A Factsheet for Civil Society

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Renewable Energy for a Decentralised, People-Centred Energy Transition in Africa

What is a Decentralized Renewable Energy (DRE) system?

A decentralized energy system (DRE) describes a system, in which energy production facilities and the site of energy consumption are located in close proximity. These DRE systems vary in sizes and range from an installed power capacity of 1 W (single solar lamp) to an installed power capacity of up to 2 MW (large mini-grid). A DRE system allows for more optimal use of renewable energy as well as combined heat and power, reduces fossil fuel use, and increases eco-efficiency. The local distribution grid can work independently from the main grid (also referred to as off-grid) or can be connected to the main grid. Domestic, institutional, or commercial consumers are sourcing electricity from one or several generation units in the region. This factsheet focuses primarily on off-grid DRE systems.

Why are DRE systems useful in Africa?

The African continent needs to vastly accelerate its renewable energy transition. Today, African countries have the youngest and most rapidly growing population in the world. Within this is the dual challenge of providing access to the 595 million people currently lacking electricity, while at the same time reaching the millions born every year in areas with no access to electricity[1]. At the same time, African countries have considerable and largely untapped potential in renewable energies[2] and benefit from being a latecomer, which enables leapfrogging to smart, participatory, distributed energy systems[3]. DRE can be useful in urban, semi-urban, and rural settings.

DRE systems are a reliable and cost-effective solution to electrify remote areas[4]. IEA suggests that 70% of all rural areas globally are not suited for an extension of the national electricity grid. DRE systems can provide reliable and affordable energy access for people and for productive sectors (e.g. agriculture, small, and medium-sized businesses (SMEs), community services). Further, the very nature of DRE systems ensures community focus, and promotes broad multi-stakeholder participation[5] and energy democracy, ensuring that the energy provided really performs for the people.

A number of initiatives (e.g. Sustainable Energy for All, Power Africa, AREI, LDC REEEI, Desert to Power, etc.) have been put in place to promote the use of DRE systems. Further, an increasing number of African governments (e.g. Kenya, Tanzania, Uganda, Angola, Nigeria) recognise the importance of

310 GW

the RE potential of the African continent is about 310 GW by 2030

off-grid DRE and are supporting their roll-out through specialised programs, policy reforms, and energy policies. In the early 2010s, Tanzania pioneered mini-grid market tools with a well-designed regulatory framework and financial support from donors and to date has one of the highest numbers of installed mini-grids (although electrification rate is generally very low). Another example is Kenya, who established the Rural Electrification and Renewable Energy Corporation (REREC) with the vision to provide sustainable energy solutions for all through rural electrification and renewable energy for socio-economic transformation. According to REREC, rural electrification is to be achieved mainly through mini-grids.

Desert to power initiative[6]

= Focus on 5 Sahel Countries

= 11 Countries involved and benefitting

CASE STUDY

The Desert to Power Initiative is a renewable energy and economic development initiative led by the African Development Bank. The overarching goal includes providing solar electricity access across the Sahel region by creating a capacity of 10GW through photovoltaic systems in public private, grid and off-grid projects by 2030.

The five priorities the initiative set include:

1. Accelerate the deployment of solar energy production
2. Extend and strengthen the power transmission network
3. Accelerate electrification through off-grid solutions
4. Revitalize national power utilities
5. Improve the business climate

Advantages

Social/Developmental

- DRE systems can enable progress on all SDGs
- Rural electrification and access to energy
- Energy democracy and multi-stakeholder participation
- Job creation and capacity development
- Gender-sensitive and women empowerment (see solar sisters, etc.)
- Health benefits of clean local energy (if generators, biomass cook stoves, etc. are replaced)

Environmental

- Climate mitigation through increasing the share of renewables[8]
- Lower environmental impact than large-scale RE projects (e.g. dams, wind parks)
- Potential replacement of generators and other sources of emission / pollutants

Economic

- Cost-effectiveness: RE technology is cheaper than fossil technology
- Low capital costs per project compared to utility scale power plants
- Reduced need for transmission and distribution network expansion and maintenance
- Increased eco-efficiency through lower transmission losses

Technical

- Increased energy resilience and reliability through decreased vulnerability to single points of failure (e.g. through environmental disasters)
- Increased planning flexibility due to small size and short construction lead times
- Modularity: size of DRE system adaptable to demand
- Increased energy efficiency through use of smart meters.
- Energy security through decreasing dependency on volatile fossil fuel market
- No large land areas required

Governance

- Empowerment of local authorities and local communities
- Dilution of political interference and vested interests
- Enabling of energy democracy

DRE systems can bring about multiple socio-economic, developmental, environmental and technical advantages.

