EVN

EVN ENERGY TRANSITION

Opportunities and Challenges

Content

Global energy transition trends toward 2050

01 Energy demand continues to increase, reaching peak level in 2034 then reduces to 420 EJ (2018 level)

02 Strong supply-side Energy transition from fossil fuel to VRE (wind and solar power). VRE proportion reaches 23%

03 Demand-side Energy transition, proportion of electricity consumption in total energy consumption increase from 19% (2018) to 41%

04 Invest and develop new technology spectacularly

Transport peaked in 2019; manufacturing, heating and waterway transportation will peak in 2033, 2030,and 2034, respectively

In Africa, mainland India and Southeast Asia (including Pacific island nations), demand still rise after 2050

Coal consumption peaked in 2014 and plummeted from 27% (2018) to 9%

Nuclear and gas power increase slightly and peak in 2037 and 2035 and then gradually decrease by 6% and 29% by 2050.

Electricity for buildings increase by 100%, manufacturing by 46% and traffic by 2600%

Electricity vehicles (EV) expect to share half of road vehicles by 2035 and overtake fossil fuel vehicles by 2045.

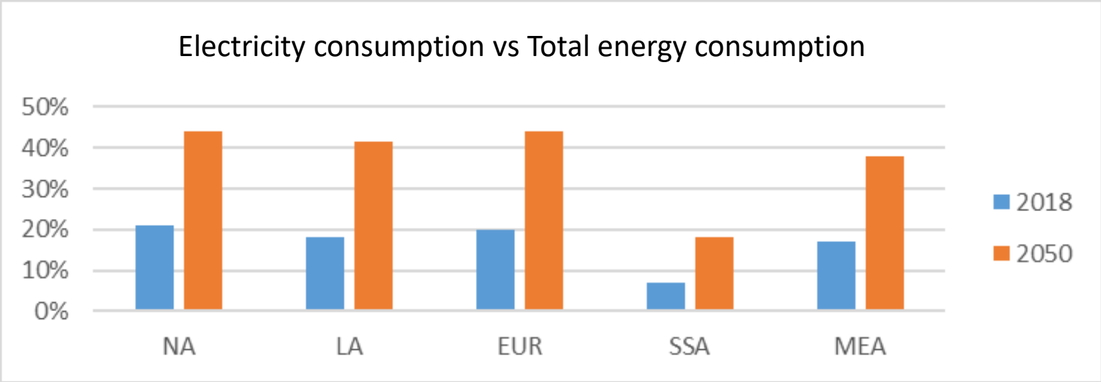
Battery increases by 25% between 2021 and 2030 and 500% in 2030-2050

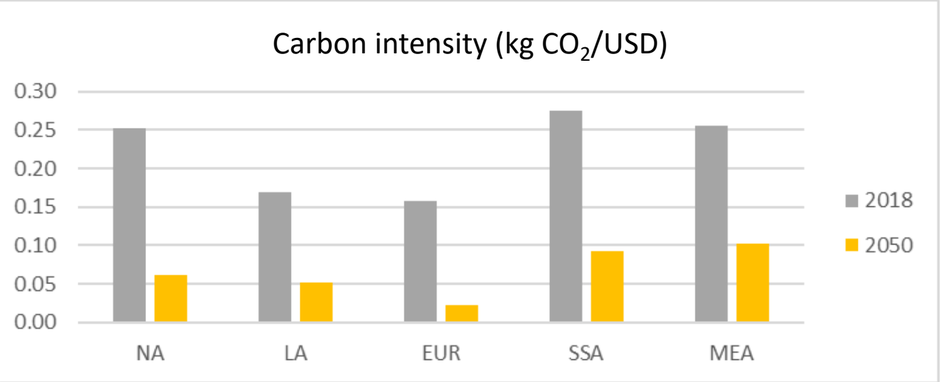
HVDC transmission grid (over 800kV) accounts for 12%, hydrogen account for 6% of the final energy demand. Carbon capture technology can absorb 5% of total energy-related emisison

