Re-assessment of net energy production and greenhouse  gas emissions avoidance after 140 years of photovoltaics development

Liu Jie

Since the 1970s, installed solar photovoltaic capacity has grown tremendously to 230 gigawatt worldwide in 2015, with a growth rate between 1975 and 2015 of 45%. This rapid growth  has led to concerns regarding the energy consumption and greenhouse gas emissions of  photovoltaics production. We present a review of 40 years of photovoltaics development,  analysing the development of energy demand and greenhouse gas emissions associated with photovoltaics production. Here we show strong downward trends of environmental impact of  photovoltaics production, following the experience curve law. For every doubling of installed photovoltaic capacity, energy use decreases by 13 and 12% and greenhouse gas footprints by 17 and 24%, for poly- and monocrystalline based photovoltaic systems, respectively. As a result, we show a break-even between the cumulative disadvantages and benefits of photovoltaics, for both energy use and greenhouse gas emissions, occurs between 1997 and 2018, depending on photovoltaic performance and model uncertainties.

Cumulative installed solar photovoltaic (PV) capacity  (CIPC) grew from less than 1MWp in 1975 to around 180GWp at the end of 2014 (refs 1–3), with a compound  annual growth rate (CAGR) of 45%. As shown in Fig. 1, major  installation markets at the beginning of the 1990s were Japan and  Italy, but from 2005 to 2014 Germany was the leading PV market  in terms of CIPC4. It is expected that China will surpass Germany  as the country with the largest CIPC during 20155. The strong  growth (Louwen et al. 2016)

# References

Louwen, Atse, Wilfried G. J. H. M. van Sark, André P. C. Faaij, and Ruud E. I. Schropp. 2016. “Re-Assessment of Net Energy Production and Greenhouse Gas Emissions Avoidance after 40 Years of Photovoltaics Development”. *Nature Communications* 7 (1). <https://doi.org/10.1038/ncomms13728.>