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Clean, green and the unseen: The CompeSA framework | Assessing Competing Sustainability Agendas in Carbon Neutrality Policy Pathways

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ABSTRACT

Competing agendas are common within the sustainability field, given its complex and diverse social, economic, and environmental priorities. They can cause less effective policy results, where multiple goals can result in trade-offs and policy compromises. This paper proposes a conceptual framework: CompeSA – Assessing Competing Sustainability Agendas in Carbon Neutrality Policy Pathways. This framework enables the exploration of competing sustainability agendas arising from the simultaneous implementation of climate change, energy transitions, and energy poverty agendas. CompeSA is built on three key steps, 1) The WHAT, aiming to define the scope, 2) The WHERE, to understand the scales at which corresponding policy impacts apply; and 3) the WHO, for deep characterization and analysis of the key stakeholder groups.

We base the development and application of the framework in Portugal, a test case strongly engaged with the carbon neutrality agenda, to illustrate important dilemmas over policy mixes and unpack emerging synergies and barriers. Identified synergies include the linked concepts of economic recovery and employment opportunities, mainly through renewable energy expansion, enhanced economic competitiveness, and skilled job creation. Improvements in air quality and the built environment contribute to health benefits. The most significant barriers are inequitable benefit allocation and power imbalances between the energy-poor and agenda-setting actors. Our demonstration shows CompeSA to be a helpful support tool for structured analysis of competing sustainability agendas and pinpoints key critical points that determine the effectiveness of sustainability policies.

1. Introduction

Following the 2015 Paris Agreement and actions to meet the corresponding climate change targets, global signatories have been challenged to implement a series of policy packages simultaneously. The European Union (EU) positions itself at the "forefront of international efforts to fight climate change" [39], committing to deep decarbonisation targets by 2050 with a net-zero greenhouse gas emissions economy. Critically, decarbonisation requires an energy transition strategy, shifting Member States from fossil fuel to renewable-based economies [35]. Among the EU's key aims is "making the transition just and inclusive for all" [36], yet it is uncertain how energy transitions will impact social justice and equity [103]. Central to this debate is energy poverty (EP), a condition where householders are unable to access a level of energy services adequate for basic daily needs such as space heating and cooling and powering appliances [128].

Political engagement with energy poverty (or fuel poverty) began in the 1990s in the UK and Ireland [63]. In European policy, however, acknowledgement of energy poverty has been

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comparatively recent [117,138]. Mitigating EP is a challenging task, partly because of its multidimensionality (caused and/or exacerbated by numerous factors). These factors were traditionally recognised as a combination of low income, poor energy efficiency, and high energy prices; it is on this basis that Brenda Boardman's first official definition of fuel poverty arose (the 10% indicator) [11]. The debate has since evolved, with numerous sources identifying additional factors contributing to EP. These include long-term illness or disability, unemployment, education, gender, and housing tenure [21,51,124,126]. EP also varies geographically, with different vulnerabilities applying in rural versus urban areas [102,111]. These geographical differences also apply at the European scale, with EP generally reduced in Northern and Central states and higher in Southern and Eastern states [12].

With 6.1% of households in the EU27 having arrears on utility bills and 7.0% unable to keep their homes adequately warm in 2019, the scale of the EP problem is significant [43,47]. The alleviation of EP requires access to an adequate level of energy services, implying the need to increase domestic energy use in cases of underconsumption and/or low ownership rates of climatization equipment [53]. In 2019, the EU residential sector accounted for 26.3 % of final energy consumption; at 63.6% of final energy consumption, heating is the primary energy use in the European domestic sector, most of which (32.1 %) is sourced from natural gas [45]. European policy thus faces a considerable challenge: implementing climate change and energy transition strategies that do not compromise citizens' ability to access the required level of energy services. With the emergence of the war in Ukraine, additional European and national policy institutions alike are under heightened pressure to deliver affordable energy without reneging on international environmental commitments.

Despite some conflicts of interest, many key measures inherent to the success of energy transitions are also essential in mitigating energy poverty, including improved energy efficiency and the increased uptake of renewables. Thus, the energy transition and energy poverty agendas are strongly interlinked and can neither be labelled fully synergistic nor entirely divergent.

To tackle the complex mix of social, environmental, and economic goals inherent to sustainability agendas [72,123] and policy mixes [65], previous authors have applied systematic frameworks. Researchers in the field of ecosystem services have demonstrated the utility of frameworks in optimizing community development in protected areas [140] and in elaborating multiple views, diverse system values, and points of controversy [67]. Frameworks have also been applied to sustainable construction, where environmental and economic aspects have been the focus at the cost of social considerations, impacting building project legitimacy and future funding opportunities [49].

We argue that these tools are highly beneficial in their capacity to evaluate the diverse goals and wide range of stakeholder values in sustainability agendas but tend to be highly context-specific, resulting in numerous siloed sustainability frameworks that are not easily transferable. We aim to address this gap by developing the CompeSA framework, an analytical tool for the evaluation of complex processes which imply simultaneous delivery of several potentially competing goals and collaboration between a wide range of actors. Thus, CompeSA is a tool aimed at high relevance for policy analysis processes and to shape legislative change. The framework was developed following a review of sustainable energy challenges in the contemporary European context, recognizing the need for tools that evaluate multiple (and sometimes competing) policy agendas. Our deliberate focus on process evaluation in the design of CompeSA makes it a highly adaptive tool for similar instances of competing agendas across the field of sustainability.

We apply our framework to the climate change (CC), energy transition (ET), and energy poverty (EP) agendas in Portugal. Portugal was chosen because it juxtaposes impressive progress with the energy transition against a high incidence of EP [86]. Thus, it illustrates that the energy transition is not *prima facie* synonymous with energy poverty alleviation. Our research aim is to assess the interactions of these three policy agendas and, in so doing, to explore key areas of synergy and competition.

We apply this novel conceptual framework to assess competing sustainability agendas by addressing three questions:

i) What topics do the agendas define and address? (Literature review and policy analysis)
ii) Where are these topics managed (nationally, regionally, or locally)? (Policy scale analysis)
iii) Who makes decisions, and who bears their impact across policy topics? (Stakeholder analysis)

This paper is organised as follows: Section 2 reviews the interplay between the distinct yet overlapping policy agendas. A European perspective is complemented by a focused appraisal of Southern European energy policies. Section 3 outlines the Portuguese case study and methodological approach. The Results and Discussion for each step in the CompeSA framework are provided in Section 4, and Section 5 concludes.

