts of a just energy transition. An event for one up to a few streets can be organized from within the neighborhood with the support of social workers, Green AmbassaDoors, and municipality staff. Large festivals need the support of Tilburg Municipality's event management and local heroes' support to attract enough people.

Online Platform

An online platform will be offered to provide general and tailored information about the REC and track the energy production and consumption of the renewable energy system. It will be the key element for the online communication campaign. It will display the content in different languages spoken in the community (Dutch, easy-to-understand Dutch, English, Turkish, (Moroccan), Arabic, Russian, Romanian, and Bulgarian).[240] The app will be developed for IOS and Android as the major operating systems. The information will be provided not only as brief texts but also as information clips that are easy to understand. To engage the individuals with gamification, quizzes will be used. The clips can also be displayed on major social media platforms like YouTube (Shorts), TikTok, or Instagram (Reels).

Besides providing all relevant information,[241] there will be a chatbot function as the first point of contact. If the chatbot cannot direct the citizen to the correct information, the citizen will be transferred to either an administration employee, the respective Green AmbassaDoor, or an expert in the community center. There will be the option to generate an appointment directly from the app for an on-site meeting with the Green AmbassaDoor or the administrative expert.

The app will offer an easy-to-use calculation of how much energy the renewable energy system will approximately generate. If it is a solar system, it will be based on the location, roof orientation, space, and averaged reference values for nearby buildings. Therefore, the city users have to include their location and different values on digital slide controls. For city users with solar panels, the app will display the energy produced linked to the smart power grid. The municipality benefits from the data provided by the platform by evaluating where further measures need to be taken, such as where the production of renewable energy is the highest or, for example, whether there is room

[240] https://allecijfers.nl/gemeente/tilburg/#migratie-achtergrond
[241] Information already available at https://www.duurzamertilburg.nl

for further PV modules. The platform can be used in other cities, thereby triggering the project's scalability.

7. Discussion

After analyzing the literature on energy poverty in the Global North and the Global South, the author developed the research question based on the theories of energy democracy, energy justice, the city as a commons, and energy as a commons. The research analyzes whether energy communities can be a tool to contrast energy poverty and aims at addressing the mismatch between a consistent national policy framework on energy poverty coupled with a small concentration of energy communities, such is the case in Italy, and an inconsistent national policy framework on energy poverty coupled with a large concentration of energy communities; such is the case in the Netherlands. In particular, the author analyzes how vulnerable communities can be enabled to participate in the energy transition and co-govern renewable energy sources as commons. Further, the analysis explored the possibility of creating a framework to foster the development of social energy communities that could be scalable to different geographic and socio-economic contexts.

To do so, the thesis develops two experimental projects. The first experimental project, Co-Roma, aims to increase the concentration of energy communities in Rome and then scale up to other Italian cities. The second experimental project, Tilburg JET, aims at developing a pilot social energy community to be scalable in other vulnerable contexts. Eventually, Tilburg could replicate the Co-Roma platform to support the development of other social energy communities. Ultimately, both projects can contribute to the uptake of social energy communities and help contrast energy poverty in the respective countries.

The two experimental projects are applications of the theory of energy democracy, energy justice, city as a commons and energy as a commons, as they show that making energy democratic and just can bring important social, economic, and environmental benefits, especially for vulnerable communities, often left behind in the energy transition. This goal is in line with the targets set by SDG 7 by 2030 to ensure universal access to modern energy services[242] and to increase the share of renewable energy in the global energy mix.[243]

As seen in the studies by Giotitsas et al.,[244] energy as a commons can be envisioned through microgrids. This is not the only solution and can apply to several contexts, but it is not the best option for others. As we have seen, in Italy, the most suitable option is to sell the surplus to the national grid so as to receive economic incentives from the GSE. Instead, in the Netherlands, it is more suitable to become self-sufficient so that the national grid is not overloaded.

[242] United Nations General Assembly (2015) Sustainable Development Goals. Goal 7: Affordable and Clean Energy. Target 7.1: By 2030, ensure universal access to affordable, reliable, and modern energy services. See https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-7

[243] United Nations General Assembly (2015) Sustainable Development Goals. Goal 7: Affordable and Clean Energy. Target 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix. See https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-7

[244] Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354.

The research has highlighted several other important topics. First, why do energy communities thrive in some places, like the Netherlands, even without a robust regulatory framework, rather than others, such as Italy? A strong cooperative behavior, observed in some Northern EU countries, seems to be a critical enabling factor. If so, what stakeholder engagement strategies could facilitate such behavior in citizens? How are they different in the Global North and the Global South? Capacity-building seems to be another key enabler. In particular, it seems that knowledge institutions should take a prominent role in capacity-building. As demonstrated by the Co-Roma experimental project, knowledge institutions can catalyze local communities around shared values to develop community-led energy initiatives.

Furthermore, national energy poverty indicators are already present in the EU, but organic city-specific indicators are still lacking, hindering the possibility of a bottom-up approach. The Anguillara social energy community has developed an algorithm to assess relative energy poverty within the community and reallocate state incentives to benefit the most vulnerable households. The algorithm could be scalable to other social energy communities in Italy, but in other countries, it would need to be tailored to their sustainable investment strategies. This leads to the last point of discussion, which is that sustainable investment strategies, much like engagement strategies, are context-based and differ greatly between the Global North and the Global South. The paragraphs below explore these points in detail.

Enabling Conditions for Energy Communities

The growth of energy communities responds to the increasing demand for energy autonomy, but it is widely diversified globally and within the EU, despite the standardized system backed up by the RED II Directive. The Netherlands is an energy community pioneer, even though it lacks a proper regulatory framework, as the RED II directive has yet to be implemented. The fact that targeted legislation is still pending can create legal barriers for further development.

Despite the lack of regulation, a large concentration of energy cooperatives is present. These projects are often started by enthusiasts with a background in the energy sector keen to work on innovative technologies. They are often supported by municipalities, which provide venues and financing for renewable energy projects. An enabling factor, therefore, seems to be cooperative behavior. This pattern is also observable in Germany, the country with the highest concentration of energy communities. Both countries have a long history of cooperatives, which helped to transition to a collective renewable energy focus.

Nevertheless, cooperative behavior in the Netherlands often does not acquire a solidarity perspective, particularly in supporting energy-poor households. This is partly because of the lack of targeted incentives for households to profit from energy communities. The opposite pattern is observed in Italy, where the state grants incentives for energy self-produced and shared within the community. This is a key enabler in the development of social energy communities, in which members can reallocate economic incentives to benefit the most vulnerable households. Furthermore, interviews within the Tilburg Municipality led me to understand that vulnerable households in Tilburg tend to isolate themselves from the community, which is a bottleneck in the deployment of effective engagement strategies. This is different than in Italy, where vulnerable communities often tend to be very cohesive, a pattern demonstrated by the many social projects, among which social energy communities, developed in vulnerable neighborhoods throughout the country.

Stakeholder Engagement Strategies

If bottom-up cooperative behavior is a core enabler for the development of energy communities, then it is necessary to analyze what stakeholder engagement strategies can facilitate the uptake of this behavior. First, evidence shows that stakeholder engagement strategies are context-based, and often, some that work in the Global North may not be effective in the Global South. For example, in the Global North, official channels often engage citizens in the decision-making process.

In contrast, stakeholder engagement in the Global South faces significant challenges, such as a lack of formal structures for stakeholder engagement, weak civil society organizations, and a lack of trust between stakeholders and decision-makers. Furthermore, many regions are much more diverse than the Global North. For example, Africa alone is home to thousands of ethnic groups, each with their language, dialect, and culture, which can make it difficult to ensure that all voices are heard in decision-making processes.

To address these challenges, stakeholder engagement strategies must be tailored to each region's unique social, economic, and political contexts, incorporating local knowledge and expertise. They need to focus on building trust relationships between stakeholders and decision-makers, enabling transparency and accountability. A first step can be to co-develop engagement strategies with local communities and build local communities' capacity to effectively engage with decision-makers.

Knowledge Institutions for Capacity-Building

Capacity-building is another critical enabler for developing energy communities, as it empowers local communities to participate in decision-making processes. Nevertheless, traditional capacity-building processes based on public-NGO partnerships need to be enhanced to consider the needs of the local communities. The focus has been mainly on training programs, workshops, and knowledge-sharing platforms to transfer knowledge from experts to local communities. These tools aim to build technical capacity and create a skilled workforce, but they may neglect the broader social, cultural, and political factors that influence the acceptance of disruptive innovations. In other words, they may apply a "one-size-fits-all" approach. In doing so, they may fail to engage local communities in decision-making processes, which might lead to failure in transferring the co-ownership and co-management of the innovation.

