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Can the Green Economy deliver it all? Experiences of renewable energy policies with socio-economic objectives

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HIGHLIGHTS

- Open question if renewables achieve both environmental and socioeconomic objectives.
- Two policies each assessed looking at energy access and employment respectively.
- Important role of governments and need for monitoring capacity is confirmed.
- Short-term socioeconomic benefits realized in two cases, but they may not sustain.
- Cases underline need for methodologies to better assess multiple-objective policies.

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ABSTRACT

The Green Economy (GE) paradigm aims to reconcile environmental and socio-economic objectives. Policies to deploy renewable energy (RE) are widely perceived as a way to tap the potential synergies of these objectives. It is, however, still largely unclear whether the potential of simultaneously achieving both environmental and socio-economic objectives can be fully realized, and whether and how multiple objectives influence policy design, implementation, and evaluation. We aim to contribute to this aspect of GE research by looking at selected country experiences of renewable energy deployment with respect to the socio-economic goals of job creation or energy access. Across the cases examined, we find the following implications of relevance for the GE framework: First, we confirm the important role of governmental action for GE, with the specific need to state objectives clearly and build monitoring capacity. Second, consistent with the "strong" green growth variant of GE, some of the cases suggest that while renewable deployment may indeed lead to short-term socio-economic benefits, these benefits may not last. Third, we underline the urgent need for new methodologies to analyze and better understand multiple-objective policies, which are at the heart of the GE paradigm.

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1. Introduction

One of the main premises of the "Green Economy" (GE) concept is that low-carbon energy technologies have considerable potential to achieve socio-economic objectives alongside environmental ones. In essence, the GE paradigm promises a new holistic model of societal well-being. This is evident from UNEP's definition of the concept: A green economy "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" [1]. However, GE is a relatively vague concept that builds on a number of implicit assumptions, which have been scrutinized in scientific literature. In this regard, Bowen and Hepburn [2], largely based on Jacobs [3], identify two forms of green growth (GG), which can be seen as more specific versions of a GE. "Standard" green growth concepts postulate that green (i.e. environmental) policies will reduce economic growth in the short run, but increase it in the long run. In contrast, "strong" green growth asserts that green policies can also increase economic growth in the short run. Bowen and Hepburn [2] further claim that from a theoretical point of view, strong green growth may only hold under one of the following conditions: (a) if, during an economic downturn, green policies provide an important stimulus for economic recovery ("green Keynesianism"); (b) if green

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policies explicitly address existing market failures, for example an inadequate provision of infrastructure; or (c) if green policies incentivize entrepreneurs to establish competitive advantage in green technologies and services through associated innovation.

Apart from its dependence on specific assumptions, the concept of GG is also questioned on fundamental grounds. First, critics of the so called "growth imperative" like Daly [4] question whether growth – green or otherwise – can actually increase wealth, or at least increase it faster than illth. Jakob and Edenhofer [5] question whether growth in general, as well as de-growth as an alternative, are useful approaches at all. They reason that growth as an approach fails to explicitly identify the objectives that should ultimately be achieved *via* economic growth. In other words, they see growth as a means, rather than as an end, to achieve societal welfare. One implication of this stance for the GG and GE concepts is the necessity to specify policy objectives, so as to evaluate the performance of green policies in achieving them. The most important reference here is certainly the Sustainable Development Goals (SDGs), not least because it has been explicitly argued that a GE is essential for sustainable economic development [6]. We therefore depart from a focus on growth as a metric to assess the relevance of the GE concept in policy-making and look at the interlinkages between renewable energy policies and jobs as well as energy access.

The above GE literature raises several important questions that motivate this paper and are addressed in four exploratory case studies. First, to what extent do green policies explicitly target socio-economic objectives or are even driven by these objectives? For instance, empirical evidence suggests that RE deployments, particularly in developing countries, are often implemented as socio-economic policies; see for example Recalde [7] on Latin America and Steinbacher [8] on Morocco. This is important because formulated or intended objectives obviously determine how policies are designed and evaluated, and are also likely to affect how they perform in achieving multiple objectives. In fact, this issue of multi-objective policies is as yet largely unexplored in the literature. A second relevant aspect with a view to the "strong" green growth concept outlined above is to explore whether green policies are able to bring about socio-economic benefits in the short to mid term – and not only in the long term. Against this background, we aim to look at several countries' experiences along these two lines of inquiry – the role of multiple objectives in policy design and stated short-term benefits in terms of outcomes – and reflect upon their implications for GE and GE research. We aim to add value to the GE debate by covering heterogeneous cases – South Africa, Germany, Morocco, and Kenya – and derive lessons learned from these countries. Our aim is exploratory in nature and we do not strive to judge or evaluate policy effects in particular cases.

Specifically, we focus on policies for the deployment of renewable energy and two socio-economic objectives identified by SDG 7 and 8, namely the provision of energy access and job creation. According to UNEP [1], low-carbon technologies – particularly renewable energies in the electricity sector (RE) – bear considerable potential for making progress toward these and other objectives, such as public health and energy security. The IEA [9] emphasizes the role of RE in achieving universal access to modern energy sources by 2030, while IRENA [10] underlines their potential for job creation. The socio-economic dimension of RE is also acknowledged in climate change science and global policy debates. In particular, the recent IPCC [11] finds that measures to deploy RE are often associated with other societal goals – and a positive interaction is believed to create the possibility of "co-benefits."

Existing research on analyzing the potential of job creation or energy access through RE policies are largely model-based *ex-ante* assessments. A number of existing studies cover the potential of job creation through clean energy policies, both in developing and in developed countries; see for example Dai et al. [12], Bowen and Kuralbayeva [13] and the studies cited in IPCC [14], OECD [15], and GIZ [16]. Most of these studies focus on gross employment and suggest that an expansion of RE has positive effects. A smaller number of studies, using more sophisticated models, analyze net employment impacts, and the results of these also suggest that effects are positive. A notable exception, contrasting policy targets with outcomes, is Rathmann et al. [17], who look at the Brazilian biodiesel program and find that the "promised land" has not been reached. From a theoretical point of view, Fankhauser et al. [18] point out that gross employment can indeed be positive for two reasons: First, sectors immediately related to RE production are likely to expand. Second, these sectors are, in general, more labor intensive than traditional industries. The authors, however, also underline that direct employment gains are likely to diminish when technologies become mature. Long-term employment can, however, be sustained when RE expansion is successful as a green industrial policy, i.e. in building up an industry that is globally competitive [19].