Challenges [7]

Social/Developmental

- Power imbalances and resulting access privileges
- Exclusion of stakeholders (e.g. marginalised groups, migrants, women, youth, etc.)
- Ownership issues
- Conflicts over utilisation (public lighting vs small businesses)
- Lack of productive-use cases
- Lack of educational measures for communities (e.g. related to energy efficiency awareness) and skills training

Environmental

- Pollution through lack of waste management and recycling

Economic

- Poorly designed tariffs (e.g. failure to cover operating costs, unaffordable)
- Lack of access to upfront investment, especially for small projects
- Lack of private sector investment
- Lack of awareness at the investors' side
- Lack of bundling approaches to finance small-scale projects
- Initially higher capital costs per kW

Technical

- Lack of technical standards
- May result in the instability of the voltage profile
- Technology failure
- Poor system maintenance
- Lack of availability of access of replacements and spare parts
- Poor system design that does not meet energy needs or does not consider future demand

Governance

- Lack of policy framework
- Lack of energy access plan marking off-grid areas
- Lack of main grid arrival policy
- Lack of political support: state-controlled electricity markets hinder development of DRE systems
- Lack of ownership schemes and pricing systems
- Lack of institutional arrangement to ensure reliable and efficient operation and maintenance over time

Enabling and well-designed DRE policy can solve many of these challenges. Further, careful planning of DRE projects and a profound knowledge of the local context can address socio-economic and socio-technical challenges.

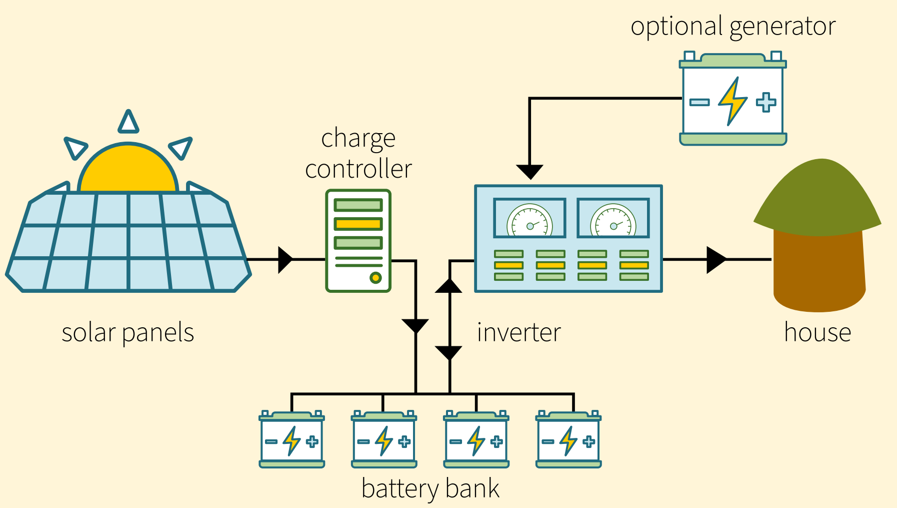
A gender perspective on DRE systems

DRE systems and their applications can be designed in ways that are gender-sensitive, because they bring energy choices to the household and community level, where women tend to have a greater voice. Further, the decentralized and modular nature of DRE systems offers great opportunity for engaging women in design, implementation, and operations and for tailoring energy services to gender-differentiated needs. This can in turn create co-benefits related to gender equality, empowerment, and income generation.