2. Climate change, the energy transition and energy poverty in Europe

2.1. Synergies & trade-offs in sustainability agendas

From large hydroelectric dams driving habitat loss and fragmentation [20,78] to bioenergy with carbon capture and storage (BECCS) systems causing an increased risk of desertification [27], many solutions to CC entail trade-offs. In the energy sector, an important trade-off is the solar energy roll-out and competing land uses such as food production [135], a similar trade-off applies between wind energy and biodiversity concerns [133]. Solar panels and electric vehicles rely on the extraction of minerals, which can cause soil contamination and the displacement of indigenous communities [132]. Mineral extraction also requires substantial resources in terms of water and energy input and thus has associated greenhouse gas emissions [23].

Since the 1990s, the EU has aimed to ensure a secure, competitively priced energy supply without compromising environmental targets [92]. This has proved challenging, and while efforts to meet emission reduction targets have advanced decarbonisation [34], EU policy has simultaneously recognised several socio-economic issues entrenched in a traditional fossil-fuel-based energy supply. Specifically, EU policy recognises inherent structural inefficiencies where the energy system is based on a centralised supply-side model rather than energy demand management [38]. There are also numerous barriers within energy markets despite the relatively mature status of liberalisation, including a disproportionate competitive advantage for large and established energy companies [66]. Uncoordinated national policies are further problematic, resulting in "energy islands" where poor connections of energy infrastructure between neighbouring countries or regions push up energy costs for consumers [38].

Notably, while many consumers struggle to reach threshold levels of comfort recommended by health bodies [94], others are defined as being in "fuel obesity" [54]. Lower levels of economic development correlate with a decreased ability to keep the home adequately warm in the EU member states [131]. Furthermore, a recent study highlights that European emissions reductions can be mainly attributed to lower- and middle-income groups [52]. [89]

call specifically on wealthy consumers to reduce "excess consumption". These findings bring the concepts of "fairness" and "equity" into view, emphasising the question of who should and should not be obligated to reduce domestic energy consumption as well as the structural modalities required to implement such normative goals.

The EU has engaged with this range of challenges when launching several policies, including the Clean Energy for All Europeans Package, the European Green Deal, the Renovation Wave, and the Fit for 55 Package. These policies feed into and support one another and present an intricate mix of instruments, including Directives, non-legislative Initiatives, and Regulations. This bundle of strategies could, in this sense, be labelled a policy mix [106]. In other words, as Lehmann (pg. 71), [65] puts it with reference to pollution, "Polluting sources may be affected directly or indirectly by several policies addressing the same pollution problem." Thus, the delivery of synergistic CC, ET, and EP strategies is subject to multiple policy influences. While it could be argued that the simultaneous pursuit of these three agendas is a transcendent goal across these various policy initiatives, these multiple influences can (as elaborated above) result in trade-off situations. Given this, a profound understanding of policy interaction is essential to maximise synergies and mitigate trade-offs [28].

Previous authors have demonstrated the value of frameworks in assessing sustainability challenges, including social sustainability aspects [49], the articulation of stakeholder values with a view to informing decision-making [67], and in the area of policy mixes itself, with [106] applying an analytical framework to assess combinations of various policy instruments in sustainability transitions. Building on these resources, we develop a conceptual framework to evaluate the barriers and synergies across different energy policy-related agendas, which have a proclivity to compete but must be synergistic to meet holistic and long-lasting sustainability targets. We develop a framework that is easily adaptable to other instances of competing sustainability agendas, as existing works tend to be quite context-specific). We also balance qualitative techniques — most appropriate for evaluating the relatively intangible concept of policy interaction — with quantitative techniques, which facilitate a clear and concise overview of stakeholder profiles.

2.2. CC, ET, and EP perspectives in Southern Europe

The latest IPCC report highlights that CC-induced changes have increased the likelihood of Southern European wildfires in the last century [127]. This is compounded by the devasting fires of the summer of 2022. Future projections include increased droughts [127] and heat waves [96]. CC impacts in European cities may be exacerbated due to the "urban heat island" effect [83]. In the immediate future, heat waves in urban areas of the Mediterranean may increase mortality by 21.8% [122].

The above illustrates the urgency of implementing CC mitigation solutions that address the built environment, thermal comfort, and, correspondingly, EP. The specific manifestation of EP varies depending on the national or regional context [73]. Supra-national Southern European regions, however, share several characteristics linked with increased vulnerability to EP. These include poor building quality, high energy prices, low incomes, the under-consumption of energy, and low rates of climatization equipment ownership [7]. Southern European countries experience comparatively short and mild winters, yet both [50,56] demonstrate an elevated rate of Excess Winter Deaths (EWDs) in these regions [50]. more recent analysis shows that Cyprus, Malta, Portugal, and Spain have an EWD rate above the EU average.

A trend of resignation to poor thermal comfort conditions has been observed in Southern European regions, with vulnerable consumers exhibiting limited capacity to improve their circumstances [57]. This is attested in the work of Santamouris et al., [112] who show a correlation between higher average annual incomes and increased total energy consumption for heating in Athens. Omic et al., [84] highlight the severity of EP in Southern European regions and demonstrate that high rates of EP correlate strongly with increased rates of income poverty, food poverty, and poor health. From an ethical perspective, these issues warrant prompt attention and emphases on equity and justice in CC and ET agendas (e.g., the European Green Deal) and correspondingly increase the pressure for political bodies to address these marked regional vulnerabilities [40].

The EU addresses these imbalances in customised ET implementation [35]. Each member state is responsible for implementing its own ET, implying a series of individual transitions guided by a broader orientation established at the European scale. With considerable renewable resource (mainly solar) capacity installation underway and planned, transitions in Southern Europe offer significant opportunities, including economic development and skilled job creation [30,113]. Renewables also provide an alternative path to the traditional link between economic growth and increased CO_2 emissions, which policymakers have long struggled to overcome [85], and green growth scholars have termed decoupling.

In practice, transitions imply a series of synergies and trade-offs for Southern European citizens. For instance, in the ET in Greece, expenditure on technical equipment pushed up electricity end-use costs, diminishing public appetite for the process [81]. In contrast, in Sardinia, the ET offers regional development, welfare, and employment in a low-income Italian region with high unemployment rates [88]. Gaining a situated understanding of the synergies and trade-offs that arise as transitions advance in various contexts is essential to inform national policy and avoid compromising the integrity of European energy transitions while integrating the most vulnerable consumers.

3. Case background and methodology

This section provides a summary of background details for the case study of CC, ET, and EP agendas targeting a southwestern EU Country, Portugal. It includes an overview of methods and then presents the conceptual CompeSA framework applied in Section 4 (Results and Discussion).