A possible solution to this problem is to have knowledge institutions step in on the side of NGOs and the public sector. As seen in the Co-Roma experimental project, the role of LabGov ETS as a knowledge institution was fundamental in aggregating the local community in the ACT Co-

District and creating the neighborhood cooperative, which will develop the energy community. It seems clear that the way to develop a social energy community starts from the aggregation of the community around shared values, which can include a shared sense of identity around cultural, natural, or social commons, such is the case of the Centocelle Park for the ACT community.

Knowledge institutions can provide project management and other technical skills that can actively involve the local community in the co-ownership of the energy community. They can also be a tool to avoid the state-capture phenomenon, where powerful interest groups use their influence to manipulate decision-making processes and capture the benefits of disruptive innovations. By empowering local communities and NGOs, knowledge institutions can counterbalance the influence of these interest groups and promote a more inclusive and transparent approach to decision-making.

A platform like Co-Roma could catalyze knowledge creation and capacity building if properly tailored to the specific needs and peculiarities of the territory under consideration. This is also suggested by Ambole et al. who claim that creating a framework to co-design the statutory, regulatory, and socio-technical configurations is necessary to support energy communities' development. In this regard, they suggest that community energy intermediates, such as NGOs or knowledge institutions focused on energy and community engagement, should connect local communities with energy companies and investors who can help them develop and fund energy projects, conduct feasibility studies, and offer co-design tools, business services, and policy advice to the community.[245]

City-Specific Energy Poverty Indicators

In the fourth chapter, the author explores the initiatives taken by the EU to contrast energy poverty at the local level, but organic city-based energy poverty indicators are still lacking, which hinders the possibility of taking a bottom-up approach. In Italy, the Anguillara social energy community has created an algorithm to assess relative energy poverty in the community and allocate benefits to the most vulnerable households. The algorithm was developed by Mauro Annunziato, former Smart Energy Director at ENEA, and it targets the most energy-vulnerable individuals within the community by taking into account *pro capite* energy consumption. Then a ranking is created, and funds are allocated to a set number of the most vulnerable individuals.

Through the RECON platform, the energy community has created an estimate of incentives that the state would allocate, and then it reserves a portion for energy poverty (energy poverty tax). The two initiators are the Municipality and a local church. According to Annunziato, with a pool of fifty families, the economic support could cut by 80 percent the energy bill of the ten most energy-vulnerable. The standard algorithm could be replicable in other contexts in Italy, but for

[245] Ambole,A.; Koranteng, K.; Njoroge, P.; Luhangala, D.L. A Review of Energy Communities in Sub-Saharan Africa as a Transition Pathway to Energy Democracy. *Sustainability* **2021**, *13*, 2128. https://doi.org/10.3390/su13042128

other contexts, the solution would have to be targeted to the specific sustainable investment strategies in place in the country under consideration.[246]

Sustainable Investment Strategies

Sustainable investment strategies are context-specific. For example, in the EU, other than national and local incentives, also deriving from Member States' NRRPs, the investment could flow through Horizon Europe projects. Generally, the best way to gather investment is to establish PPCPs to govern renewable energy community projects, which would enable the investment to flow from different kinds of sources.

In the Netherlands, incentives for renewable energy self-production are progressively diminishing, mainly due to the grid congestion. This calls for the need of additional incentives, tailored to households which seek to take part in a self-sustaining energy community. The incentives could be implemented at the local or regional level. Then, social energy communities could reallocate them using an algorithm similar to the one developed for the Anguillara social energy community.

In Italy, one way to gather further sustainable investment is to point out the shadow cost of energy poverty for the regional health system. The regions should consider that energy poverty leads to worse health conditions, weighting on the public health system. Therefore, they should invest in social energy communities. A possible framework could be to have the ASLs (*Azienda Sanitaria Locale*, Local Health Agency) participate in local energy communities. For example, in Rome, there is a plan to regenerate the Santa Maria della Pietà district, where the ASL and the Lazio region are partners with Roma Capitale to transform the area into a well-being district. One of the possibilities envisioned is to create an energy community to make the district self-sustaining.

In many areas of the Global South, the situation is completely different. For example, in the sub-Saharan Africa region, renewable energy sources are abundant, but their deployment is hindered by limited access to finance and technological expertise. Energy communities help overcome some of the challenges associated with renewable energy deployment, such as grid infrastructure limitations, high upfront costs, and lack of access to financing. By pooling resources, energy communities can achieve economies of scale, reduce costs, and increase energy security and reliability. Sustainable investment in energy communities can take many forms. For example, impact investors can provide equity or debt financing to community-based renewable energy projects, such as solar microgrids or mini-hydro plants. Furthermore, PPCPs can facilitate the deployment of renewable energy technologies and services, such as energy-efficient appliances or energy management systems, that can help energy communities maximize their energy savings and benefits.

Sustainable investment in SSA faces several challenges, which should be properly addressed. The first is that policy and regulatory frameworks are often weak, hindering private-sector investment

[246] Interview with Mauro Annunziato, former Smart Energy Director at ENEA, and developer of the energy poverty algorithm for the Anguillara social energy community.

and limiting the scalability of renewable energy projects. Policy and regulatory frameworks should include incentives that support RES generation, such as feed-in tariffs, tax incentives, and renewable energy targets. Furthermore, risk mitigation instruments, such as guarantees and insurance, should be implemented to provide a safety net for investors, particularly in countries with political and economic instability, and attract private investments which require a certain level of risk mitigation.

A second concern is the limited access to financial instruments, particularly long-term capital, which is critical for financing renewable energy projects with longer payback periods. This should be increased, particularly through innovative financing mechanisms that combine public, private, and crowdfunding capital. Measures that take inspiration from the EU, like the social taxonomy, and the Vatican, like *Mensuram Bonam*, can be tailored to other contexts and become useful sustainable finance tools. Social taxonomy aims to classify investments based on their social impact, while *Mensuram Bonam* provides a methodology for assessing the positive and negative social and environmental impacts of investments. In the context of social energy communities, they can help to evaluate and channel investment towards projects that have a positive social impact, such as improving energy access and well-being for vulnerable communities.

Other applicable financial instruments are green bonds, impact investment, and sustainability-linked loans, which include ESG goals in investment decision-making. The upcoming UNCC COP27 conference, which will focus on accelerating action on climate change, and the CBD COP15 conference, which will focus on biodiversity conservation, offer a chance to promote sustainable finance initiatives and support the growth of energy communities in the Global South, possibly creating additional mechanisms.

Furthermore, there is a lack of technical expertise, particularly in rural areas, where energy communities are needed the most, as the areas often fall outside the scope of the national grid. To overcome this challenge, public, private, and knowledge stakeholders must invest in human capital and develop technical expertise to ensure the sustainability of citizen-led energy initiatives. Finally, access to energy data must be increased, improving energy management systems, and leveraging digital technologies to optimize energy use and maximize savings.

Conclusion

Energy poverty is a major concern that is sometimes overlooked or not properly targeted. It is a concept that has a different outlook in the Global North and in the Global South. In the first case, it entails that the energy-poor individual lacks the economic means to access the energy services provided by the national grid system. In the second case, access to energy services through a stable grid system is not always guaranteed, especially in rural areas.

A key finding of this thesis is that citizen-led energy initiatives should be tailored to the community's specific needs. In Rome, energy communities are incentivized to sell energy surplus to the national grid. In the Netherlands, instead, the national grid is currently overloaded, and therefore alternative solutions need to be envisioned to make communities self-sustaining.

The analysis led to the understanding that to create successful energy communities, it is necessary to merge the Italian social approach and the Dutch innovation dynamism. A way to do so is to support local administrations in mapping and supporting projects of social energy communities through a platform like Co-Roma, which could be scalable to other contexts, such as cities in the Netherlands.

Further, the discussion highlights that stakeholder engagement strategies that work in the Global North do not necessarily work in the Global South. Many areas of the Global South need a focus on creating capacity-building, for which a platform like Co-Roma, tailored to the specific needs of the context, could become a powerful tool to catalyze innovation and drive the energy transition.

In order to have an effective impact on the territory, organic city-specific indicators for energy poverty need to be developed, also to make sure that sustainable investment strategies are tailored and effective. Sustainable investment strategies are context specific. In Italy, for example, a possible mechanism is providing evidence of the energy poverty shadow cost for the regional health system so that regions are incentivized to invest in and also actively become part of energy communities, through, for example, Local Health Agencies (ASL). In the Netherlands, there is a growing need for further incentives targeted at households, which could be an enabling factor for the development of social energy communities, as the members could reallocate incentives to benefit the most vulnerable households.

