

# National Energy Strategies: Summary Report

Thomas J. Smith, MEng Electronic Engineering with Power Systems

**Abstract**—Energy strategy is a politically emotive issue, with impacts permeating many aspects of modern life. It determines how the energy trilemma of cost, security and emissions is balanced. This report takes Italy as a case study, formulates an effective energy strategy and evaluates some of the potential impacts. This energy policy is then considered in a Malaysian context. The energy policy would require some adaption to be applied successfully in this context. It is concluded that although all energy strategies are trying to solve the same energy trilemma, countries have different priorities leading to alternative compromises. It remains to be seen if this fragmented approach to the energy trilemma will succeed in tackling the global issue of climate change.

## I. INTRODUCTION

**W**ORLDWIDE energy networks face a period of unprecedented investment and change. A potent mix of political, economic, environmental and technological factors make solving the energy trilemma an exercise in compromise. An energy strategy that effectively addresses the trilemma of cost, security and emissions [1] is vital to secure the continued development and prosperity of a nation.

## II. THE ITALIAN CONTEXT

Located in Southern Europe, Italy can be seen extending into the central Mediterranean Sea, to the north of Tunisia. GDP per inhabitant is approximately equal to the European average [2], making Italy a relatively affluent country in worldwide terms. The Economist ranked Italy eighth in terms of quality of life in the world [3]. The infrastructure in Italy is thereby well developed, but ageing.

The current energy mix is dominated by fossil fuels. In 2010, 82.7% of gross primary energy demand was met by fossil fuels [4]. Italy has limited native reserves, leading to 82% of primary energy being imported [4]. The electricity generation mix is also dominated by fossil fuels, with thermoelectric generation making up 76% of all generation [4]. Dependence on imported fossil fuels has led to Italy having the fourth highest electricity prices in Europe [5].

## III. PROPOSED ENERGY STRATEGY

The major challenge facing Italian energy policy is how to bring down energy prices, while moving toward a sustainable and secure future. High energy costs are not just a social issue, but can damage the economy of a country by driving away heavy industry and manufacturing. By decreasing the dependence on expensive imported fossil fuels, Italy can move toward a low carbon future while decreasing costs in the long term. This decrease can be achieved in the following three ways:

### A. Increased Solar

Italy is one of the sunnier locations in the EU. Although countries such as Spain, Portugal, Cyprus and Turkey are comparatively sunnier, yearly irradiation for optimally-inclined Photovoltaic (PV) modules still exceeds the market leader Germany by 400 kWh/m<sup>2</sup> [6]. The potential role for PV and Concentrating Solar Plants (CSP) are great. The European Photovoltaic Industry Association suggests that PV installations could total over 40GW by 2020 [7].

Recent energy policy has been adapted to exploit this. Through the *costa d'energia* bill passed in 2010, the effective capacity doubled between 2010 and 2011 [8]. This was due to an extremely generous feed in tariff scheme. Increasing capacity at such a rapid rate is unsustainable [9]. The strategy proposed is to increase the role of solar generation in the energy mix but in a regulated environment with staged introduction.

Increasing the role of solar power makes economic sense in Italy. A Deutsche Bank report stated that grid parity had been achieved in Italy [10]. This indicates that solar generation is competitive with grid electricity.

### B. Increased Wind

In a similar fashion to solar power, the Italian government has already made moves towards increasing the role of wind power in the generation mix. In 2012 a record 720 new turbines were deployed increasing installed capacity to just over 8GW supplying 4% of electricity demand [11].

The proposition of this strategy is to further increase the role wind power has in the generation mix. There are some significant technical challenges with increased wind generation, which are discussed by the European Wind Energy Association [12]. Corruption in the sector is a specific challenge to Italian wind generation. It was recently reported that the Italian mafia had been using wind investment to launder money and take advantage of generous incentives [13]. This has severely damaged investor confidence in Italy.

Despite these challenges wind power remains an important renewable resource. With ongoing global investment in technology, significant deployment in other EU countries and the potential for carbon free generation, it is a sensible proposition for wind to play a greater part in the Italian generation mix.

### C. Increased Trade

The unique location of Italy will allow the interconnection of European and North African grid networks. This will be achieved by HVDC interconnection. This will allow trade with countries where large amounts of cheap solar energy can be produced [14].

There is already a considerable supply chain for this type of technology in Italy. Expertise was gained from deployment of HVDC connections between Italy and Tunisia and Italy and Greece [15]. The interconnection of the European grid and the North African grid is a much larger project, but the principle technology remains the same.

Beside the opportunity to import cheaper solar thermal electricity generated in North Africa, there is an opportunity for Italy to profit further from the interconnection. Italy can charge for energy transfer through the existing high voltage grid to other European countries.

Issues remain due to the technological challenges with HVDC transmission, and the bottle necks in the current Italian HV grid. Further, trade does not necessarily placate the energy security issue with conventional sources, as it exposes Italian import prices to the whim of foreign and possibly volatile governments. However, increasing the capacity to trade with North Africa should be seriously considered.

#### *D. Wider Perspective*

Any energy policy which promotes a limited generation mix risks energy security. This policy does not suggest that the energy mix should be made up entirely of these three technologies, merely that the relative proportion of each technology should increase. There will remain a role for installed hydro-generation capacity and the most efficient CCGT stations.