Global energy transition trends toward 2050

2018 – 2050 period

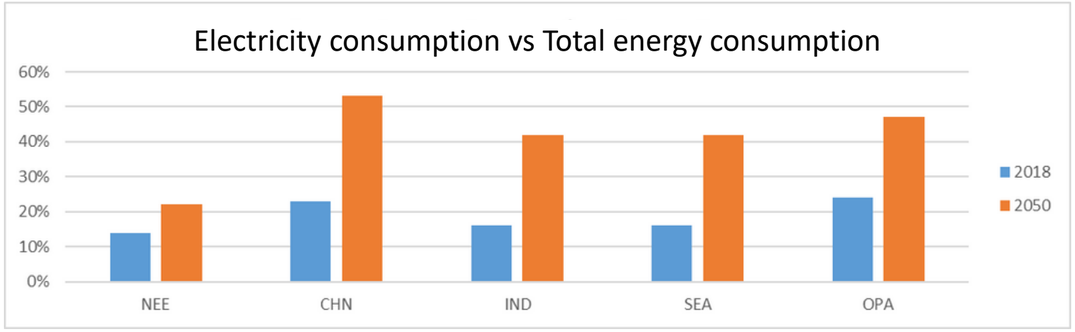
North America (USA and Canada) - NA	Latin America (from Mexico to South America including Caribbean island nations) - LA	Europe (excluding Russia and Turkey) - EUR	All African countries except Morocco, Algeria, Tunisia, Libya and Egypt) - SSA	Middle East and North Africa (from Morocco to Iran, including Turkey and The United Arab Emirates) - MEA
- Decarbonization - Reduce oil reduces two-thirds and coal to near 0 - Increase gas consumption sharply	- Increase RE (hydroelectricity, VRE) - Fossil fuels share less than 50% of total primary energy.	- Increase VRE proportion - Develop hydrogen	- A increase trend in energy demand. - Improve energy efficiency - Solar power shares over 40%	- Natural gas shares 50% - RE accounts for 20%

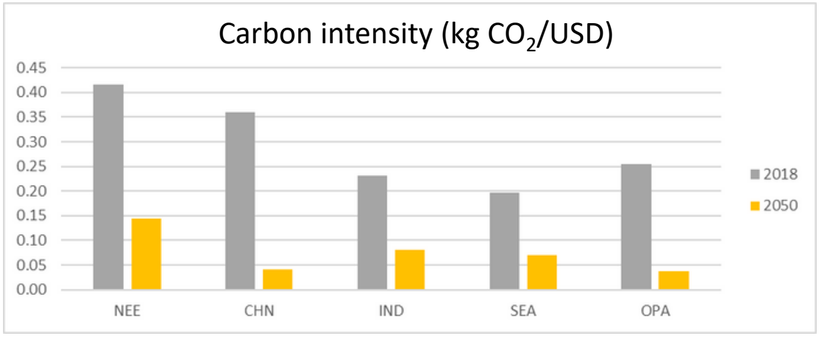




Global energy transition trends toward 2050

Eastern and Northern Europe (Russia, Mongolia, former Soviet countries except the Baltics) - NEE	China, Taiwan, Hong Kong and Macao - CHN	India, Pakistan, Afghanistan, Bangladesh, Sri Lanka, Nepal, Bhutan, Maldives - IND	Southeast Asia (from Myanmar to Papua New Guinea including Pacific Island Nations) - SEA	Australia, New Zealand, Japan and South Korea - OPA
- Decarbonization - Reduce oil reduces two-thirds and coal to near 0 - Increase gas consumption sharply	- Increase electricity in energy consumption structure from 23% (2018) to 52% (2050) - RE shares over 45% - Decrease coal from 60% (2018) to 12% (2050)	- Increase energy demand - Fossil fuels hold 62% - Change mostly two- and three-wheeled vehicles to EV.	- Increase trend in energy demand - - Increased gas and renewable energy (imports LNG) - Reduce ratio of coal and oil.	- Reduce a half of demand - Wind takes over - Electricity shares 50% int total energy usage - Hydrogen shares 9%.