In the Global South, many tools are needed to drive sustainable investment, such as an effective regulatory framework that provides certainty and stability for investors, reduces risk, and promotes transparency and accountability in investment decision-making, including incentives that support renewable energy development, such as feed-in tariffs, tax incentives, and renewable energy targets. Furthermore, risk mitigation instruments, such as guarantees and insurance, are essential as they can provide a safety net for investors, particularly in countries with political and economic instability.

Finally, many sustainable investment instruments which are being developed in the Global North, such as social taxonomy and mensuram bonam, can be tailored to Global South contexts and become powerful tools to drive sustainable investment, together with other financial instruments such as green bonds, impact investment, and sustainability-linked loans.

Bibliography

Adenikinju, A. F. (2005). Analysis of the cost of infrastructure failures in a developing economy: The case of the electricity sector in Nigeria.

AEE. Neue Studie Zeigt: Bürgerenergie Bleibt Zentrale Säule der Energiewende. Available online: https://www.unendlich-viel-energie.de/studie-buergerenergie-bleibt-zentrale-saeule-der-energiewende

Ambole, A.; Musango, J.K.; Buyana, K.; Ogot, M.; Anditi, C.; Mwau, B.; Kovacic, Z.; Smit, S.; Lwasa, S.; Nsangi, G.; et al. Mediating household energy transitions through co-design in urban Kenya, Uganda and South Africa. *Energy Res. Soc. Sci.* **2019**, *55*, 208–217

Anders Melin, Rosie Day & Kirsten E. H. Jenkins (2021) Energy Justice and the Capability Approach—Introduction to the Special Issue, Journal of Human Development and Capabilities, 22:2, 185-196, DOI: 10.1080/19452829.2021.1909546

ARERA. Deliberazione 27 dicembre 2022. **727/2022/R/EEL**. Definizione, ai sensi del decreto legislativo 199/21 e del decreto legislativo 210/21, della regolazione dell'autoconsumo diffuso. Approvazione del testo integrato autoconsumo diffuso.

Avilés, C., Oliva, S. and Watts, D., 2019. Single-dwelling and community renewable microgrids: Optimal sizing and energy management for new business models. *Applied Energy*, *254*, p.113665.

Aydos, M., Toledano, P., Dietrich Brauch, M., Mehranvar, L., Iliopoulos, T.G. and Sasmal, S., 2022. Scaling Investment in Renewable Energy Generation to Achieve Sustainable Development Goals 7 (Affordable and Clean Energy) and 13 (Climate Action) and the Paris Agreement: Roadblocks and Drivers. *Available at SSRN 4309067*.

Barroco et al. (2020) *Le comunità energetiche in Italia: Una guida per orientare i cittadini nel nuovo mercato dell'energia*. Green Energy Community: EIT Climate-KIC, Agenzia per l'energia e lo sviluppo sostenibile, ENEA, Università di Bologna.

Bednar, D.J., Reames, T.G. Recognition of and response to energy poverty in the United States. *Nat Energy* **5**, 432–439 (2020). https://doi.org/10.1038/s41560-020-0582-0

Bevolkingsontwikkeling; regio per maand [Population growth; regions per month]. CBS Statline (in Dutch). CBS. 1 January 2021.

Boardman, B., 1991. From Cold Homes to Affordable Warmth. Belhaven Press, London.

Brohmann, B., Fritsche, U., & Hünecke, K. (2006). Case Study: The Bioenergy Village Jühnde. *Report by Öko-Institute eV for Create Acceptance Work Package, 2.*

Broska, L.H.; Vögele, S.; Shamon, H.; Wittenberg, I. On the Future(s) of Energy Communities in the German Energy Transition: A Derivation of Transformation Pathways. *Sustainability* **2022**, *14*, 3169. https://doi.org/10.3390/su14063169

Camera dei Deputati (2021) *Governance europea e nazionale su energia e clima*. Published on 16 December 2021. Camera dei Deputati Servizio Studi XVIII Legislatura, Rome.

Cannavò, P. et al. (2016) *Protocollo metodologico per la costruzione di quartieri e comunità collaborative urbane (il protocollo co-città)*. ENEA. Report RdS/PAR2015/023. Available here.

Cannavò, P. et al. (2017) *Prototipazione di una piattaforma istituzionale e digitale per la creazione di uno smart collaborative district*. ENEA. Report RdS/PAR2016/026. Available here.

Caramizaru, A.; Uihlein, A. (2020) *Energy Communities: An Overview of Energy and Social Innovation*; EUR 30083 EN; Publications Office of the European Union: Luxembourg,

Carayannis, E.G., Barth, T.D. and Campbell, D.F. (2012) The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of innovation and entrepreneurship*, *1*, pp.1-12.

CBS (2018). *Energieverbruik van Particuliere Huishoudens*. Available online at: https://www.cbs.nl/nl-nl/achtergrond/2018/14/energieverbruik-van-particuliere-huishoudens

Cipolat, C., da Silveira, D. D., Ludke, Q. P., Engelmann, M. P., & Braun, A. B. *Energia limpa, renovável e sustentável: estudo de caso no Grupo Creluz.*

CoM (2022). *Reporting Guidelines on Energy Poverty*. Support and Library. Covenant of Mayors for Climate & Energy - Europe.

Comunità Rinnovabili (2022) Report by Legambiente. See www.comunirinnovabili.it

Crick, F., Hesse, C., Orindi, V., Bonaya, M., & Kiiru, J. (2019). Delivering climate finance at local level to support adaptation: experiences of county climate change funds in Kenya. *Nairobi, Kenya: Ada Consortium.*

Damien, D.P.A.F. Critical Review of the Malawi Community Energy Model. In Proceedings of the IEEE PES Power Africa Conference, Livingstone, Zambia, 28 June–2 July 2016; pp. 78–82.

Dauwe, T.; Young, K.; Jóźwicka, M. *Policies and Measures on Renewable Heating and Cooling in Europe—Eionet Report—ETC/ACM 2018/17*; European Environment Agency: Bilthoven, The Netherlands, 2018.

Day, R., G. Walker, and N. Simcock. 2016. "Conceptualising Energy Use and Energy Poverty Using a Capabilities Framework." Energy Policy 93: 255–264.

de Jong, F., and Vonk, G. (2019). Internal coordination of social security in the Netherlands. *Eur. J. Soc. Secur.* 21:2. doi: 10.1177/13882627198 44985

De Nictolis, E. & Iaione, C., The City as a Commons Reloaded: from the Urban Commons to Co-Cities Empirical Evidence on the Bologna Regulation (June 12, 2021). The Cambridge Handbook of Commons Research Innovation.

Dijkhof, T. (2014). The Dutch Social Support Act in the shadow of the decentralization dream. *J. Soc. Welfare Fam. Law* 36, 276–294. doi: 10.1080/09649069.2014.933590

Drehobl, A. & Ross L. *Lifting The High Energy Burden In America's Largest Cities: How Energy Efficiency Can Improve Low Income And Underserved Communities* (American Council for an Energy-Efficient Economy, Energy Efficiency for All, 2016).

ENGAGE.EU European University (2020) *D87 Innopreneurial spaces.* Project co-funded by the Erasmus+ Programme of the European Union.

ENGAGER (2019). *Workshop Summary Amsterdam 30-31 October 2019. Making the Most of Qualitative Evidence for Energy Poverty Mitigation: A Research Agenda and Call for Action.* Available online at: http://www.engager-energy.net/wp-content/uploads/2020/01/Amsterdam.pdf

EPAH (2022). Energy Poverty Indicators Dashboard. Directorate-General for Energy. European Commission. Available at: https://energy-poverty.ec.europa.eu/observing-energy-poverty/national-indicators_en

EPOV (2021). *High Share of Energy Expenditure Income (2M).* Available online at: https://www.energypoverty.eu/indicator?primaryId=1460andtype=barandfrom=2015andto=2015andcountries=NLanddisaggregation=none

European Commission (2023) Speech by Commissioner Elisa Ferreira at the Just Transition Fund launch event - Groningen, The Netherlands. 20 February 2023. Available at https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_23_1276

European Commission, Covenant of Mayors, Energy Poverty. Available at https://eu-mayors.ec.europa.eu/en/library/energy_poverty

European Commission, Directorate-General for Energy, Hørman, M., Georgiev, I., Wessel, R., et al. (2022) *EU's global leadership in renewables : final synthesis report : July 2021.* Publications Office of the European Union. **https://data.europa.eu/doi/10.2833/523799**

European Commission, Directorate-General for Research and Innovation, Joint Research Centre, (2019) *The strategic energy technology (SET) plan.* Publications Office.