Nuclear power has not been considered so far in this report. In 2011 the Italian government held a referendum on generating 25% of electricity from nuclear by 2030 [16]. An overwhelming majority of 90% of the public voted against nuclear [17]. In my personal opinion the decision to abandon nuclear power in Italy is a poor strategic choice. From a technological perspective, nuclear plays an important role in the low carbon generation mix as one of the only large scale base load options. However, the socio-political aspect of this issue cannot be neglected. In 2011, 15% of electricity was imported. The irony is that most of this was from French nuclear stations [16]. The Italian government must reconsider it's position on nuclear and work towards changing public opinion in order to reduce it's dependency on imported fossil fuels.

However, the increasing availability of solar, wind and trade will allow Italy to move toward a renewable future whilst lowering prices in the long term.

#### IV. THE MALAYSIAN CONTEXT

Located in Southeast Asia, Malaysia primarily consists of two regions, Peninsular Malaysia and Malaysian Borneo. In 2012, Malaysia was the third largest economy in South East Asia, behind Indonesia and Thailand [18]. The main industries in Malaysia include the manufacture and processing of rubber and palm oil, electronics and logging and timber processing.

Malaysian energy policy was introduced in 1979 with an aim to diversify the generation mix from the four main fuel sources of coal, oil, gas and hydro. In 2010 over 90% of electricity generation came from fossil fuel sources [19]. Malaysia is a large producer of fossil fuels, in 2012 it exported the second

largest amount of LNG after Qatar, although reserves are growing short in supply [20].

The issues facing Malaysian energy strategy are therefore very similar to the Italian context in that they both depend heavily on fossil fuels. A major point of difference is the economic development of each country. Italy is well developed, meaning that energy demand is expected to remain relatively constant, where as in Malaysia, demand is expected to increase by 3.1% annually to 2020 [20].

#### V. APPLICATION OF ENERGY STRATEGY

The energy strategy for Malaysia must tackle the energy trilemma effectively. Considering the economic development of Malaysia, it would be reasonable for the compromise to favour cost reduction. Heavy focus on new and expensive renewable technology may not be the optimum strategy in this context.

Hydropower has not been discussed so far in this report. In an Italian context, all sites suitable for large-scale hydro-generation are already utilised and there is little expansion possible in the sector. This is not the case in Malaysia. Hydro generation is one of the most useful renewable technologies in terms of addressing the energy trilemma. It is dispatchable, secure, carbon free and relatively cheap. There are several locations within Malaysia that could be exploited, including the Sarawak basin with a potential capacity of 28GW [21].

Nuclear power is also a consideration in Malaysia, with plans to build two new nuclear plants by 2021 [20]. This has encountered some delays due to the Fukushima disaster in 2011. However, with a peak demand of just 26GW [20], two new nuclear stations could make a significant step toward diversifying the energy mix and providing a low carbon base load.

Wind, solar, trade and fossil fuels will form some part of the future Malaysian energy policy. However, focusing on deploying new hydro generation and new nuclear generation are two important ways to diversify the energy mix, reduce dependence on fossil fuels and reduce emissions.

#### VI. CONCLUSION

The evolution of the energy strategy over the next 40 years will be costly and politically controversial. We have considered some of the various technologies that could be deployed in different national contexts. This highlights the importance of context when developing energy strategy. A blanket energy strategy cannot be developed. However, it remains to be seen whether this fragmented, decentralised approach to the global challenge of climate change will be effective in the long term.

## REFERENCES

- [1] World Energy Council, *World Energy Trilemma 2013: Time to get real*. 2013.
- [2] European Commission Eurostat, *GDP per Inhabitant Varied by One to Six Across the EU27 Member States*. June 2009.
- [3] The Economist, *The Economist Intelligence Unit's quality-of-life index* 2005.
- [4] C. Cammi and M. Assanelli *An Overview of Italy's Energy Mix* Institut Français des Relations Internationales, 2012.
- [5] European Commission Eurostat *Electricity and Natural Gas Price Statistics* 2013.
- [6] Solar GIS *Global Horizontal Irradiation - EU Map* 2011.
- [7] European Photovoltaics Industry Association *Global Market Outlook 2013-2017* 2013.
- [8] Gestore Servizi Energetici *Statistical Report 2011*
- [9] S.Schneider *Power spot price models with negative prices* Munich University, 2013
- [10] B.Beetz *Deutsche Bank: Sustainable Solar Market Expected in 2014* PV Magazine, 2013
- [11] H.Holttinen *IEA Wind 2012 Annual Report* International Energy Agency 2012
- [12] European Wind Energy Association *Wind Power and the Environment - benefits and challenges* 2006
- [13] B.Henderson *Italy's mafia turns to wind farms to launder money* The Telegraph Online 2013
- [14] Desertec Foundation *The Desertec Concept* 2013
- [15] M.R.Guarniere *Elmed Project: Technical characteristics of the interconnection and Terna HVDC experience* Tunisian Engineering Department 2008
- [16] World Nuclear Association *Nuclear Power in Italy* 2013
- [17] D.Kennedy *Italy Nuclear: Berlusconi accepts referendum blow* BBC News Online 2011
- [18] International Monetary Fund *World Economic Outlook Database* 2012
- [19] C.S.Tan, K.Maragatham, Y.P.Leong *Electricity Energy Outlook in Malaysia* 4th International Conference on Energy and Environment, IOP Publishing, 2013
- [20] U.S. Energy Information Administration *Malaysia: Full Report* 2013
- [21] F.Kan *Malaysia needs to revive Sarawak hydropower plans - Tenaga Chairman* Reuters Online, 2013