VIET

CO_2 Abatement Scenarios for Vietnam's Power Sector to 2030

Vietnam Initiative for Energy Transition

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Hanoi, 7 June 2022

Regulations

Planning

Biomass

Wind

Grid

VIET Research

Expertise

Consultancy

Training

an active

INDEPENDENT THINK TANK

since 8/2018

Credibility

Excellence

Happiness

Responsibility

Interdependence

Dialogue

Scenarios

Modeling

Economics

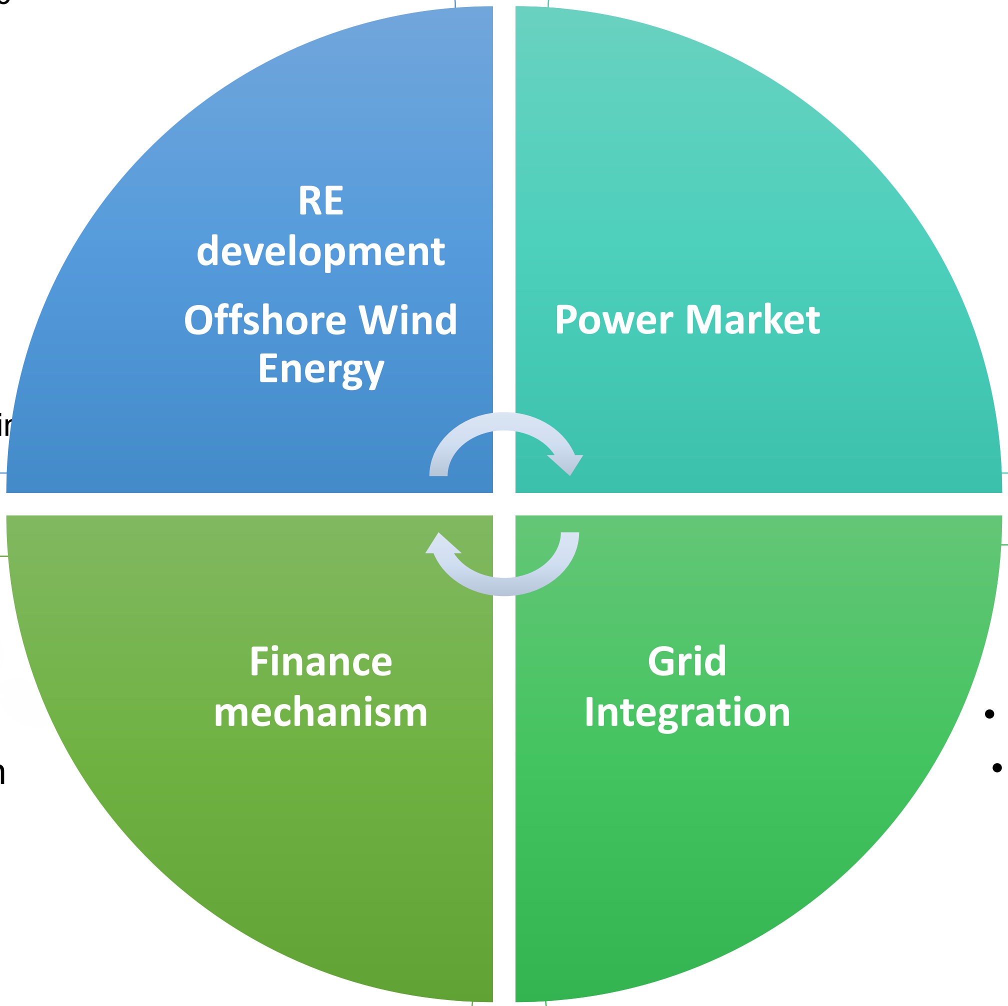
Integrated assessment

International experience

Thematic studies in VIET

- Options for wind power development to 2030
- Biomass co-firing and Renewable Standard Portfolio
- Scenarios for Solar power development to 2030
- OWE Strategy recommendation
- OWE potential zone and mechanism for sea surface exploitation
- Policy recommendation on ESIA;
  Supply chain and local content;
  Distance between wind farms and wind turbir

