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This is a well-timed and important conference for Vietnam. We are gathered here to find a path forward so that Vietnam can use energy to support the welfare of the Vietnamese people now and into the future in a way that is practical and sustainable. Before going any further, let me begin by thanking the organizers, GIZ and the Vietnam Energy Partnership Group for bringing us together and also for inviting me to speak. We will be successful if we define the energy challenges before us and identify the steps and policies needed to respond quickly, productively and realistically.

So what is the challenge? Basically, Vietnam uses a lot more energy to produce a given amount of output and that amount is growing much more quickly than elsewhere. Using electricity as a measure, since 2005 China used 66% more electricity when it doubled real GDP while Vietnam used 180% more power for the same doubling of GDP. Vietnam now has the same electricity use per capita (2500 kWh pc) as China did in 2008, so it is not that it is starting from such a low level. This year, China's electricity use will grow by 3% and Vietnam's by nearly 10%. Note that China is more urban and more industrial than Vietnam and these variables tend to raise electricity use. India, with the same GDP per capita as Vietnam uses less than half as much electricity per capita. Indonesia has nearly double the income per capita but also uses less than half as much electricity per person as Vietnam. For all energy, since 2010, Vietnam nearly doubled energy use while China grew 31% and Indonesia only 23%. One challenge is to use energy more carefully as most of ASEAN, India and China do – at least relative to production and income.

It is not only that too much electricity is used relative to others, but how it is made and recent plans to produce more of it. Past plans relied heavily on coal to produce more electricity. The reasons given for this were that hydro locations were largely exhausted (true), and gas was too expensive compared to coal. Nuclear was rejected too due to its cost and for other reasons. Renewables like wind and solar played a small but growing role. Yet looking at current trends, one

observes a decrease in coal use world-wide. In China, there is rapid construction of coal plants in spite of over-capacity and falling utilization rates. This year, essentially all electricity growth in China will come from renewable energy and gas. Provinces construct coal plants, ignoring central plans and public wishes. This is a formula for economic ruin and political instability, not a model to emulate. In India, as unsubsidized solar bids come in at 3-4 cents per kWh and displace coal-fired electricity, coal plant investment plans are being scaled back and coal-based utility companies are asking for subsidies. India plans to have more than 200 GW of renewable power (including hydro) in a few years. Note that both China and India have severe pollution problems due to coal, and other sources, and need to curtail coal for public health and in response to public outcries against dirty air and water.

I can hear the objection of EVN that their prime directive is to provide reliable and cheap power. It is all very well to buy variable solar or wind at 8-10 cents per kWh and sell it at 7 cents when, including distribution, it should be charging 10-12 cents like Thailand's unsubsidized and efficient utility does. Given strained public finances and limited subsidies, they have to take the lowest cost power available. Japan and China make cheap loans available to buy new coal plants – industries where they have excess capacity. EVN knows how to run coal plants, which can be turned on and off as needed. Now they cannot even transmit as much solar energy as is being produced to where it is needed. It would take huge investments in national grid strengthening and management to absorb the solar capacity now in place and as much as needed for future growth in demand. This is money they do not have.

Here we come to one central issue. Why is Vietnam's renewable energy so expensive compared to that in other countries, such as India? Because EVN has a weak grid, it will rationally not sign firm contracts to buy as much renewable energy as can be produced. If they cannot deliver it, they would go bankrupt buying power they cannot transmit for sale. This means that high prices are needed to compensate for risk. If the grid were stronger, better contracts (for producers) could be negotiated and auctions would bring down the cost of new energy to less than that of coal or gas. International capital, with lower loan rates and longer repayment periods than Vietnam's national capital markets, are what make cheap renewable energy possible. If laws allowed grids to be built or

improved with private capital and EVN to negotiate fair payment for carrying the power (probably 1 to 1.5 cents per kWh at first and less over time), then it would be economically feasible to buy renewable energy. Lazard, an investment bank, publishes each year the world-wide cost of electricity from different sources, In its 2019 report, solar cost 3.2 to 4.2 cents per kWh; wind from 2.8 to 5.4 cents; combined cycle gas costs 4.4 to 6.8 cents and coal starts at 6.6 cents and goes up to more than 10 with full pollution controls. If Vietnam could achieve costs similar to other developing countries, it could shift to much more renewable energy and to some use of gas. This is the direction of China and India.

