

## Electricity transportation using HVDC technology for Algerian southern sun power plants

**Abstract.** Algeria is worldly known as one of the big producers and exporters of fossil fuels. However, by developing an adequate energy policy, it could become one of the great sun power (SP) producers and exporters. Indeed with almost 2 million Km<sup>2</sup> sunny superficies, the country detains enormous SP energetic potential funds. However, eventual powerful SP plants deployment could be done far to the southern Algerian desert which makes HVDC technology the best candidate for the transmission of produced electricity towards the north region where are the main industrial poles and the most populated regions for local consumption and eventually farther to the north for electricity exportation to the European countries. The propection work presented hereafter is a study on the feasibility of using HVDC technology for such possible projects according to country's existing means and topographical and environmental characteristics.

**Streszczenie.** Algieria jest znana na całym świecie jako jeden z największych producentów i eksporterów paliw kopalnych. Jednak opracowując odpowiednią politykę energetyczną mogłaby stać się jednym z wielkich producentów i eksporterów energii słonecznej (SP). Rzeczywiście, z prawie 2 milionami km<sup>2</sup> słonecznych powierzchni, kraj ten posiada ogromny potencjał energetyczny SP. Jednak ewentualne rozmieszczenie potężnych elektrowni SP mogłoby zostać przeprowadzone daleko na pustyni południowej Algierii, co sprawia, że technologia HVDC jest najlepszym kandydatem do przesyłu wyprodukowanej energii elektrycznej w kierunku regionu północnego, gdzie znajdują się główne bieguny przemysłowe i najbardziej zaludnione regiony do konsumpcji lokalnej i ostatecznie dalej na północ w celu eksportu energii elektrycznej do krajów europejskich. Przedstawione poniżej prace poszukiwawcze są studium wykonalności wykorzystania technologii HVDC do takich możliwych projektów, zgodnie z istniejącymi środkami kraju oraz charakterystyką topograficzną i środowiskową. (**Transport energii elektrycznej z wykorzystaniem technologii HVDC dla południowych elektrowni słonecznych w Algierii**)

**Keywords:** HVDC; electrical power transport; sun power; photovoltaic.

**Słowa kluczowe:** HVDC; przesył energii elektrycznej; moc słoneczna; fotowoltaika.

### Introduction

Electricity power production-consumption industry is largely dependent on the transportation process. Indeed, its importance is directly related to the quality of the delivered electricity, the quality of distribution services, the unitary prices and moreover to some environmental concerns. HVAC (High Voltage Alternative Current) was, for a long time, the mostly used technology for electricity power transportation. This was mainly due to the alternative nature of the produced electricity and also to economical raisons. However, technological advancements, electrical power networks developments and emergent electrical power sources have bring to the fore the HVDC (High Voltage Direct Current) old technology as a competing and alternative technology.

Thanks to decades of active research efforts and huge investments, HVDC (high voltage direct current) technology had become a real and practical alternative to HVAC one. The line cost per Km rapidly became in favor of this new alternative over long distances electrical transportation lines (several hundreds of Km) and for powers beyond 200 MWs. Practical financial studies demonstrate that HVDC losses still around only 3% for 1000 Km overhead lines connection [1]. Moreover, gains in used cables (about 50%) as well as huge reduction in the cost of cable supports make the HVDC technology more suitable according to environmental point of view as well as economically. These facts make HVDC systems the most electrical power transportation mean for powerful electrical interconnections between countries and even more between continents. It also happens that this type of electricity technology is more suitable for certain forms of renewable energies like photo-voltaic (PV) energy since the latter is directly produced in DC form [1], [2].

Thanks to its highly sunny 80% of its superficies (about 2 million Km<sup>2</sup>), Algeria registers one of the worldwide highest sunshine duration from 2,000 to 6,000 Wh/m<sup>2</sup> according to regions. This enormous solar power potential could permit a very high production of clean SP energy which is far exceeding its consumption and could makes the

country an eventual exporter of this type of highly coveted energy. However, like it's demonstrated on the map of figure 1, the most sunny sites for possible mass production of this type of energy are far to the south; which makes HVDC electricity transportation technology a suitable candidate in the case of the country and encourages its adoption..

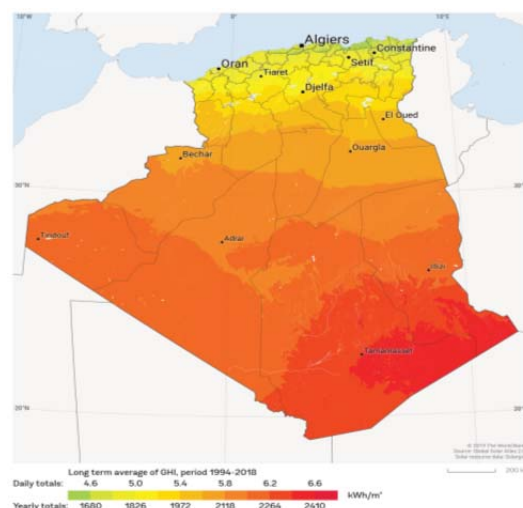


Fig.1. Algerian sunny power distribution zones (kWh/m<sup>2</sup>)

During last decades, researchers, in the HVDC field, were very active and were mainly focused on electronic parts of HVDC systems, especially converters and inverters, the exploitation of SP energy in HVDC form for everyday applications and of course the DC electric power transportation.

This investigating work begin with an overview of the basic notions of the HVDC electrical power transportation system, then a detailed environmental and economic study of the advantages of using HVDC according to the different