We apply the CompeSA framework to explore the simultaneous implementation of the CC, ET, and EP agendas in the Portuguese case. The framework combines three key steps to evaluate The WHAT (literature review and policy analysis), the WHERE (policy scale analysis), and the WHO (stakeholder analysis). These broadly adaptive steps provide policy insights and valuable feedback on the current Portuguese approach to these agendas (informative for policy design and legislation change). These analytical steps were designed to evaluate policy processes and are thus applicable in similar instances of competing sustainability agendas. Our framework extends the desk-based approach previously applied in policy analysis by Tom and Munemo [129] to assess the policy management scale and inform stakeholder analysis. Key materials include national policy documents related to research questions, collaboration based on complementary expertise amongst authors, and web-based research to develop the stakeholder list [130].

3.1. Portugal as a case study

Portugal has engaged strongly with the CC agenda in the release of the 2050 Roadmap for Carbon Neutrality [2] and 2030 National Energy and Climate Plan [1]. In fact, Portugal was one of the first

countries in the world to set a carbon neutrality goal for 2050 [61]. Despite significant economic setbacks resulting from the global Covid-19 pandemic, the country has retained focus on its climate goals and combined efforts for economic recovery with energy transition strategies. Examples include the fast-tracking of permissions for utility-scale solar photovoltaic grid connections and the introduction of financial support for building efficiency measures (IEA, 2021).

Despite these encouraging policies, a closer examination of the Portuguese case reveals a contrast between solid progress in implementing the ET with a somewhat undesirable "lived experience" [77] for many Portuguese families. Ranking fourth in Europe for the share of electricity generated from renewables [48], Portugal has benefited from the ET through both increased employment opportunities [29] and greater energy independence [121]. Portugal's newfound zeal for CC mitigation, adaptation, and ET agendas marks a turnaround after weak engagement with the Kyoto protocol and a view that renewable energy was a burden for taxpayers [18,116]. The timescales of these changes are well illustrated in a snapshot of the Portuguese energy profile over time, where in the year 2000, petrol accounted for 61.4% of total primary energy consumption, coal for 15%, natural gas for 8.1%, renewables for 14.7% and "others" for 0.7%. Comparatively, in 2020 petrol accounted for 40.9% of total primary energy consumption, coal for 2.7%, natural gas for 25%, renewables for 29.9% and "others" for 1.5% [32].

Conversely, low incomes and a highly inefficient building stock contribute to low rates of climatization equipment ownership and a worrying trend of under consumption [53]. In the first half of 2021, gas prices in Portugal were the 3rd highest in Europe [46], and electricity costs were the 8th highest in Europe; however, the proportion of taxes and levies paid on electricity were the 3rd highest in Europe [44]. The juxtaposition of progress with the ET and high energy costs shows a lack of consistency between the strategies for the different agendas and a traditionally greater focus on implementing the ET than mitigating EP, the latter being relatively new on the political agenda.

Historically, vulnerable consumers have been supported through the social tariff, a financial instrument awarded to social benefits recipients or low-income groups [42]. In line with European requirements, Portugal has now begun to address EP, starting with weak references to the topic in its 2050 Roadmap for Carbon Neutrality [2], and offering more detail in its 2030 National Energy and Climate Plan (NECP) 2030, [1]. These are supported by mitigation policies elaborated in the Long-Term Strategy for the Renovation of Buildings [101] and a definitive action plan provided in the draft version of the Long-Term Strategy for Mitigating Energy Poverty [33].

Aside from touching on the EP agenda, highlights of the 2050 roadmap include plans to source 100% of electricity generation from renewable energy sources by 2050 and the closure of the two existing coal plants by the end of 2021. Emissions from the energy system are projected to decrease by 60% by 2030 and 90% by 2050 against a 2005 baseline [2]. Collectively, the 2050 Roadmap and NECP policies present a highly ambitious Portuguese decarbonisation strategy. While policies for tackling EP show strong consistency with instructions from the EU [80], the timelines for complementary policy action are somewhat latent, with the intensification of the decarbonisation of buildings planned between 2030 and 2040. This deadline contrasts uneasily with the severity of the Portuguese EP situation.

Key measures elaborated in the Long-Term Strategy for the Renovation of Buildings include major renovation of the building stock and updating domestic appliances to A+++ models. The Long-Term Strategy for Mitigating Energy Poverty is currently awaiting publication after a public consultation period in 2021 [33]. These are the first policy documents to deal specifically with the issue of EP in Portugal and clearly demonstrate intent to address EP in conjunction with CC and ET policies.

The Portuguese approach focuses on the potential of improved building efficiency to simultaneously alleviate EP and reduce emissions from the building sector, complemented by the acceleration of an increasingly decarbonised electricity grid, the emergence of green hydrogen, and decarbonisation of major sectors such as transport. Our focus here is on building energy efficiency and other aspects related to household energy consumption and, thus EP outcomes. Indeed, emerging scholarship highlights access to and affordability of efficiency measures and the need to increase energy consumption among the vulnerable as potential trade-offs in the Portuguese ET [53]. Scholars also emphasise the potential for economic growth, low-carbon jobs, and strengthened public finances [98,118]. As we explain next, the CompeSA framework applied in this paper analyses these synergies and trade-offs between the different agendas in Portugal.

3.2. The CompeSA conceptual framework

To understand the impacts and interconnections of different policies addressing linked but potentially competing agendas, we developed a conceptual framework that integrates three key steps. Fig. 1 presents the main steps, the questions that the CompeSA framework helps address, and its application to the test case. Step 1 (the literature review and policy analysis) identifies the main topics that affect competing sustainability agendas, where key resources are identified through collaboration within the authors team. Step 2 undertakes a policy scale assessment using a matrix to indicate the scales at which these topics are managed. Step 3 (the stakeholder analysis) complements an iterative approach to stakeholder identification with a quantitative ranking of stakeholder groups to assess the relative interests and influences of these groups. For each of the three steps, the conceptual CompeSA framework suggests different methods, tools, and approaches to implement and their linkages (Fig. 1). We consider the framework to be a policy-relevant tool, useful for analysts, the provision of policy insights, and the shaping of legislation.

These three steps can be broadly applied to evaluate competing sustainability agendas in multiple instances and at various scales. We show the steps that can be used for sustainability agendas on the left side of Fig. 1 and show the CompeSA framework as applied to our selected test case on the right. The three steps are explained, subsequently drawing on Portugal's EP, ET, and CC agendas. To undertake this analysis, we conducted a desk-based study of relevant policies as elaborated below, complemented by significant experience with the Portuguese energy policy context within the author team.

Step 1. The 'what' – Topic and boundary definition

Competing sustainability agendas generally have a broad scope that is difficult to refine [134]. Thus, the process should start by defining boundaries and the main topics of focus for the analysis. Our CompeSA framework refines key topics by combining a literature review and policy analysis. Drawing on the authors' knowledge, we combine key literature on CC and ET strategy with contemporary sources on EP and relevant justice and equity issues. The literature review provides background, context and identifies key policy documents; the second purpose of the policy analysis is to identify monitoring indicators for specific topics presented in the policy documents [14].

