Part V

The Future

We have mentioned the future in other parts of the book. It is always risky to predict the unpredictable, but still we dare to do so, not only to have something to laugh at in a few years but also to express an ambition for today. For example, before 2010 there was quite a slow increase in solar PV installations, and I was fairly hesitant about its potential to replace conventional energy sources in the next few decades. However, its development took off soon after that at a rate that we had thought impossible. Technical, commercial and environmental forces have cooperated to make it possible. In the last chapter of the book we dare to express some ambitions for the next decades.

Chapter 15

Outlook to 2030 and further

"World electricity demand is expected to grow by more than 50% by 2030,
mostly in developing and emerging economies.
To meet this demand while also realising global development
and sustainability goals, governments must implement
policies that enable solar to achieve its full potential."

Adnan Z. Amin, IRENA Director-General, 2016.

The year 2030 is only 12 years away. Many organisations have published predictions for 2030 and further ahead and they are in general ambitious and optimistic. Predicting the unpredictable may give us a laugh when we read it again after a few years; but looking back is easy. It can be useful, but speculation about the future propels us forward; and there is no time to waste.

15.1 PREDICTIONS FOR RENEWABLES

IRENA (2016b, 2017a) envision an optimistic and ambitious goal for renewables. According to their prediction and ambition there will by 2030 be a doubling of the energy share from renewables, up to 36%. The share of solar PV is expected to increase six times, up to 7% of the

doi: 10.2166/9781780409443_0175

The share of solar PV is expected to increase six times, up to 7% of the global power generation in 2030. Some even more optimistic predictions say 13%. Naturally, this will require a combination of technology development, policy development and active financing instruments and investments.

The ownership of power production is going through a crucial change. Electric power systems were once dominated by monolithic state agencies and large corporations. With small-scale power generation there is now an increasing number of owners and producers. This will also change attitudes and responsibilities for the systems.

Individual welfare issues like personal health and education as well as climate benefits have been emphasised and should not be underestimated. Solar PV and wind have limited water requirements; instead they are power sources for water supply and water reuse.

It is apparent that prices for both power generation and energy storage will fall rapidly. However, cost and availability of capital will still be a major challenge since most of the price tag for renewables is up-front capital cost.

There are obvious reasons to look carefully at the potential development of sub-Saharan regions. IRENA (2013) is an informative account of the development of renewables in Africa. IEA has produced *African Energy Outlook,* the first of its kind to provide a far-reaching picture of the energy situation in sub-Saharan countries today and in the future (IEA, 2017d). This region contains 13% of the global population, but only 4% of its energy demand. However, since 2000 energy use in the region has risen by 45%, which is one indicator of rapid economic growth.

As noted in Section 1.3, grid connections are often unreliable. This makes it necessary to invest in costly private use of backup generators running on diesel or gasoline. IEA predicts that 70% of those gaining access to electricity in rural areas by 2040 will be connected to mini-grids or off-grid systems. A gloomy prediction, however, is that more than 500 million people, mainly in rural areas, will still be without electricity in 2040. IEA predicts that around two-thirds of the off-grid and mini-grid rural systems in 2040 will be powered by solar PV, wind or hydropower. Renewable systems will be increasingly competitive compared to diesel generators.

15.2 DESALINATION RESEARCH AND DEVELOPMENT

It is an important research topic to adapt desalination technology to the variability of renewable energy sources. The intermittent power production of solar PV implies that solar-powered desalination membranes will undoubtedly operate outside their optimum operation window. Therefore, it is essential to investigate the long-term reliability of variable and intermittent operation (non-stable pressure and flow rate) on membrane reliability. This includes salt passage at the ion level, fouling (colloidal, biological and organic) and scaling (mineral and salt precipitates) of membranes (Lienhard *et al.*, 2016; Zaragoza, 2018).

A lot of research is ongoing into finding new types of membranes for RO. Graphene is one of the strongest materials known. A graphene membrane is only one atom layer thick and has much higher permeability than today's membranes. This means that less pressure and electric energy will be required for desalination.

Other challenges include the overall design and optimisation of the components in the integrated system. Control and management aspects should be taken into consideration at the design stage so that the energy flow in the system can be assured for all possible operational conditions.

Another challenge is related to small-scale technology. Small-scale operations struggle to be cost-competitive with utility-scale water operations.

15.3 SOFT ISSUES

Supplying clean water using renewable energy includes many "soft" issues, as described in the preceding chapters.

Integration between energy supply and water operations should be better understood. It is essential that energy production is adapted to the needs from the loads such as the pumps, desalination units and water remediation units.

15.3.1 Education and training

Off-grid energy generation and water operations are small-scale and decentralised. There are lessons to learn from experiences so far,

and some are summarised in IEA (2014). There are problems beyond technology challenges. Many projects have failed due to inappropriate or unclear organisation of operating and maintaining systems. There must be a good understanding of the needs of the users. Similarly, it is important to make realistic estimates of current and future power needs. There are two aspects of education and training: (1) the required education to make the best use of renewable energy and water facilities and (2) the impact of access to electricity on education.

Developments of projects occur locally. We have emphasised the urgent need for training and education. There is a need for increased knowledge at all levels: among the customers and users as well as locals who can be part of the workforce to mount, install and maintain clean water operations in the neighbourhood. Such developments can create local jobs and incomes.

Access to water and energy will of course develop rural areas in terms of agricultural improvements, productivity, income and better living conditions.

Healthcare, education, home environment: all benefit from access to modern energy and to clean water. The modularity of the energy and water operations also means that they can be customised to individual needs and applications.

The impact of access to electricity on education is illustrated in 2.2. Available electricity can also contribute to people's daily habits and activity scheduling, and people's active day may be extended. These issues are analysed in detail in Riva *et al*. (2018).

15.4 FURTHER READING

SNV, a not-for-profit international development organisation, was founded in the Netherlands more than 50 years ago. SNV has a long-term, local presence in the poorest countries in Asia, Africa and Latin America. It has published an excellent training manual for solar PV (SNV, 2015).

IEA (www.iea.org), IRENA (www.irena.org) and the World Bank (www.worldbank.org) make regular updates to their predictions for renewable energy. Water and sanitation aspects are the focus for several speciality groups within IWA (www.iwa-network.org).