the other hand, hybrid forms of electricity generation, including photovoltaics, will play an important role in the future development of stand-alone applications and minigrids. The general cost reduction will make photovoltaics available to more and more people in developing countries helping their development with little degradation of air quality associated with fossil-fuel generators.

In summary, it is very likely that photovoltaics will become in the next half century an important source of world electricity. Public support and global environmental concerns will keep photovoltaics viable, visible, and vigorous both in new technical developments and user applications. Nations which encourage photovoltaics will be leaders in this shining new technology, leading the way to a cleaner, more equitable twenty-first century, while those that ignore or suppress photovoltaics will be left behind in the green, economic energy revolution.

## REFERENCES

- 1. Benka S, *Phys. Today* 38, 39 (2002); adapted from Pasternak A, Lawrence Livermore Natl. Lab report UCRL\_ID\_140773 (October 2000).
- We acknowledge Dr. Larry Kazmerski of NREL, and coauthor of Chap. 24, for developing the "myths of PV" concept as a way of dispelling common misunderstandings and issues in PV. See his paper Renewable Energy World, August 2002, 175–183.
- 3. "Energy System Emissions and Material Requirements", Meridian Corporation (Alexandria VA) report prepared for the Deputy Assistant Secretary for Renewable Energy of the USA (1989).
- Kelly H, Weinberg C, in Johansson T *et al.* (Eds), *Renewable Energy*, 1011–1069, Island Press, Washington, DC (1993).
- 5. Maycock P, Renewable Energy World 3, 59-74 (2000).
- 6. Fthenakis V, Moskowitz P, Prog. Photovolt. 8, 27-38 (2000).
- 7. Tsou Y et al., Proc. 2<sup>nd</sup> World Conf. Photovoltaic Energy Conversion, 1199–1204 (1998).
- 8. See Papers contained in Proc. of Photovoltaic Safety Conf., Sol. Cells 19, 189-397 (1987).
- 9. See Papers contained in Proc. of Workshop on Environmental Aspects of PV Systems, *Prog. Photovolt.* 6, 87–146 (1998).
- 10. www.pv.bnl.gov.
- 11. Fthenakis V, Moskowitz P, Prog. Photovolt. 3, 295-306 (1995).
- Patterson M, Turner A, Sadeghi M, Marshall R, Proc. 12<sup>th</sup> Euro Photovoltaic Solar Energy Conf., 951–953 (1994).
- 13. Fthenakis V et al., Prog. Photovolt. 7, 489-497 (1999).
- 14. Bohland J, Smigielski K, Proc. 28th IEEE Photovoltaic Specialist Conf., 575-578 (2000).
- 15. Moskowitz P, Fthenakis V, Sol. Cells 31, 513-525 (1993).
- 16. Moscowitz P, Fthenakis V, Sol. Cells 29, 63-71 (1990).
- 17. Fthanakis V, Eberspacher C, Moskowitz P, Prog. Photovolt. 4, 447-456 (1996).
- Bohland J, Dapkus T, Kamm K, Proc. 2<sup>nd</sup> IEEE World Photovoltaic Specialists Conf., 716–719 (1998).
- 19. Alsema E, Prog. Photovolt. 8, 17-25 (2000).
- 20. Keoleian G, Lewis G, Prog. Photovolt. 5, 287-300 (1997).
- 21. Knapp K, Jester T, 16<sup>th</sup> Euro Photovoltaic Solar Energy Conf., 2053–2056 (2000).
- 22. Fritts C, Proc. Am. Assoc. Adv. Sci. 33, 97 (1883).
- 23. Chapin D, Fuller C, Pearson G, J. Appl. Phys. 25, 676, 677 (1954).
- 24. Reynolds D, Leies G, Antes L, Marburger R, Phys. Rev. 96, 533, 534 (1954).
- 25. Jenny D, Loferski J, Rappaport P, Phys. Rev. 101, 1208, 1209 (1956).
- 26. Prince M, J. Appl. Phys. 26, 534-540 (1955).