In the test case, we focus on topics that intersect the CC, ET, and EP agendas. First, the key topics related to the agendas in the

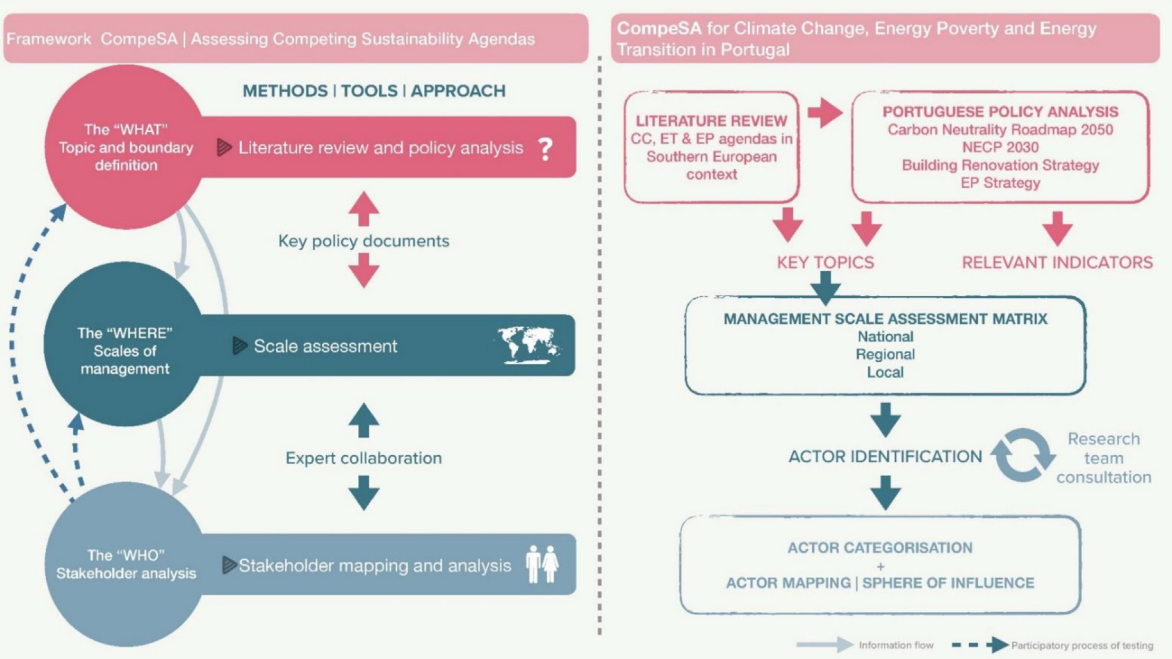

Fig. 1. CompeSA | Assessing Competing Sustainability Agendas Conceptual Framework (graphic created by the authors).

Southern European context are identified through the literature review [8,74]. The relevance of these topics to the case study is then verified through a policy analysis [109] of the following Portuguese documents; NECP [1], National Decarbonisation Roadmap 2050 [2], Long Term Strategy for the Renovation of Buildings [101], and the Public Consultation on the Long-Term Strategy for Mitigating Energy Poverty [33]. This analysis aims to identify the agendas to which each topic is linked from a policy perspective. To conclude this step, we identify monitoring indicators for each topic.

Step 2. The 'where' – Scales of management

After defining the boundaries, an assessment of scale should be conducted to establish if the selected topics in step 1 are managed nationally, regionally, or locally (the management scale). To home in on the policy synergies and barriers between the CC, ET, and EP agendas, only those topics identified across all four policy documents were carried forward to this step. Examples include "Energy efficiency upgrades" and "Just/Citizen-led transition." Each topic and corresponding indicators were searched in the policy documents. These searches were used to classify the management scale of the topics in the test case [87]. The value of this approach is its capacity to foreground gaps in the policy response, for example, by highlighting the lack of a national management strategy for a topic with national implications. This approach also contributes to the actor identification that feeds into the stakeholder analysis below.

Step 3. The 'who' – Stakeholder analysis

The third step aims to identify and analyse key stakeholders that influence and are affected by the identified topics at different scales. Stakeholder analysis has previously been used to characterize the actors in the energy system (e.g. Ref. [9], but is an underused resource in the context of EP. A two-stage process is employed to conduct the stakeholder analysis, firstly:

a) **Mapping identification analysis**- Building of a stakeholder list through literature review, web-based research and policy and management scale analysis processes applied in steps 1 and 2. This list is then developed through collaboration within the research team (as in Refs. [100,137]. Groups for inclusion are those affecting/affected by the EP agenda in the context of the Portuguese energy transition. Stakeholders are categorised according to the type and scale of operations. It should be noted that this is an iterative process which is continually refined throughout the steps described [100].

Mapping process- Use of weighted criteria to rank stakeholders adapted from Refs. [17,64,91]. Categorisation of groups as Core, Direct or Indirect. Stakeholders are ranked according to "traditional pillars" of EP; energy price, energy efficiency and income [11]. An extra point is allocated if a stakeholder influenced another topic(s) linked to EP, as identified in Table 1. Only a single point is added in these cases because there is not yet sufficient evidence to establish the relative weight of these topics; furthermore, comparing the relative importance of each topic is outside the scope of this paper. Stakeholders are then mapped using a Sphere of Influence diagram [22]. Based on these results, a round of interactions with these identified stakeholders should be conducted to test and validate the obtained outcomes regarding the "what" and the "where" steps.

4. Results and Discussion

4.1. The 'what' – links and disassociations between climate change, energy transitions, and energy poverty agendas

The results of the Literature Review and Policy Analysis are presented in Table 2 and allow the identification of the topics that

Table 1
Stakeholder scoring system.

Score 0-3	Stakeholder Type
1 = Influences one pillar or another topic/s	Indirect stakeholder
2 = Influences two pillars or one pillar & topic/s	Direct stakeholder
3 = Influences three pillars or two pillars & topic/s	Core stakeholder

Table 2
Key Topics and Indicators linked to the CC, ET, and EP agendas.