European Commission, Directorate-General for Research and Innovation, Joint Research Centre, (2019) *The strategic energy technology (SET) plan.* Publications Office. **https://data.europa.eu/doi/10.2777/04888**

European Commission, Energy Poverty in the EU. Available at https://energy.ec.europa.eu/topics/markets-and-consumers/energy-consumer-rights/energy-poverty-eu_en

European Parliament. (2018). Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources. *Off. J. Eur. Union, 5.*

European Parliament. (2019). Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on Common Rules for the Internal Market for Electricity and Amending Directive 2012/27/EU. *Off. J. Eur. Union, 158*, 125-199.

Eurostat (2021). *Electricity Prices for Household Consumers - Bi-annual Data (from 2007 Onwards) [nrg_pc_204].* Available online at: https://ec.europa.eu/eurostat/web/products-datasets/-/nrg_pc_204

Eurostat (2021). *Gas Prices for Household Consumers - Bi-annual Data (from 2007 Onwards) [nrg_pc_202].* Available online at: https://ec.europa.eu/eurostat/web/products-datasets/-/nrg_pc_202

Eurostat (2022*) SDG 7 - Affordable and clean energy. Ensure access to affordable, reliable, sustainable and modern energy for all.* Data extracted in April 2022. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=SDG_7_-_Affordable_and_clean_energy#Context

Faro Convention on the Value of Cultural Heritage for Society, 2005

Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.

Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.

Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.

Feenstra M, Middlemiss L, Hesselman M, Straver K and Tirado Herrero S (2021) Humanising the Energy Transition: Towards a National Policy on Energy Poverty in the Netherlands. Front. Sustain. Cities 3:645624. doi: 10.3389/frsc.2021.645624.

Ferster, B. Macht, G.A. Brownson, J.R.S. (2020) Catalyzing community-led solar development by enabling cooperative behavior: Insights from an experimental game in the United States, *Energy Res. Soc. Sci.* **2020**, 63, https://doi.org/10.1016/j.erss.2019.101408

For a deeper understanding also see Ministero dell'Ambiente e della Sicurezza Energetica (2022) *Piano per la Transizione Ecologica.*

Foster, S., Iaione, C. (2019) Ostrom in the City, in Blake Hudson, Jonathan Rosenbloom & Dan Cole, Routledge Handbook on the study of the commons, New York, Routledge.

Foster, S., Iaione, C. (2022) *Co-cities: Innovative Transitions Toward Just and Self-sustaining Communities.* MIT Press.

Frischmann, B., Madison, M., & Sanfilippo, M. (Eds.). (2023). *Governing Smart Cities as Knowledge Commons* (Cambridge Studies on Governing Knowledge Commons). Cambridge: Cambridge

University Press. doi:10.1017/9781108938532

Giotitsas, C., Nardelli, P. H., Kostakis, V., & Narayanan, A. (2020). From private to public governance: The case for reconfiguring energy systems as a commons. *Energy Research & Social Science*, *70*, 101737.

Giotitsas, C., Nardelli, P. H., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354.

Gjorgievski, V. Z., Cundeva, S., & Georghiou, G. E. (2021). Social arrangements, technical designs and impacts of energy communities: A review. *Renewable Energy*, *169*, 1138-1156.

González-Eguino, M. (2015). Energy poverty: An overview. *Renewable and sustainable energy reviews*, *47*, 377-385.

Governance Regulation on the Energy Union and Climate Action (EU) 2018/1999 and Electricity Directive (EU), 2019/944.

Government of the Netherlands, *Wind Energy on Land*. Available at https://www.government.nl/topics/renewable-energy/wind-energy-on-land

Hardin, G. (1968). The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality. *science*, *162*(3859), 1243-1248.

Hills, J., 2011. Fuel Poverty: The Problem and its Measurement. Centre for Analysis of Social Exclusion, London.

Hussaini, I., Onunze, C., Chiroma, A., Muhammas, S., & Ibrahim, S. (2014). *Energy Resources Development in Nigeria: Prospects and Challenges. November.*

Iaione, C. et al. (2018) *La cooperativa di quartiere come strumento di cooperazione delle comunità urbane.* Report RdS/PAR2018/036. Available here.

Iaione, C. et al. (2021) *Energy Communities: prototipazione sperimentale del modello giuridico-economico delle comunità energetiche.* RdS/PTR(2021)/053. ENEA.

Iaione, C. et al. (2021). *La governance per la gestione sostenibile e inclusiva delle comunità energetiche: analisi di pre-fattibilità economico-giuridica*. Report RdS/PTR2020/030. p.17-19.

IEA (2022), Energy Efficiency 2022, IEA, Paris https://www.iea.org/reports/energy-efficiency-2022, License: CC BY 4.0

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research & Social Science*, *11*, 174-182.

Johansson, T. B., Patwardhan, A. P., Nakićenović, N., & Gomez-Echeverri, L. (Eds.). (2012). *Global energy assessment: toward a sustainable future.* Cambridge University Press. Chapter 2. Energy, Poverty, and Development. Convening Lead Authors (CLA): Stephen Karekezi (AFREPREN/FWD, Kenya) Susan McDade (United Nations Development Programme). Lead Authors (LA): Brenda Boardman (University of Oxford, UK) John Kimani (AFREPREN/FWD, Kenya). Review Editor: Nora Lustig (Tulane University, USA).

JPI Urban Europe / SET Plan Action 3.2 (2020). White Paper on PED Reference Framework for Positive Energy Districts and Neighbourhoods. https://jpi-urbaneurope.eu/ped/

Manager, C. (2018). *Olasimbo Sojinrin. May.*

Ministero dello Sviluppo Economico, Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Ministero delle Infrastrutture e dei Trasporti (2018) *Piano Nazionale Integrato per l'Energia e il Clima.*

Morlino, L. et al. (2018) *Modelli di co-governance urbana, sostenibilità, bancabilità ed eleggibilità finanziaria di imprese civiche o di comunità: il partenariato pubblico-comunità e il partenariato pubblico-privato-comunità.* ENEA. Report RdS/PAR2017/068. Available here.

Morlino, L. et al. (2018) *Modelli di co-governance urbana, sostenibilità, bancabilità ed eleggibilità finanziaria di imprese civiche o di comunità: il partenariato pubblico-comunità e il partenariato pubblico-privato-comunità.* ENEA. Available here.

Muhoza, C.; Johnson, O.W. Exploring household energy transitions in rural Zambia from the user perspective. *Energy Policy* **2018**, *121*, 25–34.

Mulder, P., Batenburg, A., & Dalla Longa, F. Energiearmoede in Nederland 2022.

NECP (2019) *Integrated National Energy and Climate Plan 2021-2030.* Ministry of Economic Affairs and Climate Policy, Netherlands.

NECP (2019) *Integrated National Energy and Climate Plan 2021-2030.* Ministry of Economic Affairs and Climate Policy, Netherlands.

Next Generation Italy (2021) *National Recovery and Resilience Plan.* Approved by the Council of Ministers on 12 January 2021. Ministry of Economics and Finance, Rome.

Nfah, E.M.; Ngundam, J. Identification of stakeholders for sustainable renewable energy applications in Cameroon. *Renew. Sustain. Energy Rev.* **2012**, 16, 4661–4666.

Njoroge, P.; Ambole, A.; Githira, D.; Outa, G. Steering energy transitions through landscape governance: Case of Mathare informal settlement, Nairobi, Kenya. *Land* **2020**, *9*, 206.

Office for National Statistics, 2014. Excess Winter Mortality in England and Wales. http://www.ons.gov.uk/ons/rel/subnational-health2/excess-winter-mortality-in-england-and-wales/index.html accessed in 2014.

Office for National Statistics, 2022. Winter mortality in England and Wales: 2021 to 2022 (provisional) and 2020 to 2021 (final) https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2021to2022provisionaland2020to2021final

OIPE (2022) La povertà energetica nelle regioni italiane nel 2021. Available at https://oipeosservatorio.it/wp-content/uploads/2022/12/2022_PE_regioni_2021.pdf

Omenge, P.M.; Eshiamwata, G.W.; Makindi, S.; Obwoyere, G.O. Public Participation in Environmental Impact Assessment and Its

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, *325*(5939), 419-422.

Ostrom, E. (2010). Beyond markets and states: polycentric governance of complex economic systems. *American economic review*, *100*(3), 641-672.

Ostrom, E. (2017). Polycentric systems for coping with collective action and global environmental change. In *Global Justice* (pp. 423-430). Routledge.

PBL (2018). "Meten met twee maten," in *Een Studie Naar de Betaalbaarheid van de Energierekening van Huishoudens*, eds M. Middelkoop, S. Van Polen, R. Holtkamp, and F. Bonnerman (Den Haag).

REN21 (2018) SADC Renewable Energy and Energy Efficiency Status Report. Chapter 6.

Rhind, Graham (2017-09-29). *Global Sourcebook of Address Data Management: A Guide to Address Formats and Data in 194 Countries*. Routledge. p. 406. ISBN 978-1-351-93326-1.