The remaining obstacle to renewable use is not small but neither is it insurmountable. Renewable energy cannot be called upon when needed – it is only available when the sun is shining or the wind is blowing. Large-scale battery storage is not currently feasible, though costs are falling. The solution here is complicated but models exist. One solution is to have limited battery storage of a few hours to stabilize the grid and improve the quality of electricity. Utility scale storage (for four hours) with solar can be as low as ten cents per kWh and no more than 14 cents – less than gas peaker plants or diesel. Another solution is to make the grid smarter, so that other sources can respond if renewable output falls. The response of batteries over seconds, hydro over a few minutes and gas within several minutes is possible. India has found that even its coal plants have an ability to adjust output, within limits, to accommodate solar. A third option is to negotiate demand curtailment for brief periods. In any case, experience is that renewables up to 20% or so of total power can be integrated without major investment in grid management. If more than that, then several of these solutions are needed.

Vietnam is fortunate that there are already serious studies this year of many of these issues, though more work is needed. The Vietnam Energy Outlook Report 2019, issued by MOIT, the Electricity and Renewable Energy Authority of Vietnam and the Danish Energy Agency analyzes many of these issues. Another important and relevant paper is Renewable Energy for Vietnam by the Institute for Sustainable Futures, a group in the University of Technology Sydney. This models different scenarios and finds the combination of conservation and renewable energy is least cost, and even a more modest intermediate plan that uses current market prices is cost neutral compared to PDP-7.

In the end though, it is political as much as market forces that drive energy decisions. All successful governments have to deal with a rising middle class that gets fed up with pollution and demands better solutions. India, with some of the most polluted cities on earth, has created a Ministry for Renewable Energy and is moving quickly to integrate very large renewable capacity investments into their grid. China, as mentioned, is already supplying incremental energy growth from non-coal sources this year. Economists can calculate the financial cost of coal (7-8 cents per kWh in Vietnam) and estimate the pollution costs (2-3 cents in local pollution by my estimates), so the total cost of coal is ten cents – not even counting carbon dioxide. Other sources are, or should and can be, lower. Even more, the future costs of these cleaner sources are dropping. In the 3-5 years it takes to build a coal plant, they will cost even less than now.

A final thought about economic feasibility: Vietnam has prospered by integrating with the global economy. It has joined the WTO and many regional trade pacts and agreed to follow their rules. I believe that the growing costs of global warming in floods, fires, droughts, severe storms and rising sea levels will compel international action to curtail carbon in the next decade. Insurance firms are already cutting back coverage, making many investments much more dangerous. It is likely that this action will take the form of a carbon tax, locally collected and used. If a nation does not join this effort, it is likely to suffer tariffs on its exports. Investors see this coming and that is why most western banks and investors are not interested in financing coal. Even LNG or offshore gas, while necessary, can be overdone. A generating plant will last for 20-40 years. Both China and India (and the US and EU) are finding that even younger coal plants are losing competitiveness and becoming stranded assets. Many are being shut down or run less often, raising the cost of electricity to the utility. (Fixed capital and maintenance costs rise per kWh if utilization drops.) In auction markets, this is brutal. This is why Indian utilities relying on coal are in trouble. As renewable and storage prices fall further and if carbon taxes are imposed, coal investments will be multi-billion-dollar mistakes – unable to compete. Even on a pure financial basis, and forgetting public pressure and public health, this would be a heavy blow to Vietnam.

Given all of these considerations, we can see why this conference is so important. We have to figure out a way to create incentives for cheap, reliable, clean and

sustainable energy for Vietnam's people. Fortunately, there are models – from conservation programs in China to renewable grid integration in India to available loans for clean energy from many sources. The wind is blowing in the right direction as costs fall for clean energy and storage, even as they are likely to rise for carbon-heavy sources. But God is in the details. I look forward to learning a great deal in the next day or two.