Concerning energy access, several studies point to the large potential of decentralized RE for electrification, especially in rural areas [14,20]. However, initiatives for distributed renewable energy face a distinctive set of technical, policy, financial, institutional, and regulatory challenges [21,22]. Several studies have identified the main barriers to the deployment and uptake of small-scale renewables; see for example Chaurey and Kandpal [23], Sovacool et al. [24], IOB [25] and Urpelainen [26] specifically for solar home systems (SHS). For these reasons it is widely assumed that grid connection is generally preferred as an option where it is feasible [27]. Intermittency and capacity constraints of RE systems can also limit the extent to which they can satisfy commercial and productive needs, or increasing demands associated with growing appliance use. Even in areas where renewables-based options are competitive, they may still be unaffordable for poor rural households. Innovative business models or financing may be needed to make these affordable. While off-grid renewables are becoming increasingly competitive with grid-based systems, particularly in remote rural regions, the fraction of population whose demand will be met through such systems remains open to debate [28,29], and evidence on impacts is still insufficient [30–32].

In summary, there are gaps in the literature regarding the realization of the seemingly high potential and respective expectations of RE's contribution to socio-economic objectives. Studies in this direction are so far relatively sparse in the literature; this is particularly the case for large-scale RE deployment policies that are still a relatively new development.

The remainder of this paper is structured as follows: Section 2 describes the methodology used. Section 3 covers the case studies on RE policies and job creation in Germany and South Africa, while Section 4 covers the Moroccan and Kenyan case studies on the deployment of renewables for energy access. Section 5 discusses the key findings from the case studies for the GE paradigm and Section 6 concludes.

2. Methodology

Given the lack of empirical studies that specifically look at the links between renewable energy policies and socio-economic objectives, our aim in this paper is to cover a diverse range of cases in an exploratory manner and thereby help prepare the ground for more in-depth studies. In other words, our overarching aim is to grasp and present country experiences with the design and implementation of policies at the intersection of renewable energy promotion and socio-economic objectives. By doing so, we also strive to identify common patterns across these diverse cases and to link them back to the theoretical green economy debate. Importantly, we do not conduct original evaluation of any specific policy, which would be beyond the scope of this paper.

Methodologically, we approach the question of interlinkages between RE policies and socio-economic objectives by adopting a "multiple-case" design [33: 48]. In this design, several processes and events are taken into account within each case study. Cases are looked at separately in a first step and are then compared in a second step. Case studies are described by Gerring [34] as "an intensive study of a single unit with an aim to generalize across a larger set of units." Of course, the confines of this paper and our decision to address four diverse cases limit the depth to which each case can be studied, as well as generalization of respective findings. Within each case study, we mainly rely on a review of secondary sources (e.g., policy documents, statements, evaluations, analysis from in-country experts regarding the programs). In South Africa, primary data from sixty interviews carried out with stakeholders and decision-makers in late 2014 was also used [35]. Not relying on original research and making use mostly of gray literature of course limits the validity of results somewhat. Accordingly, we only claim indicative evidence in each case, which requires further peer-reviewed scientific research to be confirmed and better understood.

Case selection in this paper is based on a set of criteria that make Germany, South Africa, Morocco, and Kenya important cases for further hypothesis generation and theory building in the GE literature (on case studies and inference see [36] and [37]). First, initial case-knowledge suggests multiple policy objectives are likely to have played a role in policy formulation in the four cases. Furthermore, the selected cases are salient – and sometimes even emblematic – and are often referred to as examples; see for example Le Cordeur [38] on South Africa and Morgan and Weischer [39] on Germany. A second point considered in selecting the cases was to ensure that the policies or programs examined were large enough in scope and ambition to demonstrate discernible effects, which also ensures that data on policies is available. That said, the latter is an issue for further research and mentioned again in Section 5 of this paper.

The in-case analysis is structured along the lines of a strongly simplified model of the policy process, i.e. the policy cycle [40]. Despite numerous critiques [41: 55], the policy cycle is a useful tool/framework, enabling us to discuss the role of multiple objectives in the agenda-setting, policy formulation, and implementation phases. The policy process implies the following four questions guiding the structure of our exploratory, short case studies: (1) Are multiple objectives pursued with the adoption of the policy? (2) Exactly how are these objectives reflected in policy design? (3) What results are visible and how are these appraised? (4) Are tradeoffs or synergies visible and do they appear to influence policy redesign or the stability of policies, or possibly even termination?

Fig. 1 provides an overview of the structure of our case studies:

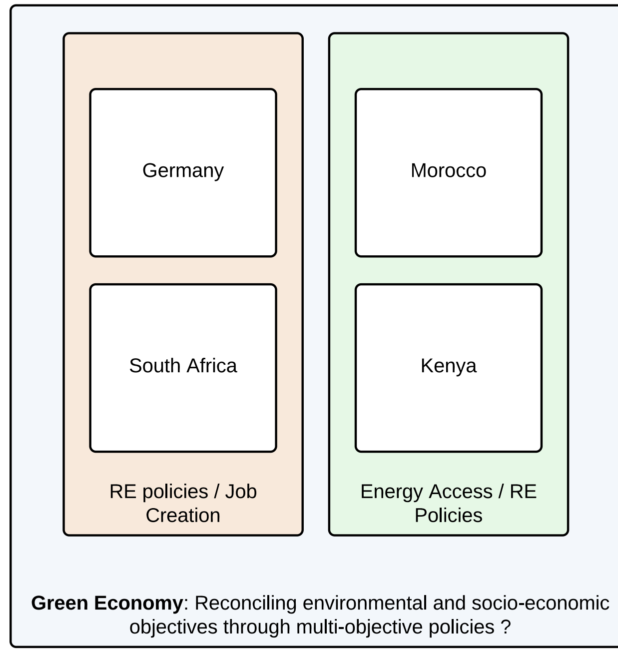

Fig. 1. Case studies and focus within cases.

