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Employment under vertical and horizontal transfer of concentrated solar power technology to North African countries

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A B S T R A C T

The process of renewable energy technology transfer to developing countries can influence the industrialization of their economies and the reduction of their greenhouse gas emissions. There are current plans to deploy large-scale solar and wind capacities in the North Africa countries, including the Mediterranean Solar Plan on the public side and the Desertec Industrial Initiative on the private side. We analyse both plans from a technology transfer perspective, drawing a distinction between vertical transfer – in which intellectual property and manufacturing capacity remains in industrialized countries – and horizontal transfer, in which manufacturing and development skills shift to the developing countries. We find that horizontal technology transfer, when 40% and more of all components are manufactured locally, would bring significantly higher number of job-years to North Africans than vertical technology transfer, and that the greatest number of jobs are induced in the service industries. However, the total job creation will still not provide jobs to all unemployed people in the entire region. A case study of Morocco suggests, however, that employment effects could be important for any country that gains a disproportionate share of new investment. Recent policy developments in North Africa show that national governments started to take into consideration possibilities and benefits of horizontal technology transfer by launching plans of industrial development and introducing the rule of local compensation, which foresees a share of components for large-scale projects to be manufactured locally and by North African enterprises.

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1. Introduction

According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) the level of CO_2 emissions need to decline globally by 50% by 2050 in order to avoid dangerous climate impacts, with reductions of 80% in industrialized countries and regions, such as Europe [28]. The development of large solar generation of electricity for domestic use in North Africa, and its export to Europe via high voltage direct current (HVDC) transmission lines, can be one of the options to reach such ambitious targets [7].

According to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, industrialized countries should transfer renewable energy technologies to developing countries, in order to help them limit and decrease their CO_2 emissions. At the same time, analysts view the transfer of renewable energy technologies as an important element of socio-economic development, helping developing countries to modernize [37]. The current rate of technology transfer appears too slow to meet either objective, and hence would need to increase [19].

Several questions remain open regarding actual benefits of technology transfer programs, which specific case studies can address. In this paper, we examine the case of concentrated solar power (CSP) development in North Africa to identify differences in impacts from scenarios with varying degree of local manufacturing of components and supply chains of CSP industries. We are looking at local versus non-local job creation due to vertical technology transfer, in which intellectual property and manufacturing capacity remains in industrialized countries, and horizontal technology transfer, in which manufacturing and development skills shift to the developing countries. We analyse this in the context of recently proposed CSP growth scenarios for the region, such as the Mediterranean Solar Plan, which foresees 20 GW of renewable energy capacity by 2020 [11,9].

2. Background

2.1. Technology transfer

Until the second half of the 20th century countries closely guarded their technology, seeing it as a source of military and economic power [21]. However, the process of transferring renewable energy technologies (RET) from industrialized to developing countries became seen as an essential step in the global reduction of greenhouse gas emissions ([41,19]). Policy-makers included RET technology transfer as an essential element of the UNFCCC and the Kyoto Protocol.

Classically technology transfer is regarded as a large-scale public investment based on foreign technology and loans from multilateral organizations. These loans have lower interest rates and longer repayment period than commercial loans. In this context, technology transfer takes two forms [25]. The first involves the manufacturing and sale of technology in host countries, while the ownership remains in foreign hands. This is known as *vertical technology transfer*. In this case, new technologies are given via investment to a target group, but there is no transfer of knowledge or skills to local manufacturers. Most often a large multi-national corporation sets its factory in a developing country, with the goal of decreasing costs of operation. In order to minimize the risk of losing intellectual property, management and technical staff are nationals of developed countries, the general workforce is cheap local labour, and the whole enterprise is owned and operated by the multinational company.

Since vertical technology transfer includes only minimal knowledge transfer and domestic capacity building, some scholars claim that it is of little value, and suggest that there needs to be *horizontal technology transfer* [39]. Under horizontal technology transfer a joint venture between a foreign and a local company is established, including technical and business training. This is a more lengthy process but it allows embedding of technology within local population and economy, which can eventually allow local partners to fund, manufacture, operate and maintain new the technologies themselves [15]. Horizontal technology transfer is more preferable to local economies as skills and knowledge are built up in developing countries but makes it more difficult for foreign companies to protect their design and to control the quality of products manufactured by local partners.

The IPCC definition labels technology transfer as a process “covering the flows of know-how, experience and equipment, for mitigating and adapting to climate change among different stakeholders such as governments, private-sector entities, financial institutions, non-governmental organizations and research/educational institutions”, and this favours the horizontal approach [27]. The process can happen through joint ventures, foreign direct investment (FDI), government assistance programs, direct purchases, joint research and development programs, franchising and sale of turnkey plants [27].

Both vertical and horizontal technology transfer involve both private and public partners. The participation of private companies is essential, since they own the rights to most of the renewable energy technologies. Hence, private companies shall be willing to invest in projects, even though the risks are often high in developing countries [23]. The public sector plays a key role through the creation of an adequate institutional framework and industrial market, as well as a favourable investment climate, all of which can reduce the perceived risks [24]. To signal their reliability, national governments often state targets for deployment of different technologies.

2.2. Scenarios for scaling up CSP in North Africa

Today the worldwide installed capacity of CSP plants in operation has reached 2550 MW [34]. The biggest share of the installed capacity is in the United States (85%), followed by Spain (15%). During the last year the European and American solar energy companies started to expand significantly their business to key developing countries, such as the Middle East and North Africa (MENA) region, China, and India.

Currently there are three CSP power plants in construction or operation in Algeria (Hassi R´mel), Morocco (Ain Beni Mathar) and Egypt (Kuraymat). Each of these plants has 20 MW of solar capacity. They all are hybrid projects, generating energy from both gas and solar heat sources. All three CSP plants were developed using the financing from the World Bank and almost all components and equipment for these plants were imported. Projects in the planning stage are much more ambitious. The largest volumes of projects are currently at the planning or operation stage in Morocco (250 MW), followed by Algeria (240 MW), Egypt (110 MW) and Tunisia (50 MW). Additionally, 500 MW CSP power station Noor I is currently under construction in Morocco. This is a large-scale parabolic trough CSP plant in the province of Ouarzazate. The first phase includes construction of 300 MW, during the second phase additions MWs will be added. The finalization of the first phase is planned by the end of the year 2015 (Fig. 1).

There have been several studies demonstrating the feasibility and costs of scaling up of CSP technology in the North African region, coupled with high voltage direct current (HVDC) lines to Europe, entailing transmission losses of only 10–15–15% ([6,42]). The economic potentials for solar energy in the Sahara deserts are much higher than all estimates for local and European