

Chapter 5

Conclusions and Policy Recommendations

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Chapter 5

Conclusions and Policy Recommendations

1. Conclusions

- (1) High shares of renewable energies can only be achieved with strong policy measures against climate change.
- ✓ Variable renewable energies (VRE), i.e., solar photovoltaic (PV) and wind, would be diffused in the targeted regions if people accept strong policy measures to combat climate change. The reasons why we need strong measures are: (i) solar PV has intermittency, (ii) the capacity credit of solar PV is lower than that of thermal power, (iii) wind power is expected to be more costly than fossil fuels and other renewables, and (iv) fossil fuel prices are not projected to rise considerably in the long term because of anticipated ambitious climate actions worldwide. Even if solar PV costs fall further to the 2050 levels, its diffusion would still require strong policy measures.
- ✓ Hydro and geothermal power are expected to penetrate fully with strong policy measures and grid interconnection expansion. However, it should be noted that hydropower may be affected by seasonal fluctuations that have not been taken into account in this study, and geothermal power would be exploited only in limited countries, such as Indonesia and Viet Nam.
- ✓ Given these limitations and the challenges associated with the expansion of renewables, the maximum exploitation of hydro potentials by grid interconnection expansion is one of the most efficient measures for achieving a high share of renewable energy.
- ✓ If strong policy measures, such as the implementation of feed-in tariff systems, are realised in the targeted nations, VRE capacities would expand more rapidly. In this case, solar PV will be diffused rapidly in such countries/regions as Thailand, Peninsular Malaysia, and Viet Nam, whilst wind power will emerge in Viet Nam. This is partly because these regions are not endowed with large hydropower potential to meet demand, so they have to rely on solar PV and wind power instead.
- ✓ At the same time, if the governments introduce strong policy measures against climate change, both coal- and gas-fired power may be less cost-competitive in the long term, and their outputs would decrease in all the regions, whilst Singapore would utilise gas-fired power with carbon capture and storage (CCS).

- (2) Further investment in grid interconnection can also contribute greatly to CO₂ emissions reduction, cost minimisation, and energy security.
- ✓ Grid interconnection enhancement would help to maximise the utilisation of the carbon-free and less expensive hydropower potential, especially in Lao PDR and Myanmar; with larger deployment of hydro facilities, investment in further expansion of grid interconnection would lead to lower CO₂ emissions and total costs at the same time.
 - ✓ If the share of VRE exceeds 15%, the required battery capacities would increase rapidly, resulting in considerable cost hikes. This constitutes a major challenge related to high VRE penetration. With larger use of grid interconnection and hydropower, however, the required capacities of solar PV and batteries become smaller.
 - ✓ The net benefits of interconnection would increase in line with strong policy measures. They would also rise as the grid capacities expand beyond the planned levels.
 - ✓ Interconnection expansion would contribute to achieving higher shares of renewables, reducing the dependence on thermal power with imports of liquefied natural gas and other fuels. This would translate to the enhancement of the energy security of the region.
- (3) The optimal energy mix may change with explicit consideration of higher fossil fuel prices, external costs, and economic development levels.
- ✓ Higher fossil fuel prices and the internalisation of external costs on fossil fuels would have similar effects to higher carbon pricing. These would lead to higher renewable ratios because of the higher relative competitiveness of renewables. Internalising health-related external costs on fossil fuels may drastically reduce the optimal thermal power shares.
 - ✓ With different intensities of decarbonisation policies, dependent on the degree of economic development, grid interconnection may contribute to the redistribution of income, although with possible increases in CO₂ emissions.
- (4) Nuclear can be a viable option as a proven low-carbon technology.
- ✓ In the hypothetical case without nuclear capacity limits, nuclear power would be introduced massively in Singapore, Peninsular Malaysia, Thailand, and Viet Nam if the governments introduce strong policy measures against climate change. However, in the countries/regions endowed with large renewable resources, the introduction of nuclear power may not be a priority.
 - ✓ Nuclear can contribute to the further reduction of CO₂ emissions and total costs. Pursuing the cost-optimal mix of low-carbon technologies would involve the promotion of nuclear power. However, intrinsic problems related to accident risks and waste management have to be addressed properly.

1.4. Policy recommendations

- Given the projected low fuel prices, the governments would need strong policy measures, such as feed-in tariff systems, to promote renewable energies, including VRE, even though the LCOE of these technologies will decline significantly in the long term. Without such measures, the high dependence on fossil-fuel fired thermal power generation may not be changed by and large.
- The governments should promote power grid interconnection expansion, at least to the planned scale, as it would help realise CO₂ emissions reductions, cost minimisation, and energy security at the same time. The governments should consider further interconnection, since it would lead to larger net benefits with stronger policy measures towards climate change. In doing so, it should be examined carefully which specific lines are the most beneficial.
- Not only strong policy measures but also other factors including the costs of VRE, international energy prices, externalities, and utilisation of nuclear can exert large impacts on the optimal diffusion of renewable energies. For this reason, the governments should continue revising future VRE diffusion targets, always taking into account the latest situation.
- As achieving very high shares of renewable energies may induce significant cost increases, the governments should also consider other decarbonising options, such as the use of fossil fuels with CCS, hydrogen, ammonia, and nuclear power. Nonetheless, we should seek to maximise VRE diffusion by implementing such measures as introducing batteries and other flexibility technologies.
- Likewise, 100% decarbonisation of the power sector may be very challenging with considerable cost increases and might be viewed as giving too much priority to CO₂ emissions reduction. However, we should also note the inevitable need to decarbonize energy systems, given the growing global concerns about climate change. The governments should seek for a well-balanced policy mix, considering not only economic effectiveness but also environmental issues and energy security at the same time. With the existing grid interconnection, the total annual cost increases from US\$30,585 million/year in the base case to US\$36,323 million/year in the 40% solar PV case. The results imply that offshore wind power will be introduced with high shares of solar PV because the two technologies are complementary, generating electricity at different times.