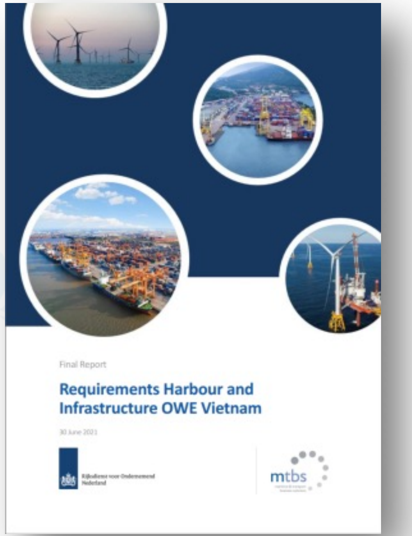
- Transparency in electricity price
- State management role in power sector
- Virtual Power Plant
- RE Auction mechanism
- Energy storage

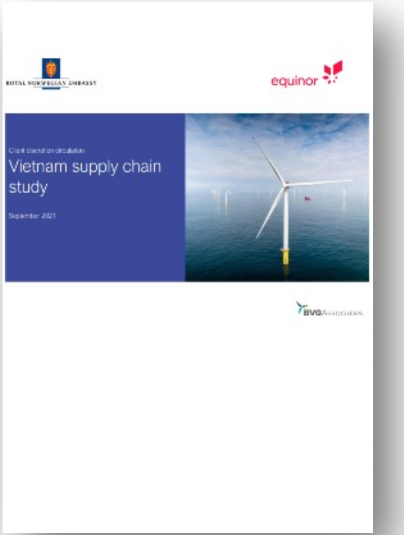


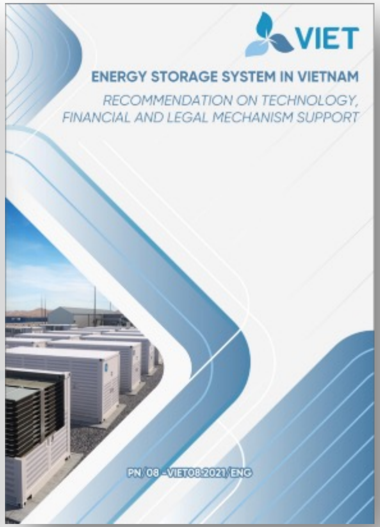
- Mechanism to mobilize investment capital for the transmission system in Vietnam
- Coal retirement mechanism
- Super-ESCO: Investment mechanism
- Green bonds, Carbon market

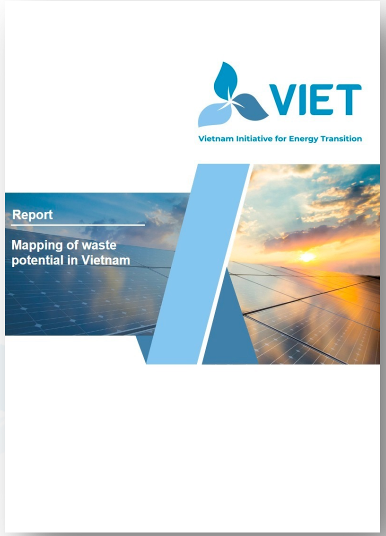
- Grid integration for offshore wind to 2030
- Grid capacity for onshore wind and solar integration to 2022 and 2025
- Grid planning up to 2025 and 2030
- Grid inter-connection standard