3. RE deployment and job creation

3.1. South Africa: Job creation as a core driver of RE deployment

3.1.1. Job creation as a key driver for the design of RE policy

South Africa's electricity system relies on coal for well over 90% of its generation, leading to pressure to diversify in the direction of cleaner sources of energy [42]. The main policy for deploying RE in South Africa is the Renewable Energy Independent Power Producer Procurement Program (REIPPPP) launched in 2011 to replace previous feed-in tariffs that were never effectively implemented [43]. Interviewees from the public and private sector with an energy background in South Africa were asked to rank the objectives of the RE policy (for methods, see also [8,44]). The main underlying drivers identified for the REIPPPP were energy security as well as job creation and industrial policy. Improving security of supply – in light of the growing incapacity of South Africa's state-owned utility ESKOM to finance and manage the addition of much-needed electricity capacity – was seen as a top driver for the program (average rank of 2.4 out of 15 objectives proposed). Only job creation was seen as an even more important policy objective (average rank of 2.2), and it was often mentioned together with the objective of industrial policy (2.5). The very strong interlinkages between socio-economic objectives and the REIPPPP were recently underlined by South African Energy Minister Tina Joemat-Pettersson, who stated that the program is designed to "contribute to economic growth and job creation, in addition to the contribution it makes to security of electricity supply" [45].

The REIPPPP is not the only reflection of socio-economic objectives in clean energy and climate policy debates in South Africa. The government's New Growth Path sets a goal of "300,000 additional direct jobs by 2020 to green the economy," with "renewable energy construction and manufactur[ing] of inputs" as main contributors [46]. Estimates of the number of jobs created through the deployment of renewable energy in South Africa range from roughly 36,000 direct additional jobs to well over 400,000. The maximum figure depends on how many indirect jobs are taken into account [47: 135]. The objective of creating local jobs should be viewed in the context of South Africa's 52.6% youth unemployment rate in 2014 (increased from 50.1% in 2011) and a total unemployment rate of about one quarter of the population [48].

3.1.2. The South African Renewable Energy Independent Power Producer Procurement Program (REIPPPP)

The REIPPPP is a tender-based renewable energy procurement program, where power purchasing agreements (PPAs) for defined volumes of capacity for each technology are tendered in a two-stage process in yearly rounds [49]. The program is notable for the important place it grants to socio-economic objectives, which are directly reflected in policy design. A particular feature of the evaluation of bids in the REIPPPP is that only 70% of points are allocated based on price, while 30% is based on other criteria targeted at achieving socio-economic policy objectives in line with development priorities and the requirements of the Broad Based Black Economic Empowerment Act [49: 13]. One quarter of the 30 "economic development" points that bidders can earn relates to direct job creation requirements [50: 55]. Other socio-economic objectives include local content requirements, black ownership, and local economic development, which are defined in specific ways in the context of the REIPPPP [51: 16]. The diversity and scope of economic development criteria and the direct involvement of local communities set this program apart [51].

3.1.3. Evaluations of the achievement of the job creation target

The South African Department of Energy estimates that 25,526 direct jobs (one job being defined as one person-year) were created by the 1417 MW of successful projects in bidding round three (7813 jobs were available during the construction phase). This more than doubled the number of jobs created by projects from round two [47: 135]. For the fourth REIPPPP bidding round, which closed in 2015, successful projects are expected to create 27,365 person-years of direct employment over a 20 year period, of which 7071 will be available during construction; 95.9% of jobs are committed to be held by South African citizens [47].

Given the poor quality of electricity supply in South Africa and frequent blackouts that constrain economic development, the indirect effects of the REIPPPP on job creation are also expected to be positive. By adding much-needed electricity capacity within a short time-frame, solar and wind projects are expected to generate net financial benefits of 4bn ZAR in the first half of 2015 [52].

In addition to direct job creation by REIPPPP projects, large and increasing proportions of local content in successful projects are likely to have positive effects on job creation in South Africa. Local content in PV projects in round four exceeded 64% (up from 38.4% in round 1), and the equivalent of wind is 44.6%, up from 27.4% in round one [53]. The associated decrease in prices of the tenders indicates that – in the South African case – local content requirements and increasing economic efficiency can go together. The special features of the South African market (size, availability of finance, excellent resources) need to be borne in mind for the transferability of lessons to other developing countries. The question has been raised, however, as to whether the current design of REIPPPP leverages the full potential of economic development throughout the program. As pointed out by Eberhard et al. [49: 28], the focus on value-based assessments of local content could limit the potential for job creation given that higher-value components tend to be less labor-intensive.

Beyond the official government numbers, recent studies [49–51,54] assess the developmental achievements of the REIPPPP. Findings from Stands' comprehensive survey on job creation in the REIPPPP [50: 84] – the first of its kind in the South African context – indicate that the "program has exceeded all thresholds and targets set out in the bid document scorecard. Results communicated by the Department of Energy might thus underrepresent actual job creation, "leaving room for speculation and rumors about this new industry to emerge" [51: 20]. The uncertainty surrounding official job creation figures in South Africa underlines the tremendous need for further independent assessments of job creation through the REIPPPP, with continuous evaluation and monitoring. Furthermore, project companies are found to be "taking the [economic development] requirements seriously" [50: 90,51: 2], and to be genuinely interested in delivering the developmental aspect of their projects, given the political priority attached to job creation and local development [50: 84].

Despite the generally positive assessment of the REIPPPP, including on dimensions other than job creation, a lack of transparent communication and consistent monitoring has led to uncertainty surrounding the achievements of the REIPPPP in the past. There has been anecdotal evidence concerning foreign renewable energy companies flying in their workforce, even for truck driver jobs. With the success of foreign utilities in bidding round three (with more than half of PV capacity won by Italian utility company Enel), this has strengthened the voice of renewable energy skeptics. Nuclear and coal activists readily point out the jobs potential in their respective industries.