How do DRE systems work?[10]

DRE systems allow generating electricity where it is needed. It involves home-owners, small communities or businesses owning and operating electricity generation and/or storage assets largely for their own use. Solar photovoltaic systems (SPS) are most commonly used for rural electrification purposes. Also possible are solar thermal technology (e.g. for water heating, solar cooking) wind, hydro, geothermal, and biomass[11]. To ensure reliability of DRE systems, energy generation can also come in conjunction from a variety of sources (e.g. PC, wind turbines, biomass, generators) in so called hybrid-systems. In off-grid DRE systems, the installed power generation capacity is independent from the main grid. A typical SPS off-grid systems is composed of (Fig. 1):

- **Photovoltaic cell/module/array:** to convert solar energy into electric energy
- **Charge controllers:** to protect and regulate the charging of batteries
- **Rechargeable battery bank:** to store the surplus of solar energy. Through the employment of storage technologies, the energy use can take place independently from the time of generation.
- **Inverter:** to convert the direct current (DC) from the photovoltaic modules in alternating current (AC), which is necessary for products such as domestic appliances, computers, and urban lights. If the power generation capacity is less than 100 W, the inverter can be avoided, thus avoiding conversion losses.
- **Optional generator (in hybrid-systems)** as emergency response back-up (in case batteries are empty and sun is not shining)



P = V*I

P is the electric power measured in watts (W),
V is the electric potential or Voltage measured in volts (V), and
I is the electric current measured in amperes (I).

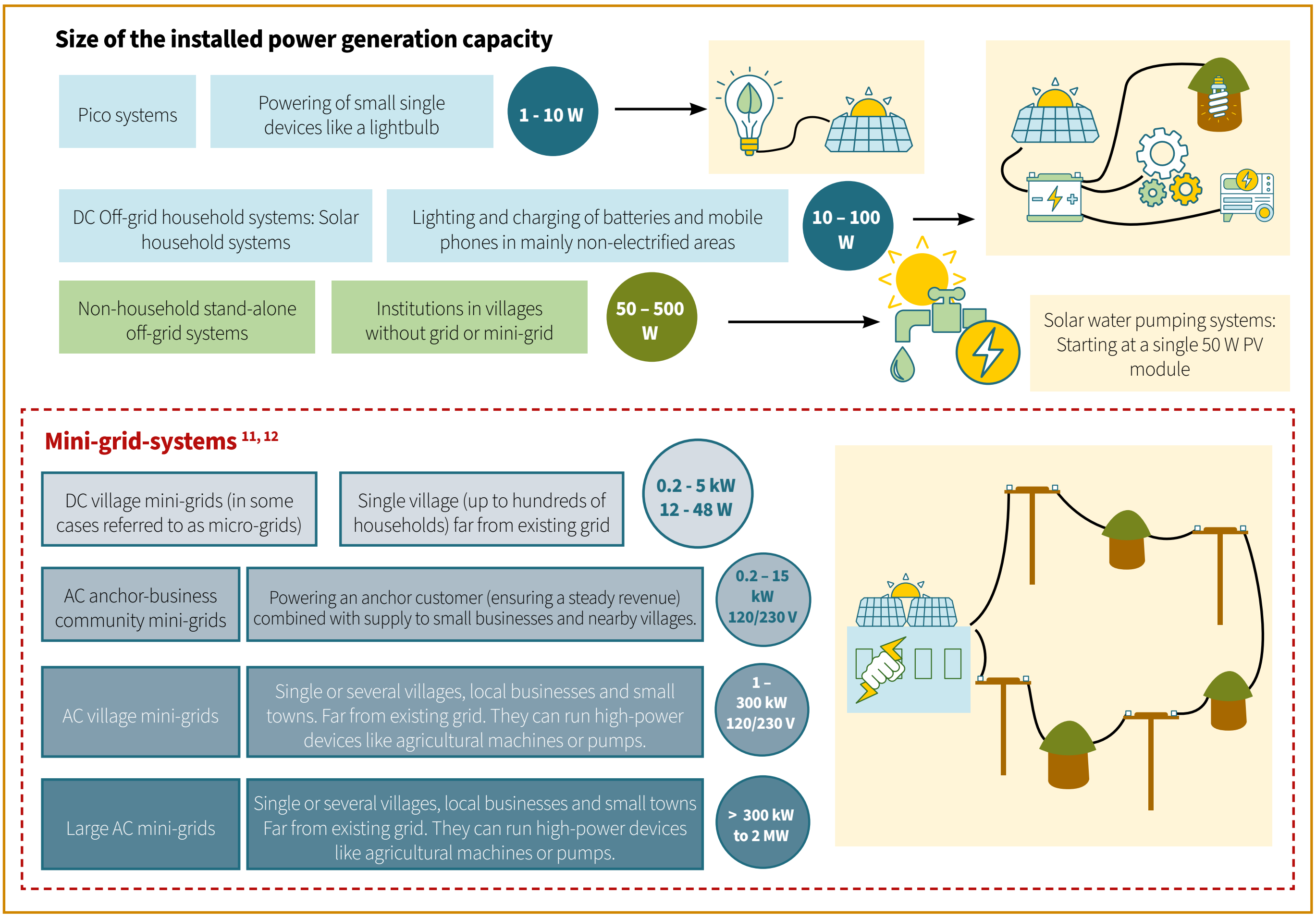
Figure 1: Elements of a typical SPS off-grid system