Rijksoverheid (2020). *Definitief Einde Gaswinning Groningen Wettelijk Geregeld*. Available online at: https://www.rijksoverheid.nl/actueel/nieuws/2020/11/24/ definitief-einde- gaswinning- groningen- wettelijk- geregeld (accessed April 22, 2021).

Rogers, J.; Simmons, E.; Convery, I.; Weatherall, A. Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy* **2008**, *36*, 4217–4226.

Ross, L., Drehobl, A. & Stickles, B. *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency* (American Council for an Energy Efficient Economy, 2018)

Salmeri et al., (2017) *Developing clean energy solutions in Latin America's major cities: An introduction for subnational energy policy decision-makers*. Carbon Trust & the Inter-American Development Bank (IDB)

Schellekens, J., Oei, A., and Haffner, R. (2019). *De Financiële Gevolgen van de Warmtetransitie. Een Onderzoek Naar de Investeringsuitdaging, Effecten op Energie-Betaalbaarheid en het Potentieel van (nieuwe) financieringsvormen*. Ecorys.

Scottish Executive (2002). *The Scottish Fuel Poverty Statement*. Scottish Executive, Edinburgh.

See the concept note of *Diritto ed Economia delle Comunità Energetiche*, Special Number for the Review *Diritto e Società*, published by LabGov.City in 2023. Concept note available at request.

SETO, US Department of Energy. Available at https://www.energy.gov/eere/solar/community-solar-basics

Solar Sisters (2018). Light. Hope. Opportunity. Available at http://www.cleancooking2015.org/wp-content/uploads/2015/05/SS-Womens-Enterpreneurship-and-economic-empowerment-1.pdf

Sovacool, B.K. (2014) What are we doing here? Analysing 15 years of energy scholarship and proposing a social science research agenda, Energy Res. Soc. Sci. 1 (2014) 1–29. Council for Renewable Energy (CREN) (2012) Nigeria Electricity Crunch. http://www.reneablenigeria.org

Straver, K., Mulder, P., Hesselman, M., Tirado Herrero, S., Middlemiss, L., and Feenstra, M. (2020). *Energy Poverty and the Energy Transition*. TNO.

Substantive Contribution to Environmental Risk Management: Insights from Eia Practitioners and Other Stakeholders in Kenya's Renewable Energy Sub-Sector. *In Energy and Sustainability VIII*; WIT Press: Southampton, UK, 2019; pp. 133–144.

Szulecki, K., & Overland, I. (2020). Energy democracy as a process, an outcome and a goal: A conceptual review. *Energy Research & Social Science*, *69*, 101768.

Tarpani, E.; Piselli, C.; Fabiani, C.; Pigliautile, I.; Kingma, E.J.; Pioppi, B.; Pisello, A.L. Energy Communities Implementation in the European Union: Case Studies from Pioneer and Laggard Countries. *Sustainability* **2022**, *14*, 12528. https://doi.org/10.3390/su141912528

The Climate Change Act 2016, 10 179 (2016). Kenya.

Thema, J., & Vondung, F. (2020). *EPOV Indicator Dashboard: Methodology Guidebook*. Energy Poverty Observatory. European Commission.

TNO. 2020. *White Paper: Energy Poverty and the Energy Transition: Towards Improved Energy Poverty Monitoring, Measuring And Policy Action.*

TNO. 2023. P10119. *Energy Poverty: A Science and Policy State of Play*. Date: 02 February 2023. Authors: Caroline van Ooij, Anika Batenburg, Nam Chi Nguyen, Koen Straver

United Nations General Assembly (2015) Sustainable Development Goals. Goal 7: Affordable and Clean Energy. Target 7.1: By 2030, ensure universal access to affordable, reliable, and modern energy services. See https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-7

United Nations General Assembly (2015) Sustainable Development Goals. Goal 7: Affordable and Clean Energy. Target 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix. See https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-7

US Energy Information Administration (2018) *2015 Residential Energy Consumption Survey (RECS)*

Woonbond (2013). Rapportage Woonlasten Onderzoek. Lefier.

Woonbond (2019). Rapportage Meldpunt Energiealarm. Available online at: https://www.woonbond.nl/sites/woonbond/files/publicaties/Rapportage_Energiealarm.pdf

Webliography

https://www.duurzamertilburg.nl

https://www.brooklyn.energy/about

https://cermaglianoalpi.it/index.php/chi-siamo/

https://www.smarthome.enea.it/smartsim/login

https://wetten.overheid.nl/BWBR0009755/2022-10-01

https://openresearch.amsterdam/nl/page/43873/european-city-science-initiative-csi-eu

https://joint-research-centre.ec.europa.eu/index_en

https://www.comunirinnovabili.it/la-rete-delle-comunita-energetiche-rinnovabili-e-sostenibili/

https://www.comunirinnovabili.it/la-rete-delle-comunita-energetiche-rinnovabili-e-sostenibili/

https://www.regione.piemonte.it/web/temi/sviluppo/sviluppo-energetico-sostenibile/comunita-energetiche-rinnovabili-piemonte

https://www.liander.nl/grootzakelijk/transportschaarste/beschikbaarheid-capaciteit

https://allecijfers.nl/gemeente/tilburg/#migratie-achtergrond

https://climate-laws.org/geographies/netherlands/laws/electricity-act-dde0dfd7-d8b9-49bb-9369-29bc5c05c624

https://climate.ec.europa.eu/eu-action/european-green-deal/delivering-european-green-deal/social-climate-fund_en

https://corporate.enelx.com/en/question-and-answers/what-is-a-microgrid-and-how-does-it-work

https://corporate.enelx.com/en/question-and-answers/what-is-a-microgrid-and-how-does-it-work

https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210128-1/

https://elaw.org/nl.urgenda.15

https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en

https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en

https://energy.ec.europa.eu/topics/energy-strategy/energy-union_en

https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=EN

https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

https://fesr.regione.emilia-romagna.it/opportunita/2022/sostegno-allo-sviluppo-di-comunita-energetiche-rinnovabili

https://knowledge4policy.ec.europa.eu/foresight/topic/continuing-urbanisation/developments-and-forecasts-on-continuing-urbanisation_en

https://powerafrica.medium.com/engaging-kenyan-communities-in-energy-development-d8b16848e7b4

https://powerafrica.medium.com/engaging-kenyan-communities-in-energy-development-d8b16848e7b4

https://rural-energy-community-hub.ec.europa.eu/landscape-energy-cooperatives-germany_en

https://sue.enea.it/product/cittadini-attivi-e-comunita-intelligenti/social-urban-network/

https://tilburg.incijfers.nl/dashboard/arbeidsdeelname

https://tilburg.incijfers.nl/dashboard/werk-en-inkomen

https://www.adb.org/news/speeches/smoothing-green-just-energy-transition-asia-pacific-ashok-lavasa

https://www.comune.roma.it/web/it/notizia.page?contentId=NWS1010051

https://www.comune.roma.it/web/it/notizia.page?contentId=NWS993312

https://www.comunirinnovabili.it/comunita-energetica-e-solidale-di-napoli-est/

https://www.enelgreenpower.com/countries/europe/Italy/renewable-energy-communities

https://www.enelx.com/it/it/storie/2020/05/comunita-energetiche-cosa-sono

https://www.engageuniversity.eu/engage-eu-expedition/

https://www.epa.gov/greenpower/green-power-communities-list

https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-the-energy-performance-of-buildings-directive

https://www.gov.uk/winter-fuel-payment/overview

https://www.legambiente.it/comunicati-stampa/nasce-la-rete-delle-comunita-energetiche-rinnovabili-e-solidali/

https://www.libertyville.com/1113/Sustainability

https://www.pv-magazine.com/2023/01/24/grid-congestion-continues-to-increase-in-netherlands/

https://www.regione.lazio.it/notizie/Comunita-energetiche-rinnovabili-al-via-oggi-domande-bando https://www.rvo.nl/subsidies-financiering/sce/algemene-voorwaarden

https://www.tno.nl/en/newsroom/insights/2020/11/tackling-energy-poverty-together/

https://www.tno.nl/en/sustainable/system-transition/social-innovation/preventing-energy-poverty/

https://www.usaid.gov/powerafrica

https://www.usaid.gov/powerafrica/kenya

https://yeseurope.org/the-potential-of-energy-communities-in-the-new-sharing-economy/

https://dhomus.smartenergycommunity.enea.it/

https://recon.smartenergycommunity.enea.it/

https://ilsr.org/community-power-map/

https://labgov.city/co-city-protocol/

https://windenergysolutions.nl/blog/the-success-of-a-community-owned-windturbine-in-the-netherlands/