"Improving lives through wind energy" reflects the industry's concern of being seen as contributing to socio-economic development through its projects. Industry stakeholders interviewed stressed that any sign of fabricated job creation expectations would put into question the future of the REIPPPP. Underlining that any policy in South Africa had to be a jobs policy above all, project developers worried about unrealistic expectations of substantial job creation and local content. At the same time auction results were expected to decrease round after round and RE projects to come online within short timelines. Concerns over the REIPPPP's track record seem to have waned and recent ministerial announcements point to an extension of the REIPPPP [45]. The South African case nevertheless illustrates the importance of managing job creation expectations and transparent communication of achievements, both in terms of the quantity and quality of jobs [50,51]. The limited size of the overall program and a complete lack of visibility beyond 2020 create highly challenging conditions for RE companies expected to contribute to economic development. A stronger focus on transparency, capacity development (including among project developers), and communication between stakeholders involved appears necessary to safeguard acceptance and future expansion of a renewable energy program that is expected to excel in several dimensions. Even more importantly, the lack of independent and thorough monitoring of the REIPPPP, particularly concerning the very sensitive political issue of job creation, makes an evaluation of the promise of GE challenging.

3.2. Germany: Two stories of creating competitive advantages in RE industries

3.2.1. The role of jobs for renewable energy promotion

The promotion of renewable energy (RE) in Germany was primarily driven by environmental concerns, but prospective job creation has been a welcome side effect and important political motivation. The feed-in tariff scheme (Renewable Energy Act, EEG) was set up in 2000 as the main policy for deploying RE. The main intention of it was to develop different technologies for environmental reasons,[1] but there was also the promise of creating new jobs. A particular concern was that the 1998 electricity market liberalization would lead to a long-term decline of RE deployment in this sector. Moreover, it was feared that decreasing energy prices would put jobs in the newly created wind industry at risk [55,56]. Employment, however, has never been an official objective in the underlying EEG Act. This was recently reemphasized by the German Government [57], which stated that it is only a welcome side effect.

Job creation as an argument and reason for RE deployment has continued to be of political relevance, even though the evidence for it is primarily implicit. The ministries in control of RE deployment have continuously commissioned studies to analyze the impact on job creation, suggesting that they view it as a politically relevant indicator. Moreover, the number of jobs created was also highlighted in the recent Energiewende monitoring report [58]. Finally, a survey of policy experts on the goals of the Energiewende [44]

[1] Since then other measures have been introduced, but the EEG definitely remained the most important one.

suggests that jobs, together with acquiring technology and market leadership in RE technologies, still play a crucial role in the political debate. This is also because they are of use in gaining political support for RE promotion from the employed and their associations.

3.2.2. Policy design & complementary measures

The fact that job creation is not an official objective is also reflected in the design of the policies. In particular, unlike the case of South Africa and many other countries (see [59]) the EEG does not contain any explicit local content provisions that require a certain proportion of the installed plant to be produced domestically. The only action that had been taken in this regard were trade sanctions imposed at the EU level in 2013 to keep at bay the "dumped and subsidized imports of solar panels from China" [60] which were backed by the German government.

There have, however, been a number of complementary measures of economic promotion – explicit and implicit – from both the federal and state governments to foster job creation and industry development through the deployment of renewables. These measures comprise financial tax incentives, favorable custom duties, export credit assistance, quality certification, and different forms of loans; see Lewis and Wiser [61] and Kuntze and Moerenhout [59]. Data on such measures is, however, sparse and unsystematic except for the official funds provided for energy R&D by the federal and state governments (see [62]). The total financial volume of all measures together is unclear, but it is very likely dwarfed by the 16 billion EUR in EEG expenditures in the same year [63].

3.2.3. Impacts of RE expansion on jobs

Fig. 2, based on Lehr et al. [64], shows gross employment through the deployment of RE for selected years in the period from 2004 through 2013. Jobs include both direct and indirect jobs: the former are jobs in companies that provide goods and services directly related to RE, for example wind turbine manufacturing, while the latter are jobs lower down the supply chain, for example production of silicon wafers (also see [16]). Estimates of net employment, i.e. the overall balance of jobs created and lost, can, however, be either positive or negative: according to Lutz et al. [65] net job creation turned negative in the power sector, which uses by far the most RE, but this is positive in other studies (e.g., [66]). From a societal perspective, net effects are the more relevant indicator, but they are methodologically very difficult to estimate and thus figures are relatively uncertain. Moreover, gross job effects are useful in analyzing the long-term structural effects of job creation (see Section 1). This is why we concentrate on them in the following paragraphs, focusing on the most insightful cases of wind and solar PV.

With regard to wind energy, the majority of jobs are related to investment, including exports (86%). More specifically, (onshore) wind turbine manufacturing is characterized by a high proportion of exports (61%) and, at the same time, a very low proportion of imports (1%); two German companies (Siemens and enercon) have been in the global top ten for years (see [67]). Wind energy thus more or less resembles the prototypical case of a globally competitive industry as aspired to by (green) industrial policies.

The emblematic example of the German solar industry appears to be a more salient case, especially since it is alleged worldwide as providing evidence of failure to build up an industry. In fact, the development of employment in solar cell and module production leaves no doubt about the rise and fall of this industry. According to federal labor market statistics (see Fig. 3) jobs in the field of module and cell production rose from around 2000 at the beginning of 2009 to more than 12,000 in late 2011, only to plunge back down to around 2000 in the middle of 2014. Two related explanations are often given for this (see for example [64,68]): (a) The surge of PV deployment made companies too optimistic regarding the future demand and considerable production overcapacities were built. Many of these capacities had to be shut down when demand for German modules and cells proved lower than expected. (b) Many new players, particularly in China, entered the world market in the late 2000s and increased competition led to an industry shake-out, which particularly affected German companies due to their cost disadvantages. This is underlined by looking at the proportion of German products installed in the German market, which fell from around 60% in 2008 to 15% in 2011. The proportion of Chinese products, however, rose from 21% in 2008 to 60% in 2011 [68].