Grid-connected DRE system

If there is no direct use of the generated energy and no storage medium but a possibility to link the system to the national grid, a “grid-connected DRE system” can be a more suitable option to ensure permanent access to energy. In such a system, energy that is not consumed directly can be fed into the grid to avoid waste and generate income. Grid-connected DRE systems can be less expensive and more effective, because it is not necessary to store energy.

DRE systems have the advantage that they can be adapted in size to the respective demand of the region. The available systems start at stand-alone systems on household or non-household level (Fig. 2), which are useful for locations that are not fitted with an electricity distribution system. In stand-alone systems, the energy produced is either directly connected to a DC load (direct-coupled systems) or can be connected to a battery. Typically, the power is generated through a single solar panel with a size of 1-100 W or through a group of panels up to a size of 500 W. The energy can power small single devices (e.g. lamps, radio, phone charges, etc.) or multiple devices in a single household, or non-household appliances such as water pumping systems for small-scale agricultural use.

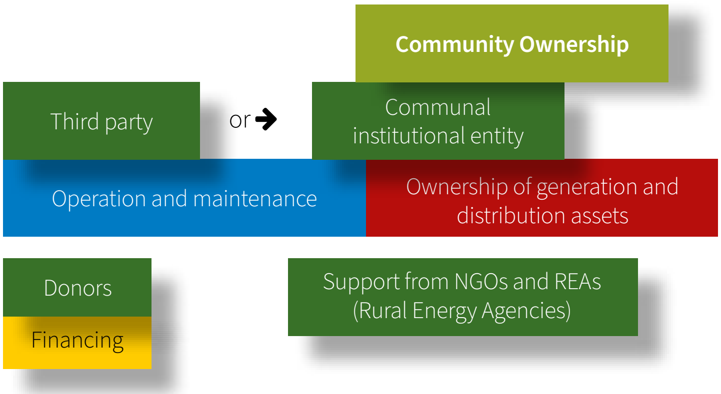
In order to power more than a single household, e.g. a village with small businesses and other productive uses such as agricultural machines, mini-grid systems are installed. Mini-grids are electricity distribution networks involving small-scale electricity generation and can optionally be connected to the main grid. The big advantage of mini-grids, however, is that they are a cost-effective solution for electrifying rural communities where a grid connection is challenging in terms of transmission and cost. Mini-grids are suitable for a power generation capacity up to 2 MW (Fig. 2).



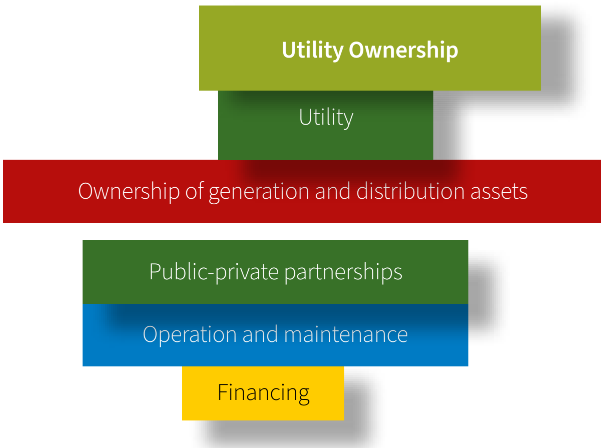
What are Ownership Models of DRE systems?