https://www.legislation.gov.uk/ukpga/2011/20/contents/enacted

https://www.tilburg.nl/inwoners/subsidies/regeling-klimaatfonds/

https://www.uva.nl/en/about-the-uva/organisation/faculties/faculty-of-science/contact-and-location/amsterdam-science-park/amsterdam-science-park.html?cb

https://www.veckta.com/2020/10/20/small-wind-turbines-for-microgrids/

https://www.windbase.eu/projects/wind-farm-spinderwind.aspx

https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en

https://www.arera.it/allegati/relaz_ann/21/RA21_volume_2.pdf

https://www.comunirinnovabili.it/manifesto-c-e-r-s/

https://www.comunirinnovabili.it/manifesto-c-e-r-s/

https://www.engageuniversity.eu/2021/06/17/engage-eu-innopreneurial-mindset/

https://www.engageuniversity.eu/2021/11/22/engage-eu-innopreneurship-literacy-concept/

https://www.government.nl/documents/publications/2013/09/06/energy-agreement-for-sustainable-growth

https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2023-02/comunita_energetiche_slide_feb2023.pdf

https://allcharts.info/the-netherlands/neighbourhood-abdij-en-torenbuurt-tilburg/#info_population

https://wijkpaspoort.vng.nl/?admin=BU08553702

https://www.linkedin.com/feed/update/urn:li:activity:7067043954956849152/

https://www.tiwos.nl

https://communitydirectors.com.au/help-sheets/community-batteries-101

https://www.enexisgroep.nl/investor-relations/publicaties-presentaties/#halfjaarberichten-&-jaarverslagen

https://www.theguardian.com/environment/2021/apr/05/community-batteries-what-are-they-and-how-could-they-help-australian-energy-consumers

https://www.deingenieur.nl/artikel/communal-battery-for-solar-power-in-rijsenhout

https://blogs.worldbank.org/energy/neighborhood-battery-system-conserving-energy-and-reducing-emissions-netherlands

https://ecoligo.com/en/blog/solar-as-a-service-provider-launches-first-solar-project-in-nigeria/

https://www.esi-africa.com/business-and-markets/sharing-the-power-with-communities-led-mini-grids-to-increase-nigerian-energy-access/

https://www.linkedin.com/pulse/shared-solar-gardens-possible-nigeria-jonathan-fawumi-kayode/

https://www.nigeriaelectricityhub.com/2018/10/09/renewable-energy-and-sprouting-issues/

Annex

A: Interviews

Speech by Yusuf Çelik, Alderman for Housing, Neighborhoods, and Integration at the Tilburg Municipality, to the ENGAGE.EU students held at Tilburg University on July 11th, 2022. Transcript available at request.

Interview with Giuseppe Chindemi, Ecogena (Acea) CTO, held online on February 8th, 2023.

Interviews with Guido Sgambati, Energy Efficiency Project Engineer at Ecogena (Acea), held online on February 15th, February 24th and March 7th.

Interview with Guido La Rose, sustainable strategist from the Climate Office at the Tilburg Municipality, held via e-mail on March 20th, 2023. Transcript available at request.

Interview with Sheila Foster, Professor of Law and Public Policy at Georgetown University, Chiara Pappalardo, Doctor of Juridical Science at Georgetown University, and Elena de Nictolis, Post-Doctoral Global Fellow at New York University held via e-mail on March 21st and 22nd, 2023. Transcript available at request.

Interview with Aleardo Furlani, Innova CEO, held online on April 3rd, 2023. Transcript available at request.

Speech by Edoardo Zanchini, Director of the Climate Office at Roma Capitale, held on April 14th, 2023, at the House of Emerging Technologies, Rome. Transcript available at request.

Interview with Simone Mori, ENEL Director of Europe, held online on April 17th, 2023. Transcript available at request.

Interview with Simone Benassi, Simone Benassi, Head of energy communities in Italy at Enel X, held online on April 21st, 2023. Transcript available at request.

Interview with Thijs ten Caten, Master student of Law and Technology at Tilburg University and researcher under commission from the Tilburg Municipality held via-email on April 28th, 2023. Transcript available at request.

Interview with Mauro Annunziato, former Smart Energy Director at ENEA, and developer of the energy poverty algorithm for the Anguillara social energy community, held online on May 9th, 2023. Transcript available at request.

Interview with Manoe Ruhe, Project Manager of Urban Development at the Tilburg Municipality, held at the Tilburg Municipality on June 1st, 2023. Transcript available at request.

LUISS Luiss law, digital innovation, sustainability LAB GOV.City acea ENEA ENGAGE·EU TILBURG

Interview with Robert Kint and Maaike Paulissen, Policy Advisors for the Energy Transition at the Tilburg Municipality, held at the Tilburg Municipality on June 1st, 2023. Transcript available at request.

Interview with Tijs van Gisbergen, Policy Advisor for the Energy Transition at the Tilburg Municipality, held online on June 2nd, 2023. Transcript available at request.

B: Social Business Plan

Link to the interactive version: https://luiss-my.sharepoint.com/:x:/g/personal/chiara_scalia_studenti_luiss_it/EbgR0Yk82SBKtQFLJk_rRm8Bquy4HaUJbiJIIxNTcFeRsw?e=5dBRBr

Voce	Unità di misura	Anno 0 (costruzione)	Anno 1	Anno 2	Anno 3	Anno 4	Anno 5	Anno 6	Anno 7	Anno 8	Anno 9
Energia immessa (non autoconsumata dalla CER)	KWh		350.000	348.250	346.509	344.776	343.052	341.337	339.630	337.932	336.243
Energia immessa (autoconsumata dalla CER)	KWh		1.050.000	1.044.750	1.039.526	1.034.329	1.029.157	1.024.011	1.018.891	1.013.797	1.008.728
Energia prodotta dall'impianto e immessa in rete	**KWh**		**1400000**	**1393000**	**1386035**	**1379104,825**	**1372209,301**	**1365348,254**	**1358521,513**	**1351728,906**	**1344970,261**
Remunerazione energia in rete	€		210.000,00 €	208.950,00 €	207.905,25 €	206.865,72 €	205.831,40 €	204.802,24 €	203.778,23 €	202.759,34 €	201.745,54 €
Prezzo del KWh immesso	€/kWh		0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €
Incentivi GSE	**€/MWh**		**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**
Scambio immediato	€/MWh		110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €
Spese di trasmissione	€/MWh		9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €
Componente zonale	€/MWh		4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €
Totale incentivo	**€**		**129.150,00 €**	**128.504,25 €**	**127.861,73 €**	**127.222,42 €**	**126.586,31 €**	**125.953,38 €**	**125.323,61 €**	**124.696,99 €**	**124.073,51 €**
OPEX	**€**		**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**
Manutenzione impianto	€		15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €
Affitto coperture esistenti che non soggette ad attività di bonifica da amianto	€		12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €
Gestione flussi energetici CER	€		12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €
Gestione societaria	€		15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €
Risparmio atteso	**€**		**285.150,00 €**	**283.454,25 €**	**281.766,98 €**	**280.088,14 €**	**278.417,70 €**	**276.755,61 €**	**275.101,84 €**	**273.456,33 €**	**271.819,05 €**
Investimento	€	900.000,00 €									
Flusso di cassa attivo	**€**	**-900.000,00 €**	**285.150,00 €**	**283.454,25 €**	**281.766,98 €**	**280.088,14 €**	**278.417,70 €**	**276.755,61 €**	**275.101,84 €**	**273.456,33 €**	**271.819,05 €**

Anno 10	Anno 11	Anno 12	Anno 13	Anno 14	Anno 15	Anno 16	Anno 17	Anno 18	Anno 19	Anno 20
334.561	332.889	331.224	329.568	327.920	326.281	324.649	323.026	321.411	319.804	318.205
1.003.684	998.666	993.672	988.704	983.760	978.842	973.947	969.078	964.232	959.411	954.614
1338245,41	**1331554,183**	**1324896,412**	**1318271,93**	**1311680,57**	**1305122,167**	**1298596,556**	**1292103,574**	**1285643,056**	**1279214,84**	**1272818,766**
200.736,81 €	199.733,13 €	198.734,46 €	197.740,79 €	196.752,09 €	195.768,33 €	194.789,48 €	193.815,54 €	192.846,46 €	191.882,23 €	190.922,81 €
0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €	0,15 €
123,00 €	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**	**123,00 €**
110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €	110,00 €
9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €	9,00 €
4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €	4,00 €
123.453,14 €	**122.835,87 €**	**122.221,69 €**	**121.610,59 €**	**121.002,53 €**	**120.397,52 €**	**119.795,53 €**	**119.196,55 €**	**118.600,57 €**	**118.007,57 €**	**117.417,53 €**
54.000,00 €	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**	**54.000,00 €**
15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €
12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €
12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €	12.000,00 €
15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €	15.000,00 €
270.189,95 €	**268.569,00 €**	**266.956,16 €**	**265.351,37 €**	**263.754,62 €**	**262.165,84 €**	**260.585,02 €**	**259.012,09 €**	**257.447,03 €**	**255.889,80 €**	**254.340,35 €**
270.189,95 €	**268.569,00 €**	**266.956,16 €**	**265.351,37 €**	**263.754,62 €**	**262.165,84 €**	**260.585,02 €**	**259.012,09 €**	**257.447,03 €**	**255.889,80 €**	**254.340,35 €**