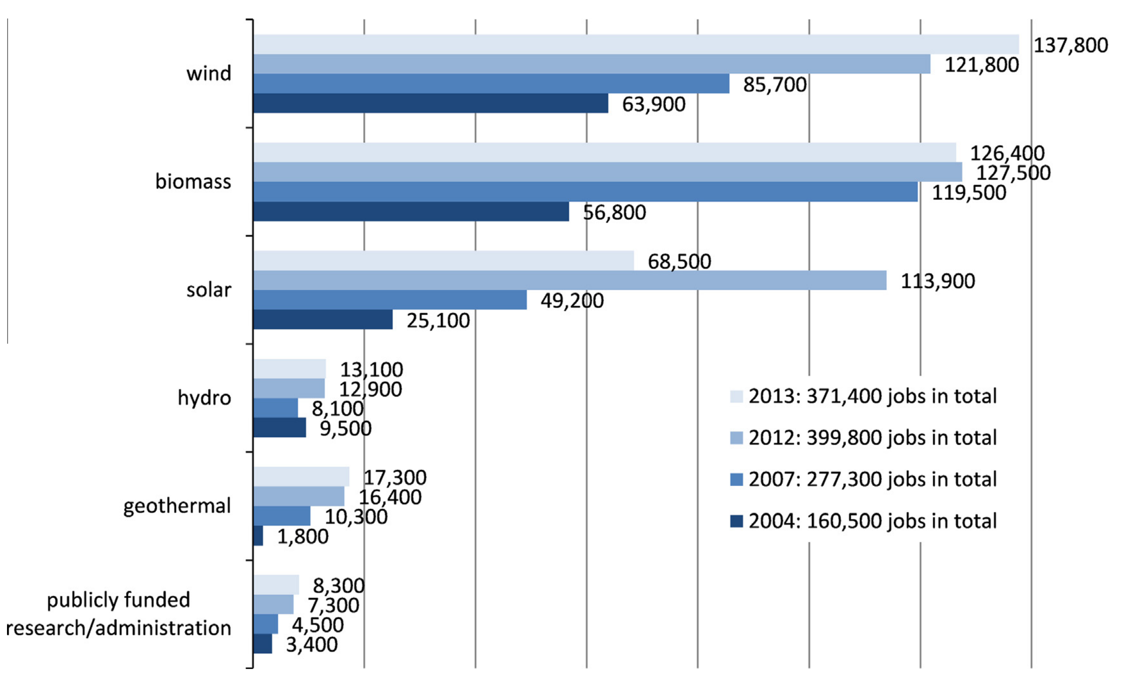

Fig. 2. Estimated gross employment effects through RE in Germany (based on [64]).

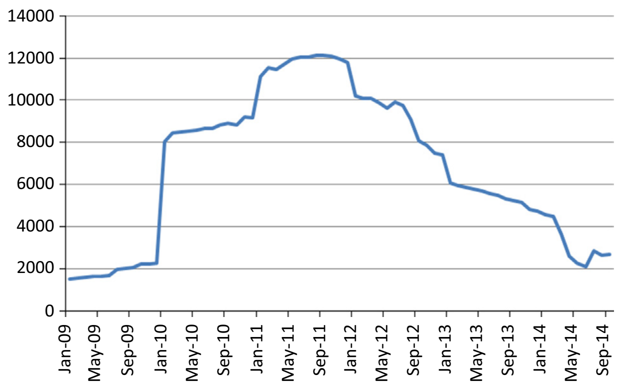

Fig. 3. Jobs in solar module and cell production. *Source:* Destatis.

This development does not hold true for all solar industries though, as other industries higher up the value chain have fared considerably better. According to data provided by VDMA [69] PV equipment producers as a whole provided more than 50% of the world market share in 2015 and are thus still well positioned; for a list of companies and number of employees see GTAI [70]. This confirms earlier assessments, for example by Claudy et al. [71], according to which the prospects are particularly good in sectors where German companies are already established and have strong comparative advantages, such as manufacturing (also see wind industry above). Hence, the widespread notion that job creation has completely failed in the solar industries must be put into perspective.

3.2.4. Lessons and feedback of achieved effects on policy stability & design

In summary, Germany's record in creating and sustaining new industries and jobs through RE deployment is so far mixed. Developments in the solar cell and module production have shown that the new industries were eroded by world market competition. The more successful cases of wind energy – and in terms of absolute jobs to a lesser extent also bioenergy and other parts of the solar industry value chain – suggests that existing comparative advantages may be a decisive factor. Of course, the question of how such comparative advantages can be sustained in the long term also remains open. In particular the negative outcome in the solar industry has so far had no visible impact on RE policy design and deployment targets. The reason is presumed to be that Germany's Energiewende was never primarily a job policy and environmental concerns prevailed.

4. Energy access polices and RE technologies

4.1. Kenya: Slow grid extension as a driver for market-based off-grid PV

4.1.1. Genesis and evolution of rural electrification plans and policies

In 1974, the first Rural Electrification Programme (REP) was launched to increase access to electricity in rural areas in Kenya. Early progress was slow, as estimates from a 1993 survey suggest that household electricity access among rural households was about 3% (see Table 1) [72]. In 1997, the first Rural Electrification Masterplan was developed to plan, prioritize, and accelerate rural electrification in Kenya. However, progress continued at a very slow pace. Estimates from a 2003 national survey suggest that rural household access to electricity had crept up to only 4.6% [73]. Other national sources suggest that rural electrification stood at about 2% at the turn of the millennium [74]. The Rural Electrification Masterplan was updated in 2009 and envisaged rapid expansion of on-grid capacity. However, household electrification rates in rural areas remain very low; the most recent estimates suggest that it was less than 13% in 2013 [75].

Table 1
Rural electricity connections and SHS deployment in Kenya. *Sources:* 1) Kenya Power [96]; 2) Estimated from [97]; 3) [72,73,75]; Note ⁎ includes rural, urban and institutional.