One of the key benefits of DRE systems is that they enable the promotion of multi-stakeholder participation and energy democracy. There are four main ownership models for DRE systems[14, 15]:

01 **Community Ownership[16]:** This can include the legal ownership of the community or the possibility of ownership through buy-in (symbolic ownership). The operation and maintenance can either stay in the community's hands or be outsourced to a third party. In the case of legal ownership, financing can come from (local) donors, NGO's, and rural energy agencies. There are several legal forms of community-ownership models, including cooperatives, partnerships, non-profit organizations, community trusts, and housing associations. Community ownership has a strong focus on the generation of socio-economic benefits. It enables community empowerment, energy democracy and can be designed to address gender-differentiated needs. Further, it can create job opportunities and livelihood diversification, thereby counteracting youth migration to cities. Community ownership can also help to foster energy and environmental consciousness.



02 **Utility Ownership:** Ownership for generation and distribution is with the utility. Financing and operation and maintenance can be distributed between public and private entities. In this context public-private partnerships can be formed.

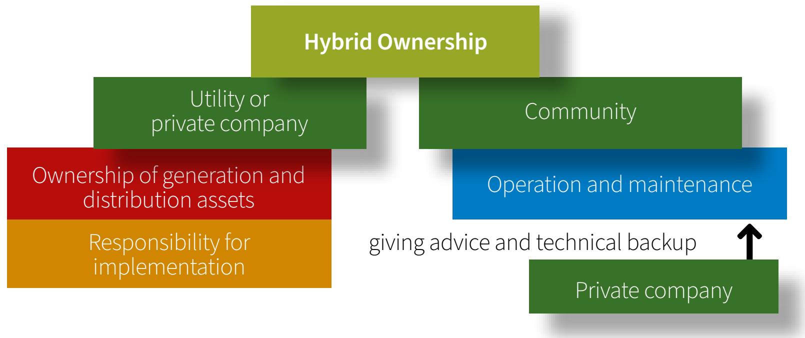


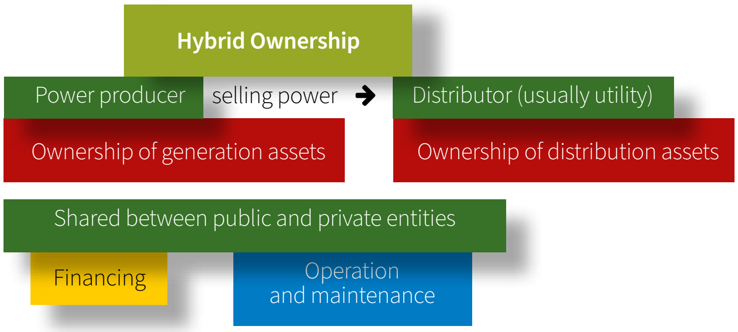
Description of the Elements

Ownership of generation and distribution assets	Commonly describing legal ownership of the generation and the distribution facility. It can also include the sense of ownership in the form of buy-ins from local population.
Financing	Funding of the system components, operation, and maintenance through public and private entities.
Operation and maintenance	To keep up the performance of the system and ensure longevity of the components the correct operation and regular maintenance work (e.g. adjustment, cleaning, lubrication, replacements etc.) are essential.
Responsibility for implementation	Comprising the organisational tasks and keeping an overview of the elements of the ownership.

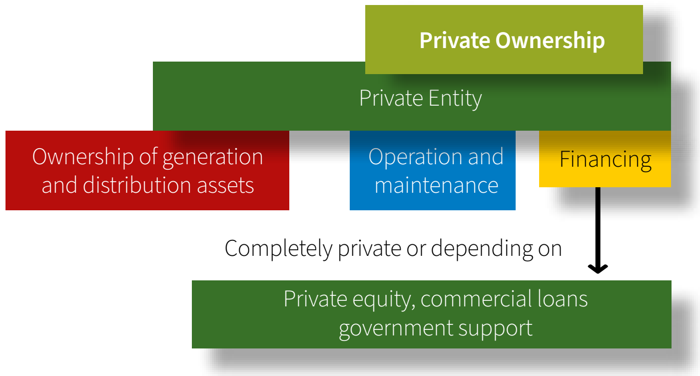
03 **Hybrid Ownership:** The ownership of power generation and distribution as well as the operation and maintenance and financing of the system are shared between two or more entities.