List of Linked Topics	Associated Agendas				Monitoring Indicators as identified in policy documents
	RNC 2050	NECP 2030	Building Renovation Strategy	EP Strategy	
Building Quality, Retrofit & Zero Energy Buildings	CC, ET, EP	CC, ET, EP	CC, ET, EP	CC, ET, EP	- Number and percent of buildings retrofitted - Number of EPCs by class - Number of "deep renovations" - Total number and m^2 classified as NZEBs - Number and m^2 of buildings with facades and green covers - Energy consumption in buildings - GHG emissions from buildings
Energy Efficiency Upgrades	CC, ET, EP	CC, ET, EP	CC, ET, EP	CC, ET, EP	- Number and type of upgrades installed - Government funds directed into energy efficiency measure - Value of taxes directed into energy efficiency measures - Energy consumption in buildings - GHG emissions from buildings
Uptake of Renewables	CC, ET, EP	CC, ET, EP	CC, ET, EP	CC, ET, EP	- Contribution renewables to energy profile (by type and geographic distribution) - Energy consumption in buildings - GHG emissions reductions
Decentralization/Renewable Energy Communities	CC, ET	CC, ET, EP	CC, ET	CC, ET, EP	- Number of citizens participating in energy communities - Local energy production statistics
Health & Well-being (Mental & Physical)	CC, ET	CC, ET, EP	CC, ET, EP	ET, EP	- Costs to health service - Excess Winter and summer deaths
Low Income	–	CC, ET, EP	ET, EP	ET, EP	- Income statistics (earnings, pensions, social support)
Thermal Comfort	CC, ET	CC, ET, EP	CC, ET, EP	CC, ET, EP	- Thermal comfort index - Percentage reduction in the hours of discomfort in the home reported
Energy Expenditures	–	CC, ET, EP	EP	EP	- Energy costs statistics - Arrears on energy bills
Economic Recovery	CC, ET	CC, ET	CC, ET,	CC, ET, EP	- Profitability of renovation measures; current net value, payback period & cost, Investment by annual saving - Job creation
Just/Citizen-Led Transition	CC, ET	CC, ET, EP	ET, EP	CC, ET, EP	- Monitor rates of EP - Creation of citizen support network - Promotion of regional carbon neutrality roadmaps
Employment	ET	CC, ET, EP	ET	ET, EP	- Job creation - GDP - Employment in the construction sector
Vulnerable Consumers	–	CC, ET, EP	ET, EP	CC, ET, EP	-Number of consumers categorised as vulnerable
Under Consumption & Climatization Equipment Ownership	–	–	ET, EP	–	- Programme for the substitution of inefficient equipment - Energy consumption for heating and cooling - Buildings Energy Performance Gap (summer and winter)
Energy Independence	CC, ET	CC, ET	ET	EP	- Contribution of endogenous sources to primary energy consumption - Contribution of endogenous sources to final energy consumption - Financial savings on fossil fuel imports

bridge social, environmental, and economic sectors, providing a valuable testbed for analysing competing sustainability agendas through the framework [14]. The review revealed that Portugal shares common Southern European causes and impacts of EP, such as low incomes and poor thermal comfort, yet differs from its Southern European neighbours in its comparatively good performance in implementing the ET [60,61]. Currently, Portugal ranks higher than Spain, Italy, Greece, Cyprus, and Malta in both the overall share of final energy from renewables and the share of electricity produced from renewables [48].

The topics which were consistently linked to all three agendas across the policy documents were "Building retrofit & Zero Energy Buildings," "Energy efficiency upgrades", and "Uptake of renewables". These three topics were consistently at the centre of the Portuguese strategy to realize the ET and to mitigate EP. "Decentralization/Renewable energy communities" and "Just/Citizen-led transition" were also topics that were strongly linked with ET and EP, they were also interlinked with one another, where decentralization was considered synonymous with citizen participation in the ET [1].

"Underconsumption & climatization equipment ownership" was only explicitly referred to in the Long-Term Strategy for the Renovation of Buildings [101] regarding the potential of Nearly Zero Energy Buildings to facilitate energy consumption increases. Both the Long-Term Strategy for the Renovation of Buildings and the draft version of the EP strategy promote methods such as insulation which increase thermal comfort without increasing energy consumption [33]. Despite the raising of valid concerns in the Long-Term Strategy for the Renovation of Buildings regarding the "rebound effect" [2], evidence suggests that to bridge the existing buildings energy performance gap and for "under-consumers" to meet recommended temperature thresholds, an 11-fold increase in energy consumption for space heating and a 24-fold increase in consumption for space cooling would be necessary. Based on the current technology portfolio, these increases could represent an extra 8.8 Mt CO_2 for space heating and 1.7 Mt CO_2 for space cooling [53]. This limited accounting for underconsumption, and equipment ownership is reflective of a broader general focus on technology in transitions and a comparatively reduced understanding of the groups who must undergo the transition [119].

Arguably "climatization equipment ownership" is partially addressed by energy efficiency upgrades and building retrofit targets, for example, in the installation of equipment such as heat pumps [2]. Energy efficiency upgrades imply costs that will vary

depending on the quality of the building and the requirements of the inhabitants [76]. Generally, it is likely that the more vulnerable a person is, the more significant their energy requirements are [103]. Less affluent groups are more likely to live in degraded buildings and have a higher exposure to environmental risks [141]. Portuguese policy partially addresses these issues through financial support schemes towards energy efficiency upgrades. Existing and previous schemes require residents to pay for the upgrades upfront and to claim back the costs retrospectively [19]. These initiatives link clearly with CC and ET objectives and directly tackle energy efficiency targets, but they are unlikely to be accessible to those in energy poverty. More recently, the EP Strategy set the background to address this problem by offering vouchers established in the "Vale Eficiência" program, a potentially positive step towards mitigating EP [33].

The timelines involved in the implementation of building retrofit and energy efficiency upgrades are somewhat fluid at present [33]. Still, the dimension of the problem is significantly greater than the currently available and foreseen funding [93]. Given that the Portuguese response to EP is still developmental, this is to be expected to some degree. Going forward, however, it is critical to set clear objectives against measurable timelines. The complex nature of EP means that it can have a dynamic nature, with households moving in and out of the condition as circumstances change [104], making effective targeting of the energy-poor very difficult for policymakers. This has been evident in the UK, where despite early engagement with EP, the condition persists until the present day [79]. Nonetheless, the setting of timelines in the UK has allowed EP to be monitored comprehensively, which is helpful information for keeping the issue at the forefront of the political agenda [125,139]. Drawing on examples such as the UK (where the issue of EP is more established) could be a valuable lesson-learning opportunity in the Portuguese case, providing insights into good practices and avoiding the repetition of mistakes [70,128].