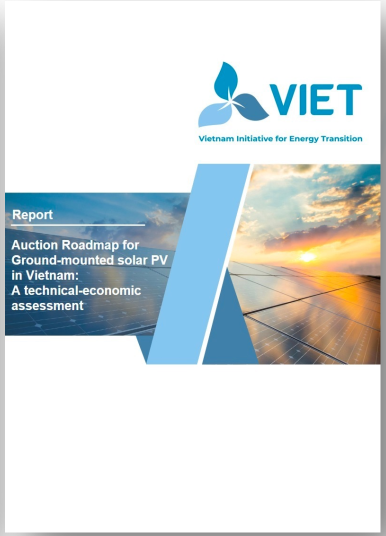
2021's publications

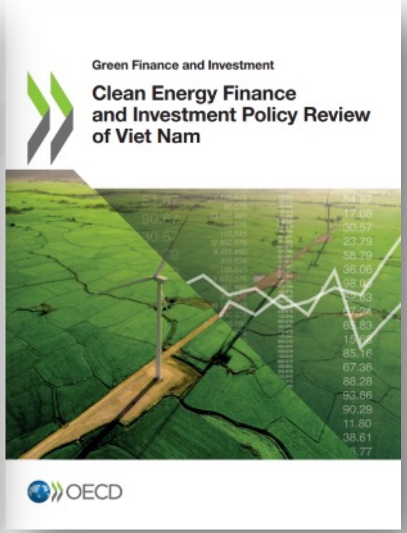


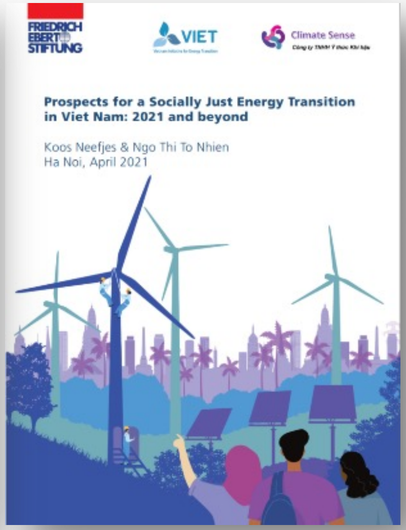


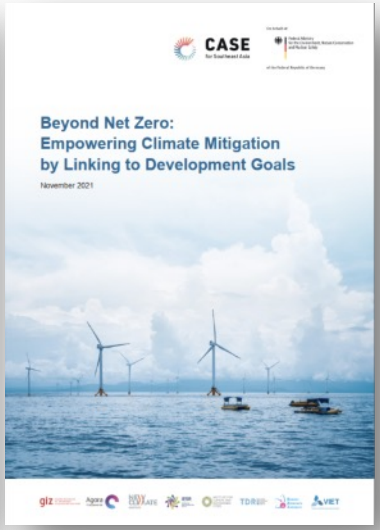


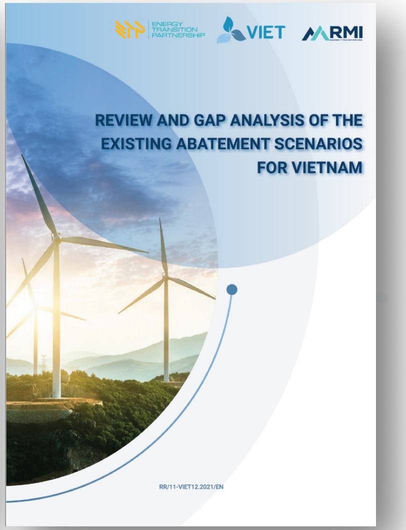












Content

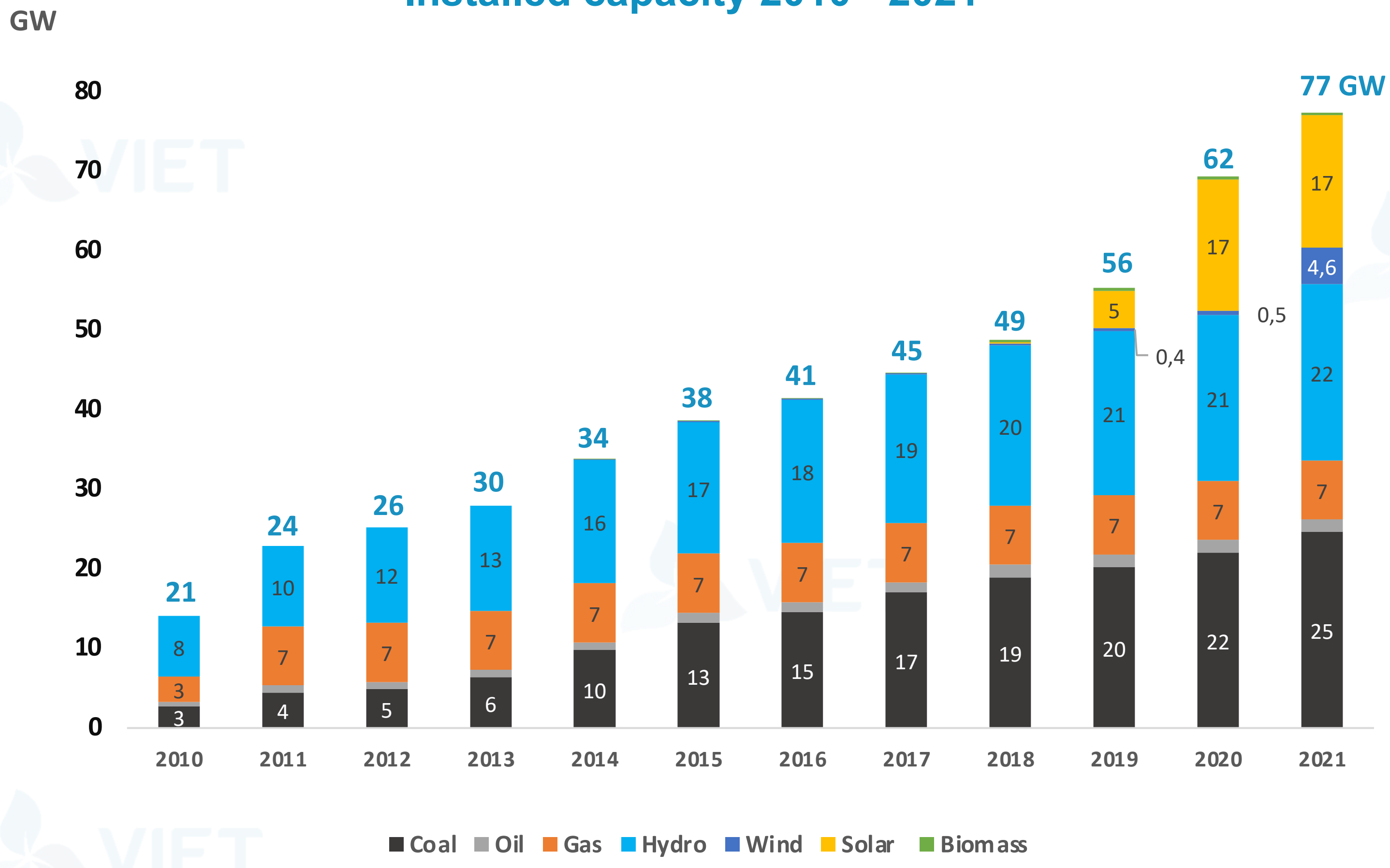