Alternative distribution





04 **Private Ownership:** The ownership of all assets lies with one private unit. Rarely the systems are fully financed by the private owner, but rely on commercial loans or governmental support.



Footnotes

1 https://iea.blob.core.windows.net/assets/2f7b6170-d616-4dd7-a7ca-a65a3a332fc1/Africa_Energy_Outlook_2019.pdf
2 https://www.irena.org/publications/2015/Oct/Africa-2030-Roadmap-for-a-Renewable-Energy-Future
3 https://www.germanwatch.org/sites/default/files/Reviewing%20Africas%20RE%20Initiatives_A4.pdf
4 https://openknowledge.worldbank.org/bitstream/handle/10986/31926/Mini-Grids-for-Half-a-Billion-People-Market-Outlook-and-Handbook-for-Decision-Makers-Executive-Summary.pdf?sequence=1&isAllowed=y
5 https://www.tandfonline.com/doi/epub/10.1080/00139157.2019.1564212?needAccess=true
6 https://www.afdb.org/sites/default/files/2021/09/06/desert_to_power_progress_report_2020-en.pdf
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22 https://irena.org/-/media/Files/IRENA/Agency/Publication/2020/Apr/IRENA_GRO_Summary_2020.pdf?la=en&hash=1F18E445B56228AF8C4893CAEF147ED0163A0E47
23 https://www.germanwatch.org/de/19561
24 https://iea.blob.core.windows.net/assets/888004cf-1a38-4716-9e0c-3b0e3fdbf609/WorldEnergyOutlook2021.pdf

The project **"Ensuring a People-Centered Energy Transition in Africa through Civil Society Engagement"** aims at strengthening the engagement of civil society in energy system transformation processes in five African countries – Morocco, Nigeria, Cameroon, Botswana, and Kenya. The project promotes an approach to implementing energy initiatives focused on transformational change in the energy sector through more appropriate policy frameworks and enabling environments on the national, regional, and continental level. Thereby, the project contributes to an effective acceleration of the renewable energy transition, which not only results in significant short- and long-term emissions reductions but also in well-designed renewable energy systems that meet the energy needs of the population and are more resilient to extreme weather events, droughts and supply shortages.

The project is implemented by PACJA with the support of Germanwatch and is financed by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

GERMANWATCH

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IKI INTERNATIONAL CLIMATE INITIATIVE

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Appendix to Factsheet

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Dimensions of an enabling, national Decentralised Renewable Energy Policy

The renewable energy sector holds benefits for other sectors such as poverty reduction, environmental protection, socio-economic development, public transportation and agriculture. Hence, accelerating the implementation of decentralised renewable energy (DRE) projects that bring about those intersecting solutions requires, governments, policy makers, and regulators to establish an institutional framework and national strategies that are planned in an integrated manner in coordination with other development policies.

The multitude of socio-economic and environmental benefits of DRE systems can only be realized with a well-developed national DRE policy[17]. Further, such a policy can help with overcoming the above-mentioned challenges[18]. The design of the policy is context-dependent and needs to take into account local and country-specific circumstances. Generally, there are four dimensions to an enabling policy framework (Fig. 3):

Social / developmental dimension:

- **Job creation and capacity building:** DRE projects must be designed in ways that enable local job creation and income generation. Capacity building and skills training is necessary to create a skilled labour force to service and operate decentralized generation, storage and distribution systems, and to ensure that local communities have the qualifications to fulfil labour market requirements to access these jobs. Further, capacity building will enable local communities to participate in decision-making processes regarding DRE development and therefore enable bottom-up processes focussed on community energy needs. Capacity building should be supported by government policy and programs.

- **Women empowerment:** To leverage above-mentioned opportunities of DRE systems particularly for women, empowerment trainings should be supported as integral part for DRE planning and implementation to enable all community members to be part of decision-making processes through self-belief, building confidence and capacities, and their own ideas for change. This will ensure local communities' energy priorities are sincerely reflected in the energy needs assessment.