Year	Grid-connected rural consumers (numbers)$^{1)}$	Estimated total* installed SHS (numbers)$^{2)}$	Rural household electricity access (%)$^{3)}$
1993	n.a.	20,000	3.4
1998	48,949	66,500	4.3
2003	87,175	150,000	4.6
2008	205,287	260,000	8.1
2013	528,552	350,000	12.6

As part of Kenya's vision 2030, the Rural Electrification Authority (REA), which is mandated to accelerate the pace of rural electrification, has now set a target of increasing connectivity to 100% by 2030 with an interim goal of over 50% by 2022 [76]. This means the pace of providing new connections each year needs to increase significantly. With on-grid connection costs remaining out of reach for most poor rural customers, how this will be achieved remains unclear.

4.1.2. Evolution and drivers of residential solar home systems (SHS) in rural electrification plans and policies

Initial interest in renewables emerged after the oil crises of the 1970s and was motivated by a desire to reduce the cost of national oil imports and increase national energy sovereignty and resilience [74]. However, while these incentives still underlie the government's new plans to rapidly expand on-grid (primarily geothermal-based) renewable electric capacity, the off-grid solar PV sector is largely excluded from recent policies and plans.

The development of the solar PV sector in rural Kenya was initiated in 1984 by two ex-U.S. Peace Corps volunteers. They were instrumental in attracting interest from donors and the Kenyan government by organizing a number of demonstration projects showcasing PV systems in Kenya [77]. At the time, the government strategy for the off-grid SHS sector was one of no policy, i.e. to leave it largely unregulated. In 1986, indirect policy measures in the form of exemption from value-added tax (VAT) and duties on imported PV products and components were implemented. Since then, however, taxes and duties have been applied and removed many times and at different rates, and on different parts of PV systems [78]. More recently, since 2012, regulations for the PV sector have also come into force in the form of licensing and technical standards. On the whole, while government documents have continued to refer to solar energy, there have been few incentives and no specific targets or legislations designed to increase its uptake.

Climate change or environmental considerations appear to have neither explicitly nor implicitly motivated the SHS market development in Kenya. According to several scholars, solar PV market growth in rural areas was tied to the slow pace of grid extension and lack of confidence in the government's ability to honor its rural electrification targets [79–81]. The dramatic drop in PV prices together with increasing demand for electricity from better-off rural plantation workers and a growing rural middle class have also contributed. The availability of batteries manufactured locally has also been credited as having a positive impact.

While much of the literature on SHS in Kenya points to the private market-driven nature of the sector, recent analysis challenges this view and asserts that indirect public policy support and donor support were vital to building markets, absorbing risks, and developing actor networks that were key to the growth of the sector in

Kenya [78,79,82]. Donor support in the form of the photovoltaic market transformation initiative (PVMTI) implemented by the World Bank between 1998 and 2008, with a total budget of US$ 5 million, was particularly important for the development of the sector. The funds were used to provide technical assistance, particularly in the areas of training and quality assurance [83]. In addition, bilateral donors such as GIZ also contributed by providing direct financial resources and by creating the supporting industry and supply-side conditions to promote market development [79].

4.1.3. Targets and achievements: SHS and rural household electrification

Data on progress with rural electrification and SHS installations in Kenya over the last couple of decades is provided in Table 1 below. The REA has set specific targets for rural electrification in its strategic plan. The plan includes three phases: Phase I from 2008–2012, with targets for connecting all public facilities and one million rural customers and increase connectivity to 22%; Phase II from 2013–2022 aiming to increase connectivity to 65%; and Phase III for 2022–2030 aiming to increase connectivity to 100%. As can be seen from the table, the targets for rural customer connectivity have not been achieved for Phase I.

Monitoring and evaluation activities providing insights on experiences with PV for household uses or reliability and quality of grid-connected power supply in Kenya remain extremely limited. However, some studies indicate that between a fifth and a quarter of installed SHS in Kenya in the past were not functional or only partially functioning [81]. Erratic equipment quality and installation and maintenance standards have been cited as some of the reasons for this. The popularity of the new fee-for-service and pay-as-you-go business models in the SHS market shift the responsibility for maintenance and quality assurance to the service providers, which might be of benefit to customers. However, the systems have not been in place long enough or deployed at a scale sufficient to allow a more systematic evaluation of their merits and impacts.

4.1.4. Changes to plans and policies and future outlook

Kenya's new energy policy does not define any goals for further promoting SHS. Even support for on-grid solar appears to be lacking as the most recent Least Cost Power Development Plan (LCPDP) assumes that it is not cost competitive with other generation technologies. The most specific intentions for PV, concerning rural access goals, relate to the program for rural institutions and the conversion of a number of large remote diesel installations to diesel-PV hybrid systems [78]. More recent developments in energy policy-making in Kenya thus appear to have reversed even the few indirect policies aimed at supporting the SHS market. Economic considerations and the need to raise government revenues has led to the abolition of the tax and duty exemptions on PV products and components and even given rise to new taxes on some components [78].

4.2. Morocco: A utility-led effort to electrify remote villages off the grid

4.2.1. Genesis and evolution of rural electrification plans and policies

Starting with the creation of a special energy fund in 1975, rural electrification in Morocco was carried out through the National Rural Electrification Program (Programme National d'Electrification Rurale, PNER). The first two phases of the PNER from 1982–1986 and 1991–2000, show very slow progress [74]. A national survey from 1992 suggests that access to electricity among rural households was 15.6% [84]. The low financial capacity of the regional autonomous bodies, who were supposed to finance the program, was considered a shortcoming [85].

To overcome this situation and accelerate rural electrification, in July 1995 the Global Rural Electrification Program (Programme d'Electrification Rurale Globale: PERG) was established. At the time when the PERG was launched in 1996, official sources indicated that Morocco's rural electrification rate was 18% and that the country aimed to bring the rate of rural electrification to 80% by 2010. Since objectives were exceeded in the early years of activity, they were revised to electrify all the rural areas by the year 2007. The pace of electrification was also accelerated to target 1500 to 2000 villages per year with an estimated annual budget of 150 million dollars.