The identified indicators in the policy documents [1,2,33]; ranged from objective indicators such as greenhouse gases (GHG) emissions and energy savings, area (m_2) of buildings retrofitted to subjective indicators such as reducing reported hours spent in thermal discomfort. The diversity of indicators reflects the multi-dimensional nature of EP itself [75] and demonstrates a clear effort by Portuguese policymakers to track the impact of the measures employed in the CC, ET, and EP agendas. Despite this, the capacity of some indicators to accurately capture policy impacts in terms of EP varies [115]. For example, while energy costs data is highly relevant, the use of energy bill arrear data can be misrepresentative as in many cases, adaptive coping strategies and underconsumption can "hide" energy poverty or the extensive use of biomass in fireplaces in the country which is not unfolded in energy bills, Palma et al., [94] suggest that the "heating and cooling gap" may be larger than anticipated in Portugal due to hidden energy poverty. Similarly, although tracking the number of citizens participating in energy communities and the contribution of endogenous sources to the energy profile is informative for the CC and ET agendas, these indicators do not directly measure increases or decreases in EP.

4.2. The where – comprehensive CC and ET strategies versus fragmented economic and employment policies

Table 3 presents the results of the scale assessment, where it should be noted that there is no "right" or "wrong" number or scale of management strategies, as the advisable management strategy will vary between topics. The Table shows that "Building retrofit & Zero Energy Buildings", "Energy efficiency upgrades", "Uptake of renewables", and "Just/Citizen-led transition" had strategies identifiable at all three scales. "Health & well-being" also had strategies at each scale. National and Regional but not Local strategies were identifiable for "Employment" with only National strategies found for "Economic recovery". Evaluating the management scale through the assessment matrix gave deeper insights into the various barriers and synergies within the CC, ET, and EP agendas.

The potential of the ET to reduce undesirable health impacts of both CC and/or EP is a clear policy synergy in the Portuguese case [1,2]. Improved well-being is another desired synergy; however, mental health is underrepresented across the documents. Higher hospital admittance rates for mental health conditions have been shown to correlate with the warmer temperatures experienced during the summer months in Lisbon and other urban zones in Portugal [3,4,68].

The lack of local management strategies for "Employment" and "Economic recovery" is a potential barrier. Long-term youth unemployment and the emigration of qualified workers are significant challenges faced by Portuguese policy makers [90]. The ET is, therefore, an attractive opportunity to improve working conditions and the economy. The impacts of fossil fuel phase-out on employment are acknowledged in the 2050 Carbon Neutrality Roadmap [2], but the argument put forward in the policy document is that job creation in the renewables sector will outweigh any losses at national scale. However Alvarenga et al., [6], highlight inconsistencies in the distribution of these jobs, arguing that new jobs will target younger generations and be concentrated in urban centres, reducing benefits for older and rural communities. At NUTS II level, the Lisbon Metropolitan Area and the North (primarily the Metropolitan Area of Porto) account for 66.2% of Portuguese purchasing power [59]. Purchasing power is reduced in interior sub-regions, particularly in inland areas of the North and Centre regions [59], which require increased attention regarding the impacts of the ET and EP mitigation.

Gouveia et al., and Palma et al.,[53,94] raise concerns about future CC induced temperature increases driving up energy requirements and increasing vulnerability in these regions. This ties into broader concerns about energy vulnerability in European energy transitions and the distribution of benefits across different groups and regions [99]. The inequalities between Portuguese regions coincide with higher average maximum air temperatures in the inland areas during the hottest month of the year. For example, in 2020, the average maximum temperature was 32.3 °C in the capital Lisbon, 30.3 °C in the popular coastal tourist destination Faro and 36.7 °C in the inland predominantly agricultural Beja region [97].

The matrix also highlighted dynamic elements of the agendas, including balancing citizen participation, decentralization, and centralized energy production strategies. Substituting fossil fuels with renewables in a centralized system sustains the traditional relationship between energy suppliers and consumers; alternatively, decentralization involves consumers becoming producers [5]. Both approaches are key in the decarbonisation strategy, yet the extent to which they will play off or feed into one another is unclear. Increasing contributions from the decentralized supply may not be negative from an end-user perspective, as in the Portuguese case, centralized energy production is linked with reduced energy justice [82]. These two elements of Portuguese policy appear at odds, highlighting that increased citizen participation is not universally beneficial for all players in the ET. Lindberg et al. (2021) highlight a split of preferences between centralization and decentralization between actors in the European electricity policy mix, suggesting that this finding is not unique to the Portuguese policy case. Decentralization may, however, present additional challenges in Portugal as the country does not have a history of implementing community-level projects as other central EU countries do.

The Management Scale review revealed multi-scalar policies for

Table 3
Management scale assessment.

List of linked topics	Management Scale		
	National	Regional	Local
Building Retrofit & Zero Energy Buildings	X	X	X
Energy Efficiency Upgrades	X	X	X
Uptake of Renewables	X	X	X
Decentralization & Renewable Energy Communities	X		X
Health & Well-being (Mental & Physical)	X	X	X
Thermal Comfort	X	X	X
Economic Recovery	X		
Just/Citizen-led Transition	X	X	X
Employment	X	X	
Energy Independence	X		X

several key topics linked to the CC, ET, and EP agendas. While this demonstrated a comprehensive approach to these topics, gaps were identified in important areas such as "Employment" and "Economic recovery". Our findings show that taking a "top-down" approach to the CC, ET, and EP agendas, initially guided by instruction from the EU and then translated into national policy, does not result in uniform distribution of the intended benefits. This is substantiated by a municipal-level review of CC policies in Portugal, which showed that CC was rarely a priority in local agenda-setting [16]. Finally, open questions remain regarding balancing the interests of the various energy system stakeholders.

4.3. The who — balancing power and responsibility

This section presents the stakeholder identification analysis and mapping results. In total, 102 stakeholders were identified. The breakdown of stakeholders by scale and type is shown in Fig. 2. The majority of these stakeholders (55) were *Businesses*; these comprised a mix of energy companies, suppliers, and installers of energy efficiency equipment, smart home equipment, or micro renewables. *NGOs and associations* was the next largest group (19), followed closely by *Government* (17). The smallest groups were *Research Centre or University* and *Cooperatives*. The low representation of these two groups potentially reflects their limited capacity to influence the traditional pillars of energy poverty.

It should be noted that although not identified as a stakeholder group, Chinese investors have invested significantly in the Portuguese ET. During 2000–2014, China's cumulative investment in Portugal totalled €5.138 billion; the motivation for this investment is thought to be principally economic [95]. The strategy of owning more than 10% of organisational voting rights and thus securing significant management influence within the company is common practice among Chinese investors in Southern European ETs [95]. This investment has clear benefits from an economic perspective, providing much-needed funds to progress the ET in the region. However, international investment of this kind tends to favour a centralized approach to the ET, which, as previously highlighted, is not beneficial for all stakeholders.