- **Social safeguards:** DRE development should not be at the expense of local communities but should provide broader socio-economic benefits. Therefore, DRE development requires strict social safeguards, inclusive, transparent and accountable governance structures, local participation, multi-stakeholder involvement, and safeguarding of all rights including, socio-economic rights. Following the Precautionary Principle, the strongest social and human rights safeguards should apply. DRE projects that may involve land grabbing or forced or involuntary displacement of people should be explicitly excluded from support. The principle of free, prior, and informed consent (FPIC) of indigenous peoples should apply to any project concerning land or resource development.

Economic dimension[19]:

- **Market transformation:** Decentralising power generation requires energy market diversification and liberalisation. For countries with fully or heavily state-controlled energy markets, institutions and policies must be overhauled to support the participation of local governments, communities, and private businesses in electricity production and distribution.

- **Incentives:** Feed-in tariffs (FIT) are guaranteed payments for RE generation and allow flexibility to deliver on- and off-grid depending on a country's needs, emphasising access. FIT for grid-connected renewable energy sources could enable decentralised power generation through ensuring that utilities will accept excess power from small, decentralised producers and make it available to the local network. FIT can also enable communities to pay back soft loans for upfront finance.

- **Access to appropriate finance:** DRE require a different form of finance than utility-scale projects. Therefore, appropriate financial environments must be developed that support DRE projects. These include for example guaranteeing direct access to sustainable financing through the Adaptation Fund or the Green Climate Fund. Other tools are risk-taking instruments, such as bundling for DRE project development. Further, raising awareness among local financial institutions about the opportunities of DRE projects is necessary to help mobilize support and to make upfront finance through soft loans and grants easily accessible for local communities.