The PERG is widely considered an example of a successful rural electrification program, though many authors studying the case have had to rely on the National Office of Water and Electricity's (Office Nationale de L'Electricité et de l'Eau potable, ONEE's)[2] own evaluations and data on performance and impacts [85]. Nevertheless, the program is responsible for increasing the rural electrification rate from 18% in 1996 to over 90% by 2013. Building an extensive national village database for efficient prioritization of actions, detailed grid planning, and clear contractual arrangements with local governments are all cited as being factors responsible for the success of this program. A participative financing scheme in which those who benefited contributed 25% of the cost of electrification, local governments contributed 20%, and ONEE picked up the remaining 55% of the cost (part of which was financed from a 2.25% solidarity tax on electricity sales) was also considered an important aspect of the program [87]. A significant part (estimated at close to half) of ONEE's contribution to the program was mobilized from international lenders (AFD, IDB, JBIC, EIB, FADES, Kuwait Fund, KfW) as concessional loans guaranteed by the Moroccan government [88].

4.2.2. Evolution and drivers of residential SHS in rural electrification plans and policies

During the early years of the PERG, the national village database assessment suggested that about 8–10% of rural villages were too remote and, therefore, it was too expensive to electrify them through an extension of the grid. Thus, it was foreseen that these villages would be served by decentralized PV solar home systems. In 1998, the first major PV SHS initiative, funded by the GEF and IFC, was initiated [89]. Concerns regarding the coverage and speed of SHS dissemination, as well as adequate repairs and maintenance of the systems, led ONEE to decide to outsource the off-grid component of its rural electrification program to private contractors. Through an international bidding process, enterprises were selected for ten-year concessions and contracted to supply and maintain a fixed number of PV systems in certain specified remote regions [90]. The systems were supplied on a fee-for-service basis with households having to contribute about 10% of the cost as a connection fee and a regular monthly maintenance fee. The fee amount was determined by the type of service (size of the system) and was to be paid for over a period of 10 years [85,91]. After awarding the first concession in 2002, four other concessionaires were included in successive bidding rounds. In total, contracts were signed to distribute 105,000 SHS installations of an initial estimated 150,000 SHS envisaged when PERG was launched in 1997. International donor funding was also very instrumental in supporting the SHS deployment that became part of the PERG to provide access in remote areas [85].

The primary motivation of the Moroccan government in including off-grid SHS as part of its rural electrification strategy was eco-

[2] ONEE (formerly: Office national de l'électricité, ONE) is a vertically integrated, state-owned utility and the only buyer of electricity in Morocco. Moreover, it also supplies 41% of all electricity from its own plants and is thus said to dominate the power sector in Morocco [86].

Table 2
Rural electricity connections and SHS installations in Morocco. *Sources:* 1) Reproduced from Nygaard and Dafrallah [85] based on official ONEE's statistics; 2) Ministère de la Santé Publique & Macro International [84]; 3) Ministère de la Santè DPRF/DPE/SEIS & ORC Macro [98]. 4) Best estimate from Nygaard and Dafrallah [85].

Year	Grid-connected rural consumers (numbers)1)	Estimated total installed SHS (numbers)1)	Rural electrification coverage (%)1)	Rural household electricity access (%)2)
1993	n.a.	n.a.	18%	15.6%
1998	286,899	1885	32%	n.a.
2003	979,489	10,457	62%	51.3%
2008	1,815,047	51,509	95.4%	n.a.
2013	2,027,120	51,559	98.5%	~89%3)

nomic [92]. SHS dissemination was limited to very remote rural regions where extension of the grid was considered too expensive. However, subsequently, realizing the climate benefits of the SHS, the program was proposed for funding under the Clean Development Mechanism and was registered as one of the first programmatic CDM projects [85]. For most of the rural population, however, electricity access has been achieved through connection to the grid (see Table 2).

4.2.3. Targets and achievements: SHS and rural household electrification

Data on outcomes, achievements, and impacts of the rural electrification program (PERG) and its SHS component are exclusively available from official ONEE reports. Nygaard and Dafrallah [85] suggest that the estimates of the rate of rural electrification are likely to be based on coverage rather than on an estimate of actual household connections. Even so, they suggest that rural household access in 2013 is likely to be in the order of 89% (compared to the 98% suggested by ONEE's estimates of coverage).

Independent evaluations of the SHS component of PERG are also missing. It remains unclear why only half of the 105,000 SHS installations targeted through the concessions have been implemented, especially considering that this represents an even smaller fraction of the 150,000 originally estimated as being required. Nygaard and Dafrallah [85] speculate that consumers might have considered the SHS a second-best option, providing poorer service at too high a cost. This appears to be borne out by the fact that as of 2010, ONEE has embarked on a program to connect households to the grid in areas already provided with SHS [90] and ceased the deployment of SHS in 2009. Unfortunately, no information or evaluations exist regarding the quality and performance of the SHS installed.

4.2.4. Changes to plans and policies and future outlook

The Moroccan government has set ambitious targets to diversify its electricity mix and reduce dependence on imports. In its 2009 National Energy Strategy, renewable energy targets were set to achieve two GW each for solar, wind, and hydropower respectively by 2020 (42% of the total electricity capacity in 2020). However, these targets have been set for the construction of medium- to large-scale power plants; decentralized energy supply is not considered a core element in the Moroccan Solar Plan or the Moroccan Integrated Wind Energy Programme [93]. The key incentive for this emphasis on large-scale renewables appears to be a desire to increase energy independence. However, it also aims to attract investments, build technical expertise, and improve industrial competitiveness [8,93,94]. After years of debate and increasing pressure from Moroccan companies, the government adopted a PV roadmap at the end of 2014. In December 2015, a law (Loi 58–15) was eventually passed that will open the low-voltage grid level and thereby enable the connection of smaller scale RE installations. This is also expected to make a significant contribution to other socio-economic objectives such as job creation.

5. Discussion

In this section we reflect upon and discuss the implications of the findings of each case study for the GE conceptual framework. In Kenya and Morocco, renewable energy policies targeted the expansion of energy access arising from a failure to provide infrastructure. Both cases emphasize that governments have an important role in the implementation of a GE. In the Kenyan case, where the development of SHS was more market driven, existing assessments suggest that indirect government policies and donor finance had an important role to play. This case particularly highlights the need to put in place an effective regulatory framework with long-term targets. Without such a framework, deployment could subside over time or certainly not keep pace with targets or requirements. Related to this is the necessity to build up capacity both for policy-making and monitoring. The availability and reliability of policy reports and data for Kenya was relatively scarce. This, of course, makes assessing policies, including the socio-economic effects, very challenging, and highlights the need to strengthen national monitoring and evaluation capacities.