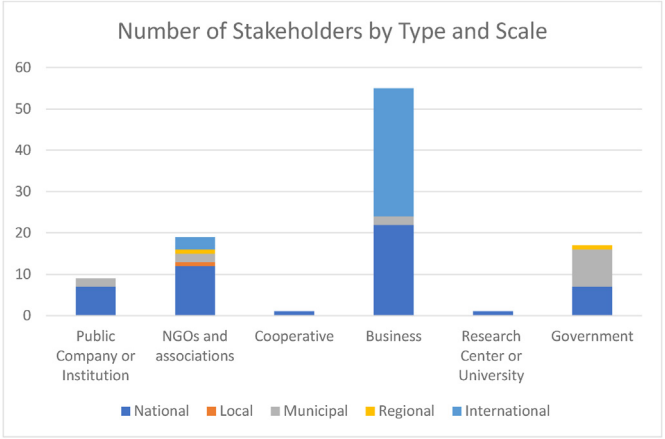

Fig. 2. Number of stakeholders by type and scale.

A significant proportion of the *Business* stakeholders were those involved in retrofit activities. A review of the websites of these groups revealed common engagement with the CC and ET agendas. Still, it did not reveal any engagement with EP or, indeed, with the concept of vulnerable consumers. This suggests that mitigating energy poverty is simply not the *Raison d'être* for these organisations. Yet, in the retrofit activities inherent to the ET, these companies will significantly interact with the energy poor.

The degree of vulnerability within energy-poor households is highly variable [77], but in cases of chronic illness or disability, interactions with consumers will generally require sensitive handling and be more time-consuming than usual. These requirements run contrary to traditional time/cost-effective business models. Indeed, research from the UK has shown that installers of energy efficiency measures tend to target the "able to pay" and question the allocation of responsibility for EP (to some extent a social welfare issue) to corporate organisations with a predominately market-based focus [107]. Thus, employment creation in the retrofit sector is synergistic with climate goals and seemingly with EP mitigation through improved energy efficiency. However, a lack of preparation in the sector for dealing with EP households creates a policy barrier. Bad relations with retrofit companies are known to affect consumer trust and can discourage rather than encourage participation in retrofit schemes, which in turn impacts the facilitation of energy transitions [31].

4.3.1. Stakeholder mapping- the impacts of power imbalances

Fig. 3 presents the results of the stakeholder mapping using the sphere of influence [22]. In the context of the CompeSA framework, the stakeholder analysis is designed as a jumping-off point for identifying actors and for gaining insight into the relative influence of these groups.

Of the 102 stakeholder groups, 27.5% were *Indirect stakeholders*, 36.3% were *Direct stakeholders*, and 36.3% were *Core stakeholders*. *Businesses* made up 78.4% of the Core group, most of these businesses operated at an international or national scale. This finding substantiates the previous gap in local employment and economic opportunities discussed in section 4.2. A further split can be drawn within the *Business* group itself, where 67.2% of this category was involved in the domestic energy efficiency/retrofit chain. This essentially presents a privatized model of these activities, which

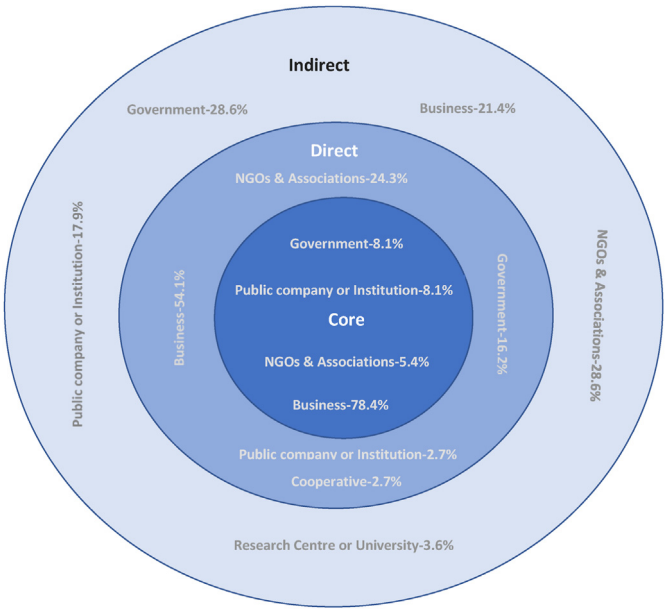

Fig. 3. Stakeholder sphere of influence.

links to concerns that efficiency policies can benefit private economic interests rather than households [55]. Furthermore, energy companies are responsible for social energy tariff payments in Portugal, demonstrating their strong involvement with vulnerable consumers at multiple levels.

The proportion of *Government stakeholders* grew as influence diminished, at 8.1% of the Core stakeholders, 16.2% of the *Direct stakeholders,* and 28.6% of the *Indirect stakeholders*. Local municipalities have been identified as key players in mitigating EP by the Covenant of Mayors [26] and, more recently at the national level, by the proposed Portuguese EP strategy [33]. This reduced level of Government influence in the *Core stakeholder* group is thus a factor of concern.

Overall, the stakeholder analysis revealed a skewing of power towards either National or International businesses and a reduced influence of other groups who also had a direct role in mitigating EP, such as *Government* and *Public Institutions.* Despite the active role in disseminating information about EP, participating in international projects, and bringing the issue to the attention of policy makers [13,24,25,71], *Cooperatives and Universities* presented a reduced influence. This suggests a trend of reduced power among stakeholders with a strong level of interest in EP and a trend of increased power among stakeholders with interests in the CC and ET agendas but not obviously in the EP agenda. This power imbalance is concerning, given that those with the necessary skill and desire to mitigate EP have limited influence. Further research into the specific interests of smaller groups may expose common goals and opportunities for collaboration which in turn would increase their influence.

4.4. The unseen

Our review of the CC, ET, and EP agendas framed within the Southern European context and specifically referring to the Portuguese case reveals mixed engagement with these agendas despite a strong impetus from the European Union to engage with all three. Our analysis of the interdependency of these agendas in Portugal revealed several *unseen* elements, compromising the ability of energy transitions to meet climate and social equity targets. Expressly, these were limited accounting for the costs of energy efficiency upgrades, economic and employment strategies that do not comprehensively address local and regional inequalities, and an imbalance in the stakeholder power dynamics in the Portuguese EP agenda.

The Mediterranean region faces unique threats due to CC; thus, we argue that strong engagement with the ET and EP agendas would contribute significantly to mitigating economic and social inequalities and enhancing regional advantages through renewable resource potential. Portugal has shown regional leadership in the CC and ET agendas, mainly in the pursuit of a more resilient economy. High rates of EP are prevalent across the Southern European region, and while Portugal faces several challenges in the mitigation of EP, the highly interlinked nature of the ET and EP agendas suggest that those countries lagging with the ET agenda risk intensifying EP and its adverse effects. Southern Europe presents a range of opportunities in a region that has long suffered more from lower incomes and reduced employment opportunities than their European neighbours [120]. These vulnerabilities have been further exposed by the COVID19 crises, particularly in zones with tourist-based economies [58].