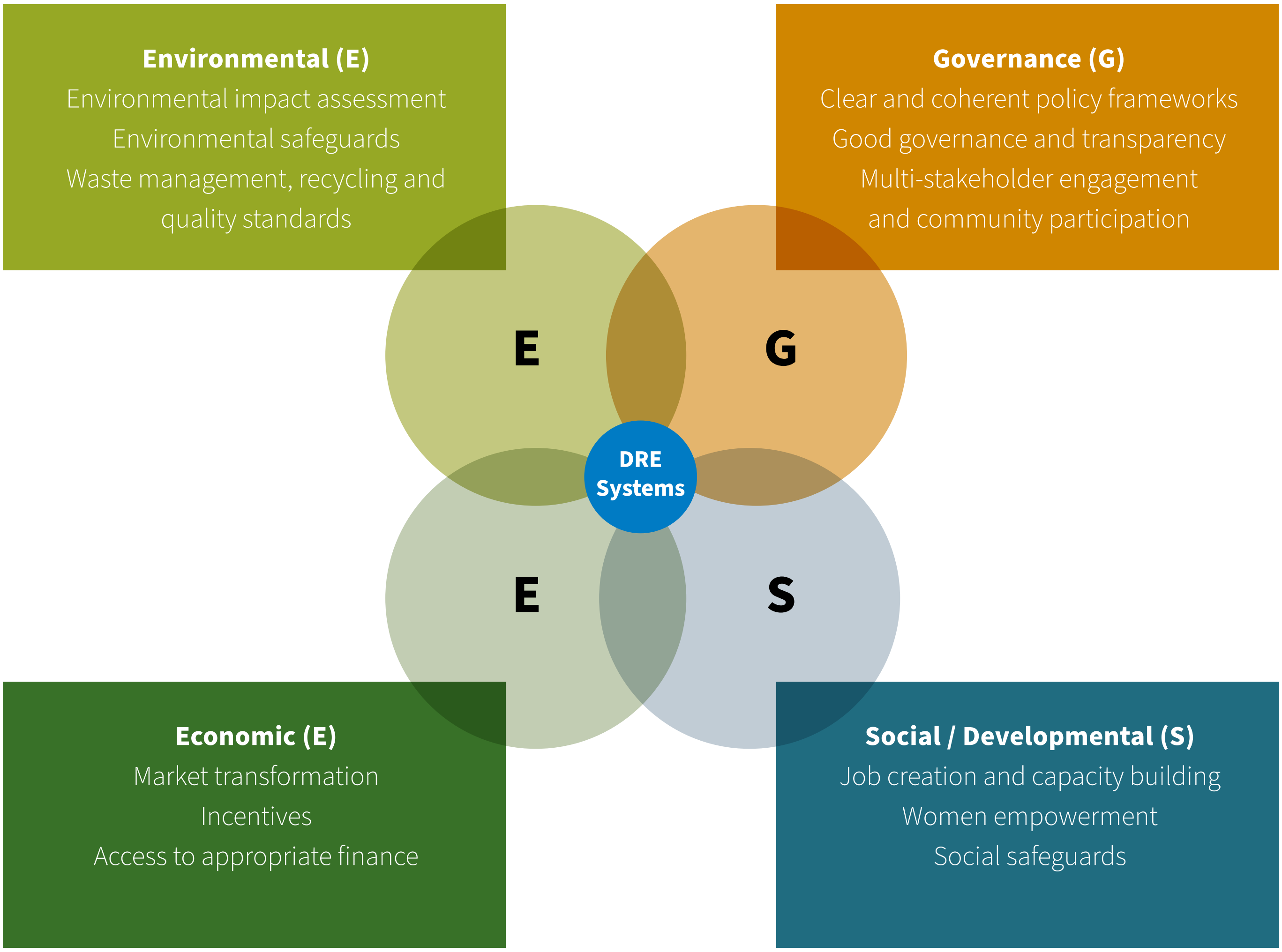

Figure 3: Dimensions of an enabling DRE policy. Adapted from PtX Hub Berlin[20]

Governance

- **Clear and coherent policy:** Creating an enabling policy for DRE systems with clear standards and regulations is key to stimulating investment, mobilizing and capitalising equity, and to accelerating DRE system deployment.

  This framework should be well-adapted to local and country-specific circumstances, be firmly embedded in the broader development plans and national energy strategies, and be in line with the Paris Agreement and the Sustainable Development Goals.

- **Knowledge sharing:** Effective practices, lessons-learned, and technical advice should be shared on local, regional, national levels and between countries.[21] Through the collaboration with other countries, a transfer of knowledge, experience and technologies can take place and promote the progress of successful integration.[22]

- **Good governance and transparency:** General key principles of good governance need to be upheld to ensure that RE initiatives serve the people and the planet. These key principles include effective leadership, transparency, accountability, and multi-stakeholder participation.[23] Further, working towards compliance with human rights and anti-corruption standards should be a prerequisite. This may require institutions and bodies that support relevant national and international government agencies and appropriate transparency mechanisms.

- **Multi-Stakeholder engagement and community participation:** Diverse and meaningful multi-stakeholder input in policy-making is necessary to ensure that decision-makers consider different issues, perspectives, and options, to guarantee that all social and environmental concerns are well considered and integrated in the planning, and to guarantee that strategies perform well for the people. On the local level, this means that communities need to be in the driving seat for DRE project development, implementation, and monitoring. Such multi-stakeholder engagement and civil society participation can ensure community buy-in, prevent external interests from driving development, and guarantee a thorough understanding of the local social and environmental context.

Environmental dimension

- **Environmental impact assessment:** Potential environmental impacts need to be assessed when planning concrete projects. This is particularly true for installations based on bioenergy and hydropower but should be best practice for all types of DRE development starting from the smallest application (e.g. solar water pumps).[24] Based on the results of such assessments, the environmental impact of DRE systems should be minimised.

- **Environmental safeguards:** Strict environmental safeguards for DRE systems should be developed to define measures and processes to effectively manage risks and enhance positive impacts for the environment. Key environmental safeguard considerations should include biodiversity conservation, sustainable natural resource management, pollution prevention and abatement, pesticide use, and greenhouse gas emissions.

- **Waste management, recycling, and quality standards:** To avoid environmental pollution (e.g. through toxic metals such as lead and cadmium), the proliferation of waste, and wastage of natural resources (e.g. of precious metals such as silver, aluminium, copper, and lithium and rare earth minerals) countries need to build a specialised waste management and recycling plan for material of RE technologies including for solar panels and batteries. Further, awareness rising amongst stakeholders is necessary to ensure proper waste management on community level. Last but not least, there is a need to invest in energy infrastructure and long-lasting, high-quality renewable energy technology to avoid avoidable creation of e-waste and negative perceptions of RE in society. To achieve this the development of national quality standards for RE technology is imperative.