LONG-TERM SUSTAINABILITY AND DEPLOYMENT STRATEGIES FOR ACHIEVING RAPID GEOTHERMAL GROWTH - INSIGHTS & EXAMPLES FROM IEA-GIA COLLABORATION

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ABSTRACT

Collaboration with other International Energy Agency- Geothermal Implementing Agreement (IEA-GIA) member countries helps identify and solve problems related to long-term sustainability of existing geothermal developments. For new projects, collaboration also provides guiding examples of successful deployment strategies that have previously achieved high regional growth rates. In some cases, despite long-term planning requirements, these growth rates have exceeded 20% per year.

For a geothermal resource, the optimum level of long-term sustainable production depends on its characteristics, but success can be achieved by properly managing fluid production and injection rates and locations. Practical fluid recharge and resource recovery occurs on time scales of the same order as the lifetime of the production cycle, depending on the ratio of extraction rate to natural heat output. Recovery is influenced by an enhanced recharge driven by strong pressure and temperature gradients. These are initially created by the fluid and heat extraction. Sustainable reservoir management involves countering the adverse effects of premature pressure and temperature decline with appropriate production and injection strategies. These may need to be adjusted at times, in order to achieve the correct balance. Flexibility in locating and utilizing future injection wells, both inside and outside the hydrological edges of a geothermal reservoir, is a key means of achieving a successful outcome.

Practical geothermal environmental management is also best achieved through seeking a balance: to avoid or mitigate adverse effects, whilst promoting beneficial effects. With acquired knowledge about the use of injection to locally sustain pressures, perceptions regarding adverse effects are gradually changing. Advanced monitoring tools provide managers with the best means of optimizing sustainability. These include: geochemical tracers, seismicity, reservoir pressure, temperature and flow transients, micro-gravity, gas and heat flux changes. All of this information is increasingly being incorporated in the calibration of more-sophisticated reservoir simulation models. Such models provide better planning tools for prediction purposes. However, nothing beats actual experience when it comes to planning and adjusting production strategies to achieve prolonged sustainability. Hence, it is important to share such experience.

Examples of recent geothermal growth rates that have exceeded 20% per year include Iceland and New Zealand. In the case of New Zealand, where generation doubled from 2006 to 2012, figure 1 illustrates the history of geothermal electricity generation compared to other renewable and fossil fuel energy sources. The projections out to 2020 are based on known project plans and economics. Long-run marginal cost favours geothermal for the next 1000 MW of new generation capacity, assuming 8% discount rate, $25/tonne average carbon emission charges, and 1.2%/year average demand growth. For both Iceland and New Zealand, the key for future growth will be demand driven. This will probably require better grid interconnection of baseload supply to high-value markets (eg. Europe and Australia) where incentives for renewable electricity are in place. Resource assessment for future expansion and replacement of depleted resources will focus on deeper and hotter roots of known geothermal systems, for which research into accessing and utilizing super-critical temperature fluids is essential. Other factors will include keeping costs down by sustaining an efficient in-country drilling and power-plant construction capability, and maintaining high drilling success rates (>85%). For increased direct use, some novel technology developments will further increase the use of geothermal heat, especially in the food, wood and mineral processing industries. Finally, applied geoscientific effort will continue to significantly reduce the investment risks, by demonstrating successful mitigation of adverse environmental impacts, and by applying adaptive injection management strategies to facilitate long-term utilization sustainability.

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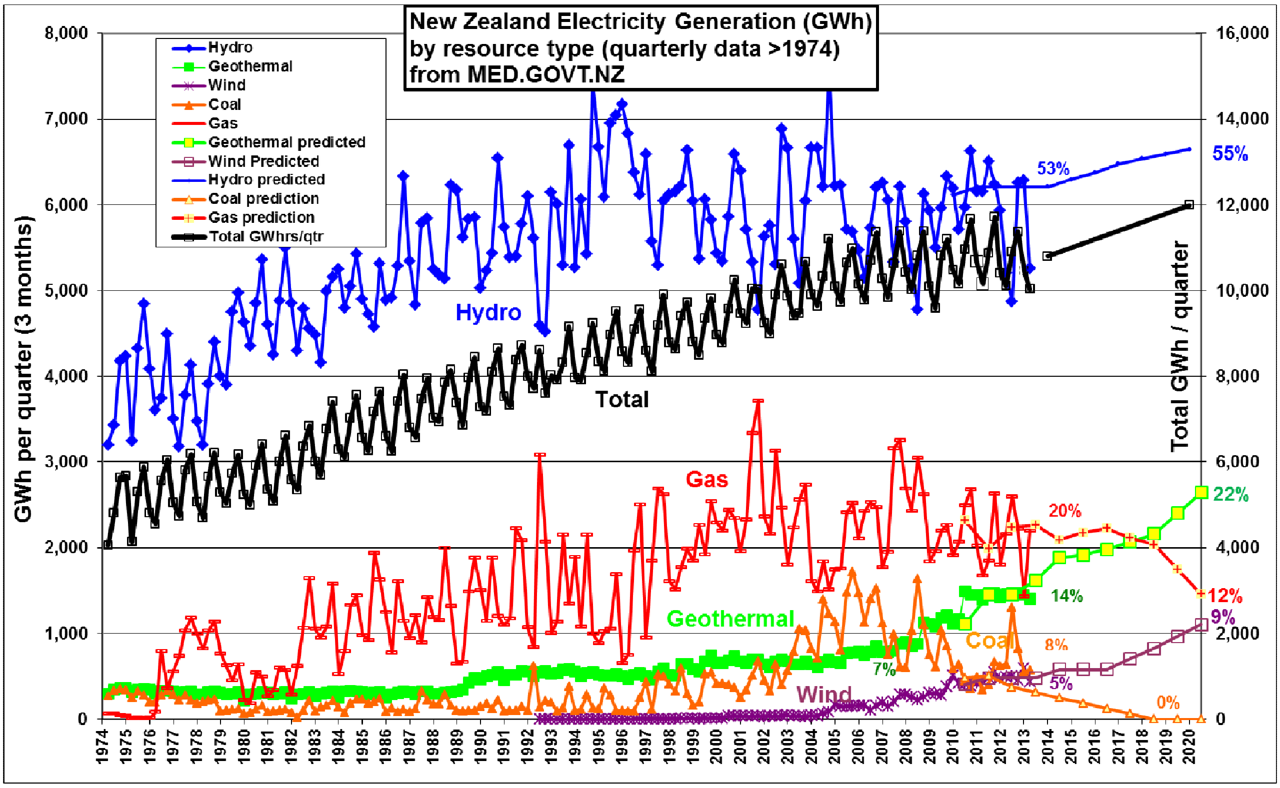

Figure 1.An example from New Zealand of geothermal electricity growth history and projections to 2020, in comparison with other renewable and fossil-fuelled energy sources. The objective is to reach 90% renewable by 2025.