Input	Unità di misura	Valore
Energia condivisa	%	75%
Taglia impianto	KW	1000
Producibilità impianto (annuale)	KWh/KWp	1.400
Perdite di producibilità (annuale)	%	0,50%
Costo impianto (su tetto)	€/KWp	900
Costo manutenzione (annuale)	€/KW	15
Superficie impianto	mq	7000
Affitto coperture esistenti che non soggette ad attività di bonifica da amianto	€	24000
Affitto coperture con contestuale bonifica da amianto	€/mq	40
Prezzo del KWh immesso	€/kWh	0,15
Tasso VAN	%	5%

Voce	Unità di misura	Valore
Investimento	**€**	**900.000,00 €**
Tempo di ritorno	**anni**	**3,295**
Valore attuale netto	**€**	**2.230.008,55 €**

C: Thesis Summary

Introduction

Community-led energy initiatives are becoming an essential tool in the Global North to participate in the energy transition but are still under-explored in many parts of the Global South, particularly in Sub-Saharan Africa. The thesis investigates whether energy communities can be a tool to contrast energy poverty. The author formulates the research question on the basis of the theories of energy democracy, energy justice, the city as a commons and governing energy as a commons. Then she analyzes case studies of community-led energy initiatives in the Global North and in the Global South, the EU renewable energy policy framework and commitment towards energy poverty. Finally, she develops two experimental citizen-based energy projects that aim to be tools to fight energy poverty.

Literature Review

Energy poverty is the inability to realize essential capabilities due to insufficient access to affordable, reliable, and safe energy services. It can be defined as absolute in many parts of the Global South, in cases where energy infrastructure is inconsistent. Instead, it can be defined as relative in the Global North, where access to energy is always granted but it is unaffordable for a part of the population. For this reason, the literature review diversifies and explores investment initiatives by regional development banks in the Global South and policies targeting energy poverty in the Global North.

The Asian Development Bank is testing an Energy Transition Mechanism to accelerate the switch from coal to renewable energy. ADB has mobilized funds to repurpose coal facilities, discovered the potential of ETM as a carbon reduction model, and collaborated with the private sector to foster investment in green infrastructure. The Sustainable Energy Fund for Africa (SEFA) and the African Development Bank (AfDB) are important sources of financing for renewable energy initiatives in SSA. Kenya has developed the Kenya County Climate Change Fund (CCCF) mechanism, which encourages community involvement in the implementation process.

In the Global North, energy poverty is often not clearly defined, but it is shown by the surge of winter deaths and hospitalizations due to lack of energy efficiency and affordability. In the US, low-income households spend three times as much as non-low-income households on their energy bills. In the UK, fuel poverty is defined as a household spending more than 10 percent of its income to achieve a satisfactory heating regime and is driven by concerns about the cost of heating and public health.

The lack of national attention to energy poverty in the Netherlands is concerning due to the mismatch of local and national action and the lack of a national framework for energy poverty. Most energy poverty investments are done at the provincial and municipal level. Italy first defined energy poverty in 2017 as the condition in which access to energy services necessitates an excessive diversion of resources. In 2021, energy poverty ranged from 4.6 percent in Marche to 16.7 percent in Calabria. In response, the government intervened to lower final electricity and gas prices, allocating € 5 billion to reduce household bills. By the end of 2021, € 2.5 million electricity bonuses and € 1.5 million gas bonuses had been granted, with a total accrued expenditure of € 700 million.

Research Hypothesis

The research question explored in the second chapter builds on the theories of energy democracy, energy justice, the city as a commons, and governing energy as a commons. These are all based on the macro-theory of the co-governance of the commons first developed by Elinor Ostrom, which suggests that it is more efficient for users to co-manage the resources rather than having government policies do so. Carayannis' quintuple helix theory suggests that the co-governance of the commons should be implemented through forms of partnerships involving five types of actors (public, private, community, cognitive, and social).

Energy democracy is a concept that involves three approaches to promoting the change of the energy system towards renewable sources. The first is energy democracy as a process of reshaping the energy sector through grassroots initiatives and social movements. At the same time, it is also itself an emerging social movement that supports the transition to renewable energy sources by opposing the fossil fuel industry's agenda and reclaiming and democratically rebuilding existing energy regimes. The second is energy democracy as an outcome of decarbonization, whereby the energy sector becomes more democratic as we transition to a distributed, renewable energy system. The third is energy democracy as a normative goal, which combines technological shifts with political change informed by democratic ideals. This work embodies the energy as a process and the energy democracy as a normative goal perspectives.

Energy justice evaluates where injustices emerge, which affected strata of society are ignored and which processes exist to reveal and reduce such injustices. More than just access to energy services, energy justice is concerned with energy policy, production and systems, consumption, energy activism, the political economy of energy and climate change. It applies justice principles to the energy trilemma: security, equity, and sustainability. The World Energy Trilemma Index ranks the energy performance of 127 countries on the three dimensions and provides recommendations on policy coherence and integrated policy innovation.

Urban commons include neighborhood and community spaces, services, natural resources, streets, and historical and cultural assets. Iaione et al. have applied the co-governance of the commons to urban areas to understand how to make cities collaborative and innovation centers. The Co-City Protocol is an index based on five design principles to rethink the city as a commons. These principles include the enabling state, social and economic pooling, urban experimentalism, technological justice, and the quintuple helix. It is characterized by six stages: cheap talking, mapping, practicing, prototyping, testing, modeling.

Energy communities are an exemplification of the institutional design principles and processes underlying the Co-City Protocol. Through energy communities, energy production becomes a common purpose and good for the members of the considered community. The definition of the model and management forms can result from a process of co-governance.

Giotitsas et al. suggest bridging the divide between social science and engineering by governing energy as a commons. The methodology could provide an umbrella framework for constructing a holistic and sustainable alternative to the current socio-economic configuration.

Building upon the theories of energy democracy, energy justice, the city as a commons, and energy as a commons, the thesis researches whether energy communities can be a tool to contrast energy poverty and aims at addressing the mismatch between a consistent energy poverty policy framework coupled with a small concentration of energy communities, such is the case in Italy; and an inconsistent energy poverty policy framework coupled with a large concentration of energy communities; such is the case in the Netherlands.

In particular, the author analyzes how vulnerable communities can be enabled to participate in the energy transition and co-govern renewable energy sources as commons. Further, the analysis will explore the possibility of creating a framework to foster the development of social energy communities that could be scalable to different geographic and socio-economic contexts.

As seen in the studies by Giotitsas et al., energy as a commons can be envisioned through microgrids. This is a valid solution for several contexts, but it is not the only one and there are better options for others. The research will also delve into suitable context-based infrastructural solutions for energy communities.

Case Studies

This chapter analyzes selected case studies of community-led energy initiatives in the Global North, such as energy communities in Europe and community solar in the United States. It then examines the state of the art in the Global South, including two Latin American countries and Sub-Saharan Africa.

It is estimated that by 2050, 264 million European citizens will join the energy market as prosumers and generate 45 percent of the market's total renewable electricity. Actors in the energy community include natural persons, knowledge institutions, NGOs, public utility companies, businesses, and local authorities. Initiators are those that set in motion the coordination of the community project.

EU law requires energy communities to be regarded on an equal footing with other players in the energy industry. Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs) are central components of the energy transition strategies in Europe. They are legal entities that provide environmental, economic, and social community benefits for their shareholders, members and for the local areas where they operate.

Germany is the first country in the EU for energy community concentration, with a large share of renewable electricity generation by private citizens. Jühnde is Germany's first Bioenergy Village that transitioned from fossil fuels to biomass and established an operational cooperative to manage the energy system.

The Netherlands is a pioneer country in the energy community trend, allowing recognized citizen groups to establish and own local networks and participate in the electricity market. There are many energy cooperatives with plans to develop into an energy community. The Netherlands has enacted a comprehensive policy for the energy transition, and is developing a strong public-private-academic infrastructure for sustainability and innovation R&I. Schoonschip is an example of an energy community with a strong environmental and social drive. The community aims to advance clean energy and sustainable living, increase system dependability, foster local economy, democratize energy system, and increase community well-being. The Schoonschip community developed a private microgrid with a single central grid connection, enabling the creation of a replicable model.