In the Portuguese case, carbon neutrality is seen as “the only way for Portugal to leverage its gains and position itself in a highly competitive international economic environment” [2]; (pg.98). To this end, Portugal has made good progress in the ET, consistently outperforming its Southern European counterparts [48]. These achievements are not only economically desirable but contribute to health and well-being improvements through the broader benefits of mitigating climate change such as reducing air pollution and improving ecosystem function [62,92]. In this sense, the CC and ET agendas can be considered broadly aligned and present several policy synergies, including benefits for health and well-being, economic recovery, and employment opportunities. Furthermore rapid, and effective climate action is increasingly a matter of public will, as demonstrated by the youth-led climate strikes [136].

This strong appetite for climate action encourages citizen participation, the principal measure by which European and Portuguese ET policies seek to address inequality. Citizen participation promises improved energy efficiency and lower energy bills [37,41]. In fact, citizen participation is not only a means of improving conditions for consumers but is essential for decentralization and energy efficiency policies. Successful citizen participation is dependent on making the benefits of ETs clear [81]. This is important in Portugal, where 76.4% of the population believe climate change is occurring, but 68.3% are concerned about energy price increases [69]. Notwithstanding these risks, the role of citizen participation demonstrates that public acceptance is highly influential despite a stakeholder group consisting mainly of international corporations.

In recent years and months, EP in Portugal has evolved from a barely recognised phenomenon at the political level to being strongly embedded in the Portuguese ET strategy. Nonetheless, numerous unaccounted for vulnerabilities remain, including gaps in opportunities for local and regional economic development and local employment opportunities. With limited leeway for domestic energy consumption increases, the issue of under consumption was not well accounted for in Portuguese policy. The balance of increasing the contribution of both centralized and decentralized renewables was also not well defined. Finally, the domination of the stakeholder group by larger national or international companies was also a barrier as these groups have strong interests in installing energy efficiency equipment and carrying out retrofit works but not in the mitigation of EP.

These policy gaps raise questions about who pays and who benefits, which are themselves linked to concepts of justice and

equity. The aforementioned power imbalances suggest that vulnerable groups will continue to be marginalised due to reduced access to the benefits of the ET. This has implications not only from a moral and ethical standpoint but also for the ET's success. One possible method for mitigating this effect is cooperation between public and private entities, as evidence has shown that when these groups share risks and benefits, carbon neutrality policies are more likely to be successful [15]. Furthermore, a deeper understanding and reflection of the synergies and barriers in ET policies would serve to redress power imbalances, promoting a more equitable and just transition.

We argue that our findings have a broader relevance than the Portuguese case alone and provide useful insights for the implementation of ETs in the Southern European zone. This is substantiated by the fact that similar challenges faced in energy efficiency and carbon neutrality endeavours in Mediterranean countries are already leading to cross border collaboration on these issues [110].

Ultimately, the function of the conceptual framework is to structure processes and data collection; the results presented herein will be tested through collaborative mixed-method approaches, combining workshops and qualitative interviews to verify and refine the central findings [10,108]. This is particularly relevant in the case of the stakeholder analysis [137] to deepen the understanding of how to support the design of more inclusive and just policies [114].

The collaborative process to be conducted engaging the “who” will provide insights on perceptions regarding the “where” and the “what”, allowing the alignment of the literature and policy findings with the stakeholders' mental models to be assessed. This is expected to increase understanding regarding the policies and agendas for the stakeholders, and on the other hand, to identify leverage points for action in the system to foster policy alignment, work on power relations and find synergies.

We acknowledge the following limitations, firstly, the framework is a desk-based approach that is advantageous in terms of both time and resources but cannot substitute first-hand knowledge gained through collaborative processes (as identified above). We, therefore, argue that the framework’s ideal application is the early stages of a research project as an aid to scope definition. Secondly, the methods applied are mostly qualitative, with the second step of the stakeholder analysis involving an empirical analysis. We took this approach precisely because we are interested in the less tangible elements of these competing agendas, such as the links between the three agendas and the scales at which policies apply. Clearly, however, the framework would not be suitable for users seeking to conduct analysis of an entirely quantitative nature.

Finally, it should be noted that while as thorough an analysis as possible was conducted of the key policy documents, at the time of writing, the Portuguese EP Strategy is under revision following a period of public consultation. The findings of this paper are thus based on the provisional version of this document.

5. Conclusions

This paper proposes and applies a conceptual framework adaptable for assessing a wide range of competing sustainability agendas. In so doing, we aim to provide a functional tool that can be applied in cases of competing sustainability agendas to help orientate the research scope, which is often extensive in the sustainability field. We applied the tool in the context of the CC, ET and EP agendas in the Portuguese context to explore policy synergies and barriers specific to the test case. We also employed the knowledge gained in the literature review to draw inferences on the general applicability of these synergies and obstacles in the Southern European context.

Overall, we found the CompeSA framework an effective method to explore the agendas in more depth. Such an approach can be adapted to competing sustainability agendas outside the energy field and to other locations. This is attested to by the fact that the CompeSA framework steps were designed to assess competing policy agendas and, in this case, have also been applied to the broader CC agenda as well as the ET and EP agendas. Furthermore, many of the methods applied in the steps were adapted from other fields of sustainability, including water resource management [105,129] and wildlife conservation [130].

As discussed, sustainability agendas often comprise a diverse mix of overlapping and divergent social, economic, and environmental criteria [123]. These criteria are often extensive, making it challenging to identify and retain focus on the central research topics. The CompeSA framework has proved to help narrow down the central topics, management strategies, and key stakeholders in the policy agendas selected herein. Applying the three steps of the CompeSA framework enables a more profound exploration of policy synergies and barriers. This examination, in turn, revealed missing links between the different agendas and how more cohesive management strategies can contribute to a more equitable energy transition and the common and divergent interests of the key stakeholder groups. These findings are ultimately useful for policy development and directing legislative change; they may also be informative for key stakeholders who wish to resolve competing interests. In this sense, we believe the CompeSA framework presents a method with low resource intensity to define and orientate the initial phases of policy design focused on competing sustainability agendas.

CRediT authorship contribution statement

Katherine Mahoney: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **João Pedro Gouveia:** Conceptualization, Methodology, Resources, Writing – review & editing. **Rita Lopes:** Conceptualization, Methodology, Visualization, Writing – review & editing. **Siddharth Sareen:** Conceptualization, Methodology, Writing – review & editing.

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