- Overview of Vietnam Power System
- Power Development Plan:
- Coal abatement scenarios
  - The scenarios
  - The finance and policy framework requirements
- Recommendations

Vietnam Power System

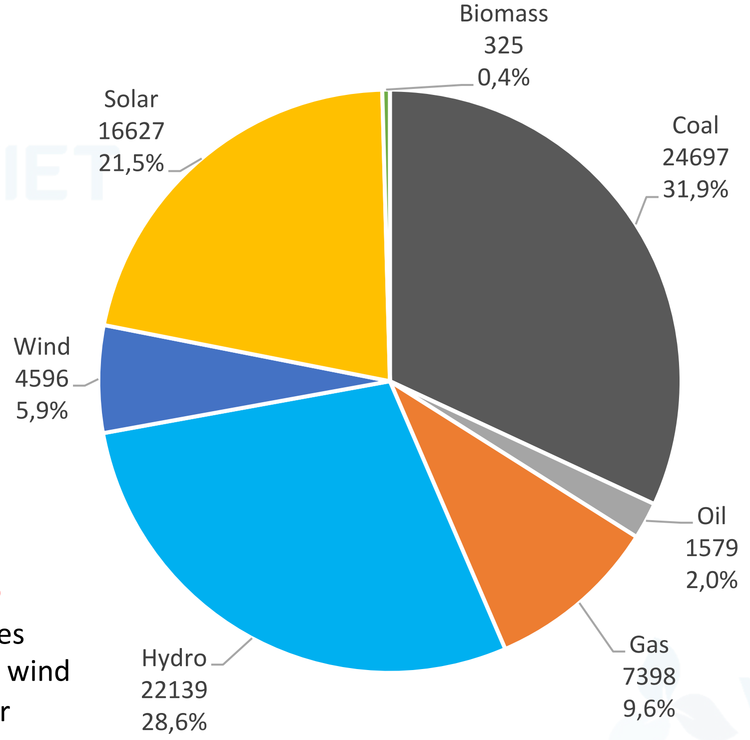
Hanoi, 7 June 2022

Power Installed Capacity

Installed capacity 2010 - 2021