The Italian Constitution outlines the ability of all citizens to participate in the country's political, economic, and social organization. With the transposition of the RED II and IEMD EU directives, the role of communities is being enhanced. The RED II decree, ARERA resolution, and TIAD have established regulatory frameworks for decentralized self-consumption systems. The Municipality of Magliano Alpi has established the Energy City Hall REC, providing a photovoltaic system, smart meters, and a Community Operational Group to create a short supply chain of skills for economic prosperity.

Local communities in the US are enacting bottom-up energy initiatives, similar to the EU policy on just transition. Community Power Map maps renewable energy projects, 100 percent renewable energy pledges, Feed-in Tariffs, Municipal Utilities, and Community Choice Aggregations. Community solar is a third-party market for solar energy, and Green Power Communities are established to enable vulnerable communities to benefit from solar energy. The Brooklyn Microgrid is an example of a community that uses more than 8.2 billion kWh of green power annually. BMG is an energy marketplace for locally-generated solar energy, connecting prosumers and consumer energy assets.

In Latin America, local governments should take the lead in implementing policies to facilitate energy efficiency, management, and uptake of renewable energy sources. They should also foster dialogue among stakeholders, re-direct finance away from high-carbon infrastructure, and increase resilience of energy systems. Creluz is a cooperative that provides free energy to 600 families and plans to expand its activities with ten more SHPs. Community MG in Chile are more profitable than self-consumption due to peak demand fees and higher levels of profitability and self-sufficiency in rural areas.

SSA needs contextualized community energy initiatives supported by tailored schemes, context-specific know-how, and strong leadership. Nigeria has implemented policies that enable the development of bottom-up energy projects. Power Africa is a US Government-led partnership to increase energy access in SSA, supporting utilities in building capacity and engaging local communities in the energy transition. Ambole et al. explored how cross-sector collaborations can support the co-creation of trans-local energy communities in Kenya, Uganda, and South Africa. They suggest having knowledge institution connect local communities with energy companies and investors to help them develop and fund energy projects.

EU Energy Policy Framework

The global energy crisis has caused increased concerns about energy security and the inflationary effects of increasing energy prices. Energy efficiency measures are the best option to handle the issue while also achieving affordability, supply security, and climate goals. The EU has taken consistent actions to measure and contrast energy poverty.

EPAH uses 21 indicators to measure energy poverty, categorizing them as main if they directly show energy poverty and secondary if they help characterize the factors that lead to a vulnerable situation. The EU has a varied percentage of energy-poor households, with the highest concentration in eastern-EU countries. The EU Energy Poverty Advisory Hub (EPAH) and the Covenant of Mayors on Climate and Energy in Europe (CoM) are working to address energy poverty at the local level. The CoM has proposed a framework to assess energy poverty, and the European Commission proposes the Social Climate Fund to finance measures and investments to reduce emissions.

The European Commission adopted the Clean Energy for All Europeans package in 2019 to support the decarbonization of the EU's energy system. Eight laws contribute to the EU's long-term carbon neutrality strategy by 2050. The Renewable Energy Directive (RED) was introduced in 2009 and has been steadily growing, reaching 22% in 2020. The revised Renewable Energy Directive (RED II) entered into force in December 2018, setting a new, legally binding target of at least 32% renewables in the energy mix by 2030. The Commission put forward a proposal for a recast Energy Efficiency Directive (EED) in July 2021, raising the level of ambition of the EU energy efficiency target and making it binding for countries to collectively ensure an additional energy consumption reduction of 9% by 2030.

In Article 8, the recast proposal doubles the annual energy savings obligation (1.5% of final energy consumption from 2024 to 2030). The Clean Energy for All Europeans package includes four pieces of legislation addressing electricity. The Internal Electricity Market Directive (IEMD) and Regulation on the internal market for Electricity (2019/943/EU) have been amended to adjust EU market regulations to new market realities. The IEMD places consumers at the core of the clean energy transition, enabling their active participation and implementing a robust consumer protection framework. The Regulation on risk preparedness in the Electricity sector (2019/941/EU) requires member states to draw up plans for dealing with potential electricity crises and put the appropriate tools in place to prevent, prepare and manage situations. Finally, Regulation 2019/942/EU transforms the Agency for the Cooperation of Energy Regulators

(ACER) from a coordinator, advisor and monitoring figure into an agency for the cooperation of national energy regulators.

Rome Experimental Project

Co-Roma is an open and responsible urban platform. It is a tool that has been tested for almost ten years for what concerns co-governance and the development of the commons. Over the years, it has focused on different aspects. The current focus is on energy communities, a trend that could further implement co-ownership and co-management in vulnerable districts.

Co-Roma will participate in the acceleration process of the House of Emerging Technologies, the Municipality of Rome's innovation hub, and will access funds from the NRRP Urban Integrated Plans. It will also be a central pillar of the project developed by Luiss University for Rome's Expo 2030 candidacy. The ultimate goal is to transfer Co-Roma to a public entity to become an effective tool to serve the local community. At the moment, the main sections of the platform are a collaboration tool, a fundraising tool, an e-commerce tool, a mapping tool, an impact measurement tool, and a matching and closing tool. The development of the future platform is focused on seven sections (coordination and networking, fundraising, local token economy, mapping, matching and closing, impact measurement and governance).

Tilburg Experimental Project

The project seeks to enable all Tilburg city users to participate in the energy transition by establishing a social energy community named Tilburg JET (Just Energy Transition). Everyone will benefit the energy community according to the shares of Energy Bonds they acquire by participating in costs of the renewable energy facility. The process is itinerant, which means that bonds can be sold to other stakeholders throughout the process, and everyone can gain progressively more participation and revenue in the venture. The energy community is co-owned and co-managed by citizens, public, private, knowledge institutions, social and environmental organizations, and local media entities, following the co-governance model of the quintuple helix.

Discussion

The author developed a research question based on the theories of energy democracy, energy justice, the city as a commons, and energy as a commons. The research analyzes whether energy communities can be a tool to contrast energy poverty and aims to address the mismatch between a consistent energy poverty policy framework coupled with a small concentration of energy communities and an inconsistent energy poverty policy framework coupled with a large concentration of energy communities. To do so, the thesis develops two experimental projects: Co-Roma, which aims to increase the concentration of energy communities in Rome and then scale up to other Italian cities, and Tilburg JET, which aims to develop a pilot social energy community to be scalable in other vulnerable contexts. Both projects can contribute to the uptake of social energy communities and help contrast energy poverty in the respective countries. This goal is in line with the targets set by SDG 7 by 2030 to ensure universal access to modern energy services and to increase the share of renewable energy in the global energy mix.

The research has highlighted several other important topics. First, why do energy communities thrive in some places, like the Netherlands, even without a robust regulatory framework, rather than others, such as Italy? A strong cooperative behavior, observed in some Northern EU countries, seems to be a critical enabling factor. If so, what stakeholder engagement strategies could facilitate such behavior in citizens? How are they different in the Global North and the Global South? Capacity-building seems to be another key enabler. In particular, it seems that knowledge institutions should take a prominent role in capacity-building. As demonstrated by the Co-Roma experimental project, knowledge institutions can catalyze local communities around shared values to develop community-led energy initiatives.

Furthermore, national energy poverty indicators are already present in the EU, but organic city-specific indicators are still lacking, hindering the possibility of a bottom-up approach. The Anguillara social energy community has developed an algorithm to assess relative energy poverty within the community and reallocate state incentives to benefit the most vulnerable households. The algorithm could be scalable to other social energy communities in Italy, but in other countries, it would need to be tailored to their sustainable investment strategies. This leads to the last point of discussion, which is that sustainable investment strategies, much like engagement strategies, are context-based and differ greatly between the Global North and the Global South.

Conclusion

Energy poverty is a major concern that is sometimes overlooked or not properly targeted. It is a concept that has a different outlook in the Global North and in the Global South. In the first case, it entails that the energy-poor individual lacks the economic means to access the energy services provided by the national grid system. In the second case, access to energy services through a stable grid system is not always guaranteed, especially in rural areas.

A key finding of this thesis is that citizen-led energy initiatives should be tailored to the community's specific needs. In Rome, energy communities are incentivized to sell energy surplus to the national grid. In the Netherlands, instead, the national grid is currently overloaded, and therefore alternative solutions need to be envisioned to make communities self-sustaining.

The analysis led to the understanding that to create successful energy communities, it is necessary to merge the Italian social approach and the Dutch innovation dynamism. A way to do so is to support local administrations in mapping and supporting projects of social energy communities through a platform like Co-Roma, which could be scalable to other contexts, such as cities in the Netherlands.