The case of Morocco is interesting in comparison because a relatively strong policy framework, with especially clear long-term targets, was put in place and the rural electrification program has been widely considered a success. Importantly, renewable deployment was largely inspired by economic, rather than environmental (green), considerations. The aim was to provide access to very remote villages that were considered too expensive to connect to the grid. Nevertheless, the fact that SHS led to an increase in access underlines that renewable deployment can indeed create short-term socio-economic benefits and thus supports the main assertion of strong green growth (see above). This is specifically the case when important infrastructure such as grid connections is underprovided (see Introduction). Recent plans of the utility to connect regions originally covered by the SHS concessions to the central grid, suggest, however, that these are increasingly being viewed as a transitional technology. Accordingly, the socio-economic benefits from the initial renewable deployment are not likely to be sustained in the long run. However, the experience with off-grid solar may have been one factor prompting plans for more large-scale solar development that are part of current policies in Morocco. In other words, this might have helped develop "green" technologies from a niche to a more encompassing, national-level project.

The South African REIPPPP illustrates how socio-economic objectives can be strongly reflected in the design of policies for the deployment of renewables. Job creation is a particularly pressing problem in South Africa, which makes it a prototypical case for GE. Political expectations for job creation through the REIPPPP were very high and even though first reports point to a fulfillment or even over-fulfillment of the creation of jobs promised by the developer, there is great uncertainty surrounding actual effects as estimated in official figures. Negative policy feedback, due to high expectations, unclear estimates of impacts, and a lack of available data and independent evaluation, are particular challenges for the assessment of South African GE concepts. These challenges seem to be typical for multi-objective policies interlinking environmental and socio-economic objectives, but have hardly been addressed in the GE literature. New approaches are only beginning to emerge, such as the framework developed by Sreenivas et al. [95].

The case of Germany is interesting in comparison because employment objectives also played an important role in renewable energy policy, but only unofficially. Job creation was not reflected in policy design and no local content provisions were included. Nevertheless, expectations were high, particularly regarding the creation of technology leadership and respective jobs in the solar PV industry. Deployment of renewables was conceived, at least implicitly, as a green industrial policy. Accordingly, the German experience constitutes a test case for the strong green growth assertion, which upholds that the creation of competitive advantages in green technologies is one way to create both short- and long-term economic benefits, such as jobs. However, while the solar module and cell manufacturing industry indeed rose to global market leadership from 2009, it experienced a considerable fall only two years later, with a corresponding decline in the number of jobs. This was the result of a global industry shake-out following increased competition in combination with little pre-existing comparative advantages; in fact, this was predicted as a possible outcome by earlier theoretical literature on job market effects. Accordingly, the case of the German solar industry questions this aspect of the possibility of (strong) green growth. This must be put somewhat into perspective, though, because in comparison the wind industry has fared considerably better. Moreover, it is also possible that a dedicated multiple-objective design might have prevented this outcome.

6. Conclusion

This multiple-case study produced several findings suggesting that the GE conceptual framework needs to be reconsidered. First, in support of earlier findings we can confirm that the role of governments in implementing a long-term GE regulatory framework is of utmost importance. This may be particularly challenging in countries like Kenya, where capacity for policy making, monitoring and evaluation of complex policy frameworks needs to be strengthened. Accordingly, capacity building is an important enabling condition to leverage the potential for GE policies and GG and should to be addressed head on.

Second, some cases suggest that renewable deployment can generate short-term socio-economic benefits, which supports the assertion of strong green growth. They also suggest, however, that these benefits may not be sustained; energy access through SHS may eventually be superseded by grid access as in Morocco, and jobs created might be lost with the rise of international competition as in Germany. Whether the benefits could – or should – become more permanent through different policy designs remains an open question. It also needs to be acknowledged, however, that the expectation of socio-economic benefits seems to have created political momentum to implement the respective "green" policies in the first place. In Germany, green policies persist despite ambiguous job creation results in some segments, while experience with SHS in Morocco has facilitated national RE policy developments.

Finally, and probably most importantly and novel, this work suggests that designing – and analyzing – policies aiming to achieve multiple objectives differs considerably from the traditional ideal-type view of policies as being targeted at single objectives. This is particularly relevant for the GE, as – at least in our understanding – it ultimately entails a "paradigmatic shift" toward such multi-objective settings. More precisely, as this paper has underlined, there is a direct interplay between renewable deployment and socio-economic objectives that works in two directions (Fig. 4); renewable deployment policies have impacts on socio-economic objectives, but these objectives also influence the design and evaluation of these policies, which in turn also influences impacts throughout the policy cycle.

This second aspect has received little attention so far. We agree with Sreenivas et al. [95] that there has been much rhetoric while the development of practical methodologies has lagged behind. Adding to the approach they propose, our findings suggest some additional elements that could be important, namely the explicit identification of objectives, clear communication and management of expectations, and a broad and transparent set of indicators for monitoring and evaluation. The availability of sound and comprehensive data is crucial not only for further GE research, but also to ensure regulatory stability and sustainable policies. Tremendous opportunities for further research exist in order to advance our understanding of the extent to which the GE can actually achieve its promise.

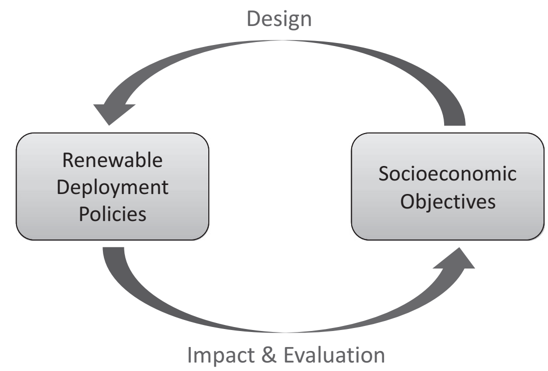

Fig. 4. Inter-linkage between renewable deployment policies and socio-economic objectives.

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