Orientation for energy transition in Viet Nam

Resolution 55/NQ-TW

Increase VRE 2045: 25-30%
Energy saving 2045: 14%

Prime Minister's statement at COP26

Net zero by 2050

Opportunities from energy transition

Investment in VRE technology and batteries has caused VRE and battery prices to plummet

By 2050, VRE price is about 5 USc/kWh (cheaper than fossil fuels). Batteries have competed with some transmission projects and continue its downward trend.

In 2019, Viet Nam's energy intensity reached 396 gOE/USD_{2015}, among the highest in the world (only lower than Ukraine, Iran, Russia and Uzbekistan).

Energy intensity can reduce through demand-side energy transition, specifically: (i) transition from petrol/oil to electricity in transportation; (ii) transition to using electric furnaces in industry; (iii) transition from gas, biomass, firewood, coal to electricity in residential cooking and commercial

Aligning the Paris agreement, the global North has pledged $100-billion financial support to energy transition a year at COP26

Financial aid prioritizes countries who are the lowest developing and most climate-change affected countries

Challenges from energy transition

Electricity price

Electricity supply security

Electricity supply security

VRE's output fluctuates over time, therefore, to ensure the security of power supply, both VRE curtailment as low demand and the availability of backup source as decline in VRE production are measured in the whole system.

Characteristics of wind power

Wind development scenario in Resolution 55

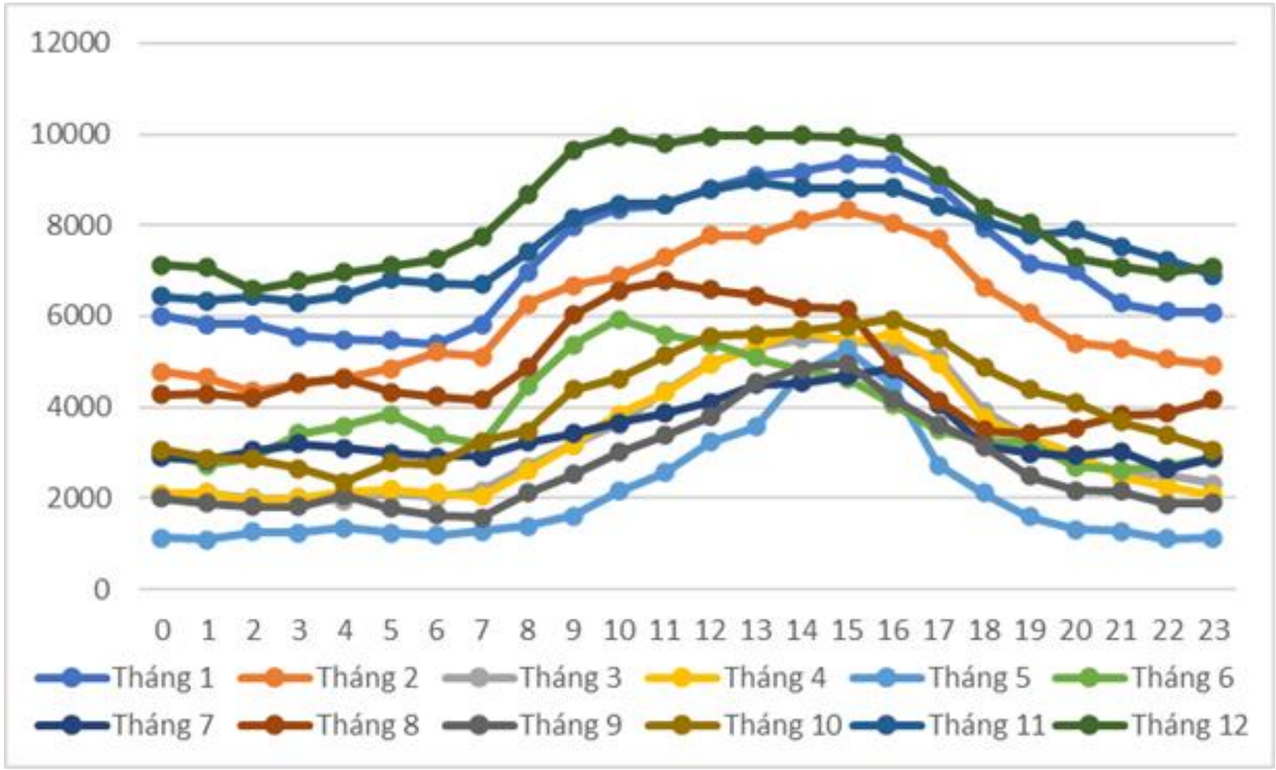
Total wind power capacity 2030: 12191 MW

Mobilization output varies greatly by month

The average daily output of the lowest month (May) is 25% of the highest one (December).

The hourly capacity fluctuation by day is insignificant

The highest hourly fluctuation is 29 MW/min



Characteristics of solar power

Solar development scenario in Resolution 55

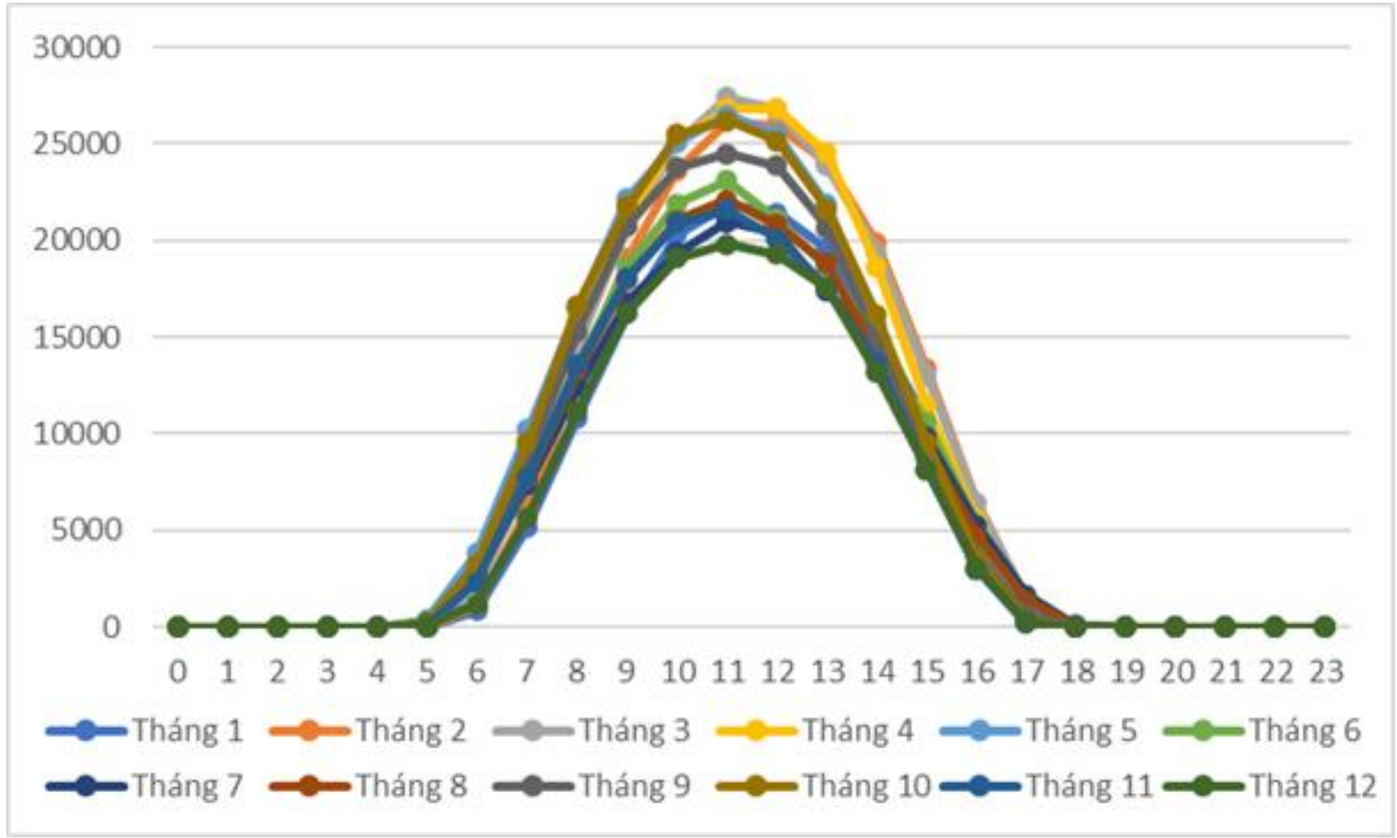
Total solar power capacity 2030: 38811 MW

Monthly output fluctuation is insignificant

December sees the lowest average daily output, corresponding to 70.5% of the highest month (April).

The hourly capacity fluctuation by day is significant

- The highest hourly fluctuation is 120 MW/min
- No supply from 18h-23h and 0h-5h



Difficulties in implementing solutions to ensure energy security as the high proportion of VRE

Energy storage technology

- Daily regulated pumped-storage hydro power (solar power): The current policy mechanism is difficult to recover capital for investors
- Seasonally regulated pumped-storage hydro power (wind power): No projects

Regional interconnected power grid GMS

- Many barriers: legal, technical regulations...
- The climate of the GMS region is not much different, so the scale of the connected grid is not large

Base-load operated power plants

- Use of fossil fuels: have to absorb CO_2, difficulties in mobilizing investment capital and import equipment
- Nuclear power: issues on safety and capital mobilization (public debt ceiling)

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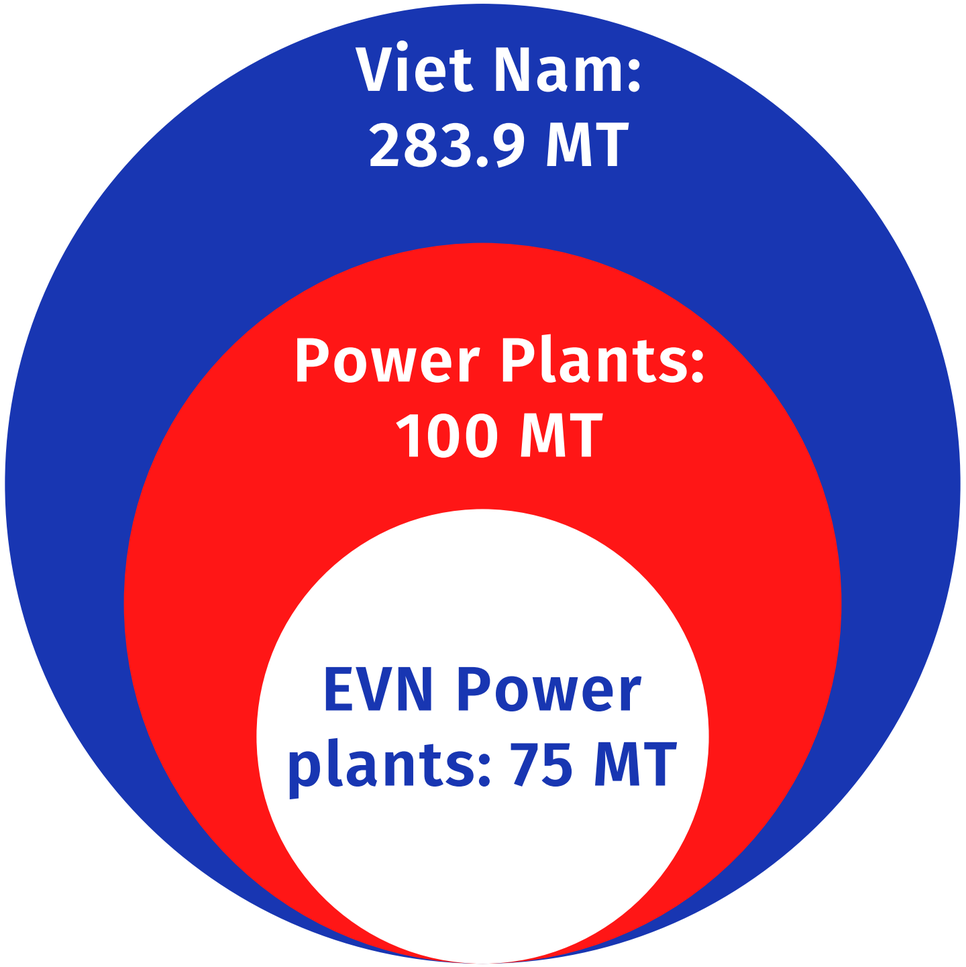
Electricity tariff



The trend of electricity tariffs which must be covered CO_2 prices

CO_2 emission in Viet Nam 2020 (estimated by BP)

283.9 million tons

CO_2 emission from power plants in Viet Nam 2020

199 million tons

CO_2 emission from EVN’s power plants in Viet Nam 2020

75 triệu tấn

CO_2 prices
(depends on many factors)

Reforestation

- Quang Nam's pilot project of selling CO2 credit, estimated at $5 per ton
- However, the areas for reforestation is limited.

CO_2 Capture and Storage (CSS)

- CSS cost for thermal power ranges from 40 US $ to 120 US$/ ton
- Locations that can apply CCS are limited (old gas fields,...)

Increase VRE, CCS, hydrogen/ammonia
(increased system cost per unit of reduced CO2)

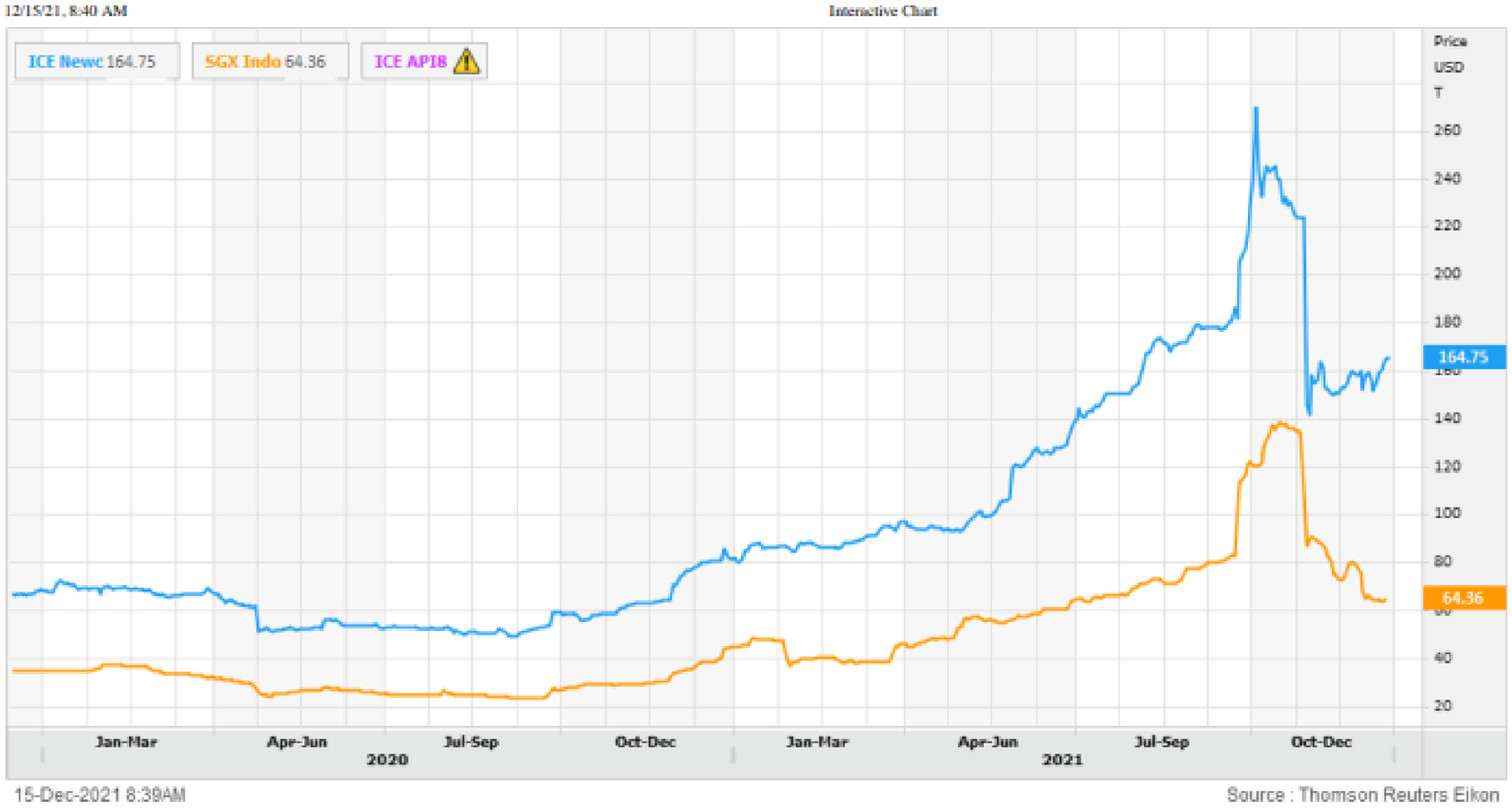
- Danish Energy Agency: carbon reach peak of 150 million tons by 2050, VRE 43%, CO_2 price at 120 US$/ton
- Japan Economic Institute: zero carbon in 2060, CCS 100MT, H_2/NH_3 38%, VRE 30%, CO_2 price at US$345/ton

Increase the imported fuel price

In 2021, the world energy crisis occurs, the historically shock high energy price (Australian thermal coal $269/ ton)

Causes

- Decline VRE production in US (hurricane-induced wind turbine incident), and Europe (low winds).
- Decrease hydropower output: Brazil (the lowest water in 100 years), China (reduction)
- Increase demand due to falling temperatures (US)
- Other factors (policy, infrastructure): China (reduced power intensity, trade war with Australia), UK (problem with Brexit), quality of transport system (India, Indonesia), gas plant incident (Russia) ...



EVN ESTIMATES TO SPEND VND16,000 BILLION MORE ON PURCHASING ELECTRICITY IN 2021 DUE TO AN INCREASE IN IMPORTED FUE PRICE

Uneconomical system operation

Due to low VRE production in the poor wind (in May) and at night, so other supply sources (load-based power plans, power grid interconnection, pumped-storage hydropower) is not enough, the VRE installed capacity is greater than the demand.

VRE must be curtailed as oversupplying or grid limitation, or fossil fuel power plants cannot operate below the minimum capacity.

Orientation for energy transition at EVN

Construction investment

- Reforestation
- Building pump-storage hydropower plant
- Link and exchange electricity within GMS
- Study for new technologies

Operation Management

Digital transformation
- Forecasting works (load, water to reservoir, VRE generation output)
- Optimal operation

Sale and customer services

- Developing demand-side management program, promoting energy efficiency
- Digital transformation

Financing projects

Approaching financial institution and instrument for energy transition to develop EVN's project

EVN

Thank You!

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