

## ESC Subcommittee on Ensuring Energy Resilience and Sustainable Growth

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### A SMART ENERGY ECONOMY: RESILIENT, SUSTAINABLE AND INNOVATIVE

#### Energy prices, carbon and security will pose challenges

1. The global energy landscape has witnessed a dramatic shift in recent years. There is a growing thirst for energy – driven primarily by Asia’s urbanisation and economic development – and the cost of energy production is rising as traditional sources of energy are depleted and the world turns to unconventional fuels that are more difficult to extract. Economic fundamentals suggest that the long term trend of energy prices will inevitably be upwards, and price volatility will continue to be a feature of global markets.
2. Climate change is a pressing environmental issue that the world will have to grapple with. Even though the Copenhagen Summit failed to reach a global agreement to reduce carbon emissions, climate change will continue to weigh heavily on the minds of political leaders and citizens. Singapore has made a commitment to cut its carbon emissions by 16 percent below business-as-usual (BAU) levels by 2020, provided a legally-binding global agreement is reached; all countries will have to factor in the cost of carbon emissions and other externalities when making choices about economic strategy and energy mix.
3. Energy security concerns will be heightened as a growing mismatch between regions with abundant energy resources and those with rapidly growing demand results in greater dependence on energy imports. As Asia becomes a net importer of energy, there will be a concomitant push to secure energy resources for domestic needs. Periodic economic and geopolitical uncertainties may hinder sustained long term investments in infrastructure required to unlock both traditional and renewable energy sources.

#### Technology can help us overcome energy challenges

4. Science and technology will play a pivotal role in helping the world meet these pressing energy challenges. The quest for alternatives to fossil fuels has been undertaken through the development of solar, wind, geothermal and next-generation nuclear power generation. Traditional energy sources have also seen technology re-shape their prospects: carbon capture and storage (CCS) can potentially alleviate the environmental impact of conventional coal-fired power generation. The maturing of technologies for obtaining natural gas from shale will bring on-stream significant supplies of this relatively cleaner fossil fuel. On the demand-side, low-

carbon alternatives to everyday appliances and machines are being developed: from electric vehicles, to smart grids and greener buildings.

*Singapore's energy position is strong but we must keep abreast of global energy developments*

5. Singapore is in a healthy energy position with power generation capacity sufficient to support electricity demand growth for the next decade. The move towards combined cycle gas turbines has made our electricity generation cleaner, more efficient and responsive. The development of our liquefied natural gas (LNG) terminal will enhance energy security by enabling access to diverse sources of natural gas. Over the years, we have built a conducive environment for research, development and test-bedding that allows us to benefit from economic opportunities in the development of new and clean energy technology solutions.

6. However, as a small, resource-constrained country, Singapore is an energy price-taker and will continue to be exposed to shifts and fluctuations in global markets. As a low-lying island state, we are vulnerable to the effects of climate change and rising sea-levels. To meet these numerous challenges and seek economic opportunities from these global energy developments, Singapore must become a smart energy economy that is resilient, sustainable and innovative.

## **MEETING OUR ENERGY OBJECTIVES**

7. The aim of this subcommittee on Energy Resilience and Sustainable Growth was to recommend strategies to achieve our national energy objectives: economic competitiveness, energy security and environmental sustainability.

8. The subcommittee's deliberations were guided by three over-arching principles. First, to ensure that energy does not become a limiting factor in the pursuit of our aspiration to be the global city of choice in Asia. Second, to continue promoting competitive markets as the primary, and most efficient, means of allocating energy in our economy. Third, to remain technology-agnostic and retain the flexibility to exploit the best options that emerge from the still-evolving energy technology landscape.

9. Against this backdrop, this subcommittee has identified five key strategies:

- a. Diversifying our energy sources;
- b. Enhancing infrastructure and systems;
- c. Increasing energy efficiency;
- d. Strengthening the green economy; and
- e. Pricing energy right.

## STRATEGY 1: DIVERSIFYING OUR ENERGY SOURCES

10. At present, Singapore is heavily dependent on gas for electricity generation – around 80 percent of our electricity is generated by gas-fired power plants. While gas-fired plants are among the most efficient and gas is the cleanest fossil fuel, Singapore’s high level of gas dependency leaves us vulnerable to price fluctuations and supply disruptions. Furthermore, the indexation of Asian natural gas prices to the price of oil means that cost of electricity in Singapore will be affected by higher and volatile global oil prices.

11. At the same time, Singapore is alternative energy disadvantaged – there is limited scope for the deployment of alternative energy on a large scale. Solar technology has some potential, but given our high urban density, there is limited space to deploy solar panels. Wind speed in Singapore is below the threshold for commercial viability and there is limited land and sea space for the location of wind farms.

### *A diversified energy portfolio is essential*

12. Diversification of our energy sources is essential to achieving our national energy objectives. The market, on its own, may not help with diversification as it will gravitate towards the lowest cost solutions. Hence, Government intervention may also be necessary to balance our energy portfolio on account of security and environmental concerns or where large capital investments are required.

### **Recommendation 1: Allow entry of new energy options on a market basis**

13. In the near-term, the import controls placed on non-LNG fuels to build up sufficient demand for LNG will limit diversification. In the medium term however, Singapore should allow entry of new energy options on a market basis. Further diversification of our fuel mix will encourage healthy competition in our electricity market and benefit household and industry consumers.

14. The power generation industry could consider options such as coal and electricity imports. Coal is expected to remain relatively cheap and is widely available from different source countries. Advances in combustion technologies are reducing the environmental impact. The import of electricity through long-distance high-voltage cables is another option. This will free up valuable land in Singapore. It could also allow us to tap on the significant renewable energy potential, such as hydro-electricity or geothermal power, in our region. Subject to economic viability and safeguards to maintain reliability and environmental standards, these options can effectively complement and supplement our current energy mix in the medium term.

## Recommendation 2: Develop renewable energy sources

15. Singapore also needs to turn to cutting-edge technologies that might evolve into viable solutions for Singapore in the long run. While renewable energy sources, such as solar and biomass, are not likely to replace gas-fired generation to meet baseload electricity demand, they can help enhance energy resilience and environmental sustainability.

16. Recognising both the potential benefits and scale limitations of renewable energy, Singapore should aim to have 5 percent of peak electricity demand supplied from renewable energy sources by 2020. Singapore, therefore, needs to continue to support innovation and the infrastructure necessary to develop renewable energy sources as a component of our national energy portfolio.

## Recommendation 3: Study the feasibility of the nuclear energy option and develop expertise in nuclear energy technologies

17. With its alternative energy disadvantaged status, Singapore needs to explore all possible options for generation of electricity to meet baseload electricity demand. Nuclear energy should not be excluded. Many countries, including China and South Korea, are expanding their fleet of nuclear power plants in response to carbon and security imperatives. There has also been increased regional interest in nuclear energy programmes. Vietnam and Thailand have announced plans to build nuclear power plants in the next decade while Malaysia and Indonesia are considering this option.

18. In Singapore's case, our small size means that there are several challenges with harnessing nuclear energy. Safety is a major concern, especially given our high urban density. Reliability of power supply is also a consideration – the large size of a typical nuclear plant relative to Singapore's total energy supply may cause problems for the electricity grid if the plant trips or is undergoing maintenance. There are also complex issues relating to nuclear fuel and waste disposal.

19. However, advances in nuclear technologies can help to address these challenges. New generation technologies are being developed which are inherently safer than earlier reactor designs, with safety systems that dramatically reduce the possibility of human error. There are also modular designs which allow smaller reactors to be produced and fuel-efficient designs that reduce the amount of waste produced.

20. While there is no immediate or near term need, Singapore should begin studying the possibility and *feasibility of nuclear energy* as an option for the longer term, particularly with regard to safety, technical factors and economic viability. This is because the process of developing nuclear energy, if deemed feasible, is likely to take at least 15 years. At the same time, *developing expertise in the evolving nuclear energy technologies* will have economic spin-offs and applications in fields such as research and nuclear medicine.

## STRATEGY 2: ENHANCING INFRASTRUCTURE AND SYSTEMS

### Smart grids will give consumers choice and make renewables viable

21. Intelligent Energy Systems (IES) will be the centrepiece of the smart energy economy. IES, or “smart grids”, use information technology (IT) to allow two-way communication between electricity consumers and grid operators. The next generation of electricity infrastructure will enable applications that empower consumers to manage their electricity usage and integrate new energy technologies into the national grid. First, IES will facilitate the opening of the household electricity market to greater competition among retailers. With a more dynamic retail market, households will be able to choose their electricity retailers and packages that best suit their needs. Second, IES can potentially work with home automation devices and smart meters to programme home appliances to function during off-peak hours when electricity prices are lowest. Smart grids will also be able to manage the intermittent output from renewable energy sources to ensure consistent electricity supply and enable their widespread use.

### **Recommendation 4: Invest in critical energy infrastructure ahead of demand**

22. While some of the required investments will meet the cost-benefit analysis of private companies, others will require aggregation at the national level to achieve a critical mass. These public goods include the electricity and gas infrastructure which may require Government to play a lead role. A robust, advanced and extensive grid and gas transmission infrastructure can make markets more efficient, open new areas for economic development and strengthen our energy security. The Government should therefore be prepared to *invest in critical energy infrastructure ahead of demand*.

23. One example is the liquefied natural gas (LNG) terminal which will allow Singapore to gain access to global gas markets. Investing in the extension of the gas pipeline infrastructure can also potentially reduce the cost of electricity and open up new economic clusters in Singapore. By investing ahead of demand, Singapore will make itself even more conducive for business and enterprise.

### **Recommendation 5: Develop Jurong Island as an energy-optimised industrial cluster**

24. Jurong Island has a diverse ecosystem of over 95 global companies with cumulative fixed asset investments of over S\$30 billion, employing about 8,000 persons to date – it is a key component of Singapore’s petrochemical cluster. In the face of increasing competitive pressure from China, India and the Middle East, our petrochemical industry must strive for greater efficiencies, particularly in the use of energy which is a significant cost component.

### Jurong Island can be a model for energy efficient industry clusters worldwide

25. Singapore should develop *Jurong Island as an energy-optimised industrial cluster*. By harnessing innovative systems-level solutions, we can provide integrated, low-cost and low-carbon solutions for the petrochemicals industry. One example is the channelling of “cold

energy” from LNG, which arrives at the terminal on Jurong Island at very cold temperatures, to cool air and separate it into its component gases, which are typically used as inputs for other industrial processes on the island. With government planning and infrastructure investment to enable such ‘exchanges’, companies can save as much as 50 percent of their electricity costs.

26. Other technologies include the use of waste heat for water-desalination and carbon capture and utilisation projects. These measures will not only lower carbon emissions, but also utilities costs for the companies in the cluster, strengthening Singapore’s competitive advantage on both these fronts.

### **STRATEGY 3: INCREASING ENERGY EFFICIENCY**

#### **Recommendation 6: Promote energy efficiency for buildings, industry and in homes**

##### *Government can help realise energy efficiency improvements*

27. Energy conservation and efficiency underpin Singapore’s efforts to reduce our energy and carbon footprint. This subcommittee reaffirms the Government’s initiatives outlined in the Sustainable Singapore Blueprint (2009) but recognises that there are impediments to energy efficiency measures despite the dual benefits of cost and carbon reductions.

28. For example, tenants who bear electricity costs often have little influence over decisions, made by the landlord, on investments in air-conditioning and insulation. Companies may also pass over investments in more efficient machines and processes because it takes a long time for these costs to be recouped from lower energy bills. At the same time, there is a lack of awareness and information among households, and even some companies, about their energy use and possible ways to use energy more efficiently.

29. The government has introduced incentives such as GreenMark incentive schemes to encourage energy efficiency in buildings. There are also grants for companies to perform energy audits and build capability for energy conservation and efficiency. Government agencies and non-governmental organisations should continue to work together to raise awareness and provide accurate information to help consumers choose equipment that best meet their needs.

30. More should be done however to promote energy *efficiency for buildings, industry and in homes* by enhancing incentives, education and adopting essential legislation such as mandatory energy audits which will help internalise energy management practices. Households and individuals will also have to make changes to their lifestyles. Significant improvements can be achieved in the long run only if a mindset of energy conservation is inculcated in all Singaporeans. The work by public, private and people sector partners to raise environmental awareness in schools and the community must continue.

## **Recommendation 7: Support clean and efficient technologies in transportation**

### Public transport key to reducing our energy footprint

31. Government initiatives can go a long way to reduce energy intensity in transportation – the third largest consumer of energy. Promoting the use of public transport remains key as it is significantly more energy efficient than private vehicles. These recommendations build upon the Government’s plans outlined in the Land Transport Masterplan (2008).

32. Alternative transport fuels and technologies could transform vehicles and land transport as we know it today. Conventional internal combustion engines are expected to become more efficient. Transitional technologies such as hybrid-electric vehicles are already commercially available and will be increasingly relevant. Full “plug-in” electric vehicles are also on the horizon but are still expensive and have yet to achieve the scale needed to meet global demand.

### Clean technologies for both public and private transport

33. Singapore should put in place the appropriate incentives *to support clean and efficient technologies in transportation*. In public transport, the replacement schedule for buses presents opportunities as half the bus fleet needs to be replaced over the next 5 years. The diesel-hybrid engine is one technology which can be up to 20 percent more fuel and carbon efficient than conventional diesel buses. However, these buses will cost more. The government should support the introduction of clean and efficient technologies for public buses through grants or financing to ensure that energy efficient public transport can be realised while remaining affordable for commuters.

34. For private vehicles, there is a need to set the appropriate incentives for the adoption of clean vehicle technologies. The existing green vehicle rebate (GVR) covers hybrid, Compressed Natural Gas (CNG) and electric vehicles (EVs), but does not take into account actual emissions or efficiency. The government should therefore consider refining the GVR such that it is based on the actual fuel efficiency or carbon emissions of the vehicle. We should also prepare the necessary infrastructure and critical enablers to ensure that new vehicle technologies can be supported when they become viable.

## **STRATEGY 4: STRENGTHENING THE GREEN ECONOMY**

35. The global low-carbon industry is a growing one with expected growth rates of 12 percent until 2020. Singapore’s investments in our clean energy eco-system have positioned us well to seize global opportunities. It has tremendous potential to create opportunities for research, businesses and jobs for Singaporeans.

### **Recommendation 8: Establish energy as a key national R&D priority**

36. Energy should be established as a key *national R&D priority*, with a dedicated funding stream and to be placed on par with other national research priorities like bio-medical sciences

and interactive digital media. Research, Development and Demonstration (RD&D) both expands the menu of solutions available to us in our energy policy and creates economic value by generating knowledge capital. Existing funding should be continued and expanded to the order of S\$500 million over 5 years. By ensuring that basic research is supported, while placing particular emphasis on industry-applied research and commercialisation, long term value and opportunities will be created for the economy.

### **Recommendation 9: Build capabilities for the green economy**

37. We have also made great strides in promoting Singapore as an important test-bed for clean energy companies to develop and experiment with cutting-edge products. Major players in solar manufacturing and bio-diesel have chosen to locate activities in Singapore because they believe the prospects for the green economy in Singapore are bright. We are on track to achieving S\$1.7 billion in GDP contribution and 7,000 jobs from the green economy by 2015.

38. Singapore will need to *enhance the supporting capabilities necessary for our green economy* to scale up, particularly in renewable energy manufacturing, test-bedding and systems integration activities. In particular, there is a need to strengthen project financing for energy efficiency projects and other energy related financial services such as venture capital and derivatives products. Specialist energy service companies will also be critical to help provide the expertise and financing to advise companies on how to make the transition to energy-efficient technologies. The government can also play an important role in training the whole spectrum of the “green collar” work force – from operators to engineers, architects and business leaders.

### **Recommendation 10: Apply a green lens to government procurement**

39. The Government is a significant customer and can stimulate significant demand for energy-efficient products to kick-start such industries. In the European Union, for example, governments have realised that energy-efficient equipment can generate cost-savings over the long term and have put in place green procurement legislation that ensures a fair playing field for all suppliers. In Singapore, the government can do the same to *apply a green lens to government procurement* – helping to stimulate the green economy while reaping savings for tax-payers.

## **STRATEGY 5: PRICING ENERGY RIGHT**

### **Recommendation 11: Price energy to reflect its total cost**

#### *Price energy to prepare for a resource and carbon constrained world*

40. The price of energy should reflect its total cost, taking into account various externalities and constraints, such as energy security and environmental sustainability. Price signals will raise awareness and influence energy consumption and investment decisions to achieve energy efficiency and conservation. For example, some countries are looking at various options for carbon pricing, including a carbon tax and cap-and-trade regimes.

41. The Government should therefore study the suitability of energy pricing schemes for Singapore to encourage consumption and investment decisions that take into account global market trends and externalities. This is to ensure that our economy is able to adapt to the rising cost of energy and to a carbon-constrained world, in the event of a global agreement on climate change. Any pricing scheme should be carefully calibrated and introduced gradually with appropriate offsets for groups such as low income households.

## CONCLUSION

42. The global energy challenge with all its facets and complexity is a problem that Singapore – an open economy and small nation state – will have to continue to grapple with. Energy that is affordable, clean and reliable will be essential for Singapore’s continued economic growth and competitiveness.

43. This subcommittee’s recommendations will help advance Singapore towards becoming a *smart energy economy*. It will balance and advance the imperatives of being *resilient, sustainable and innovative*, and support Singapore’s efforts to be a distinctive global city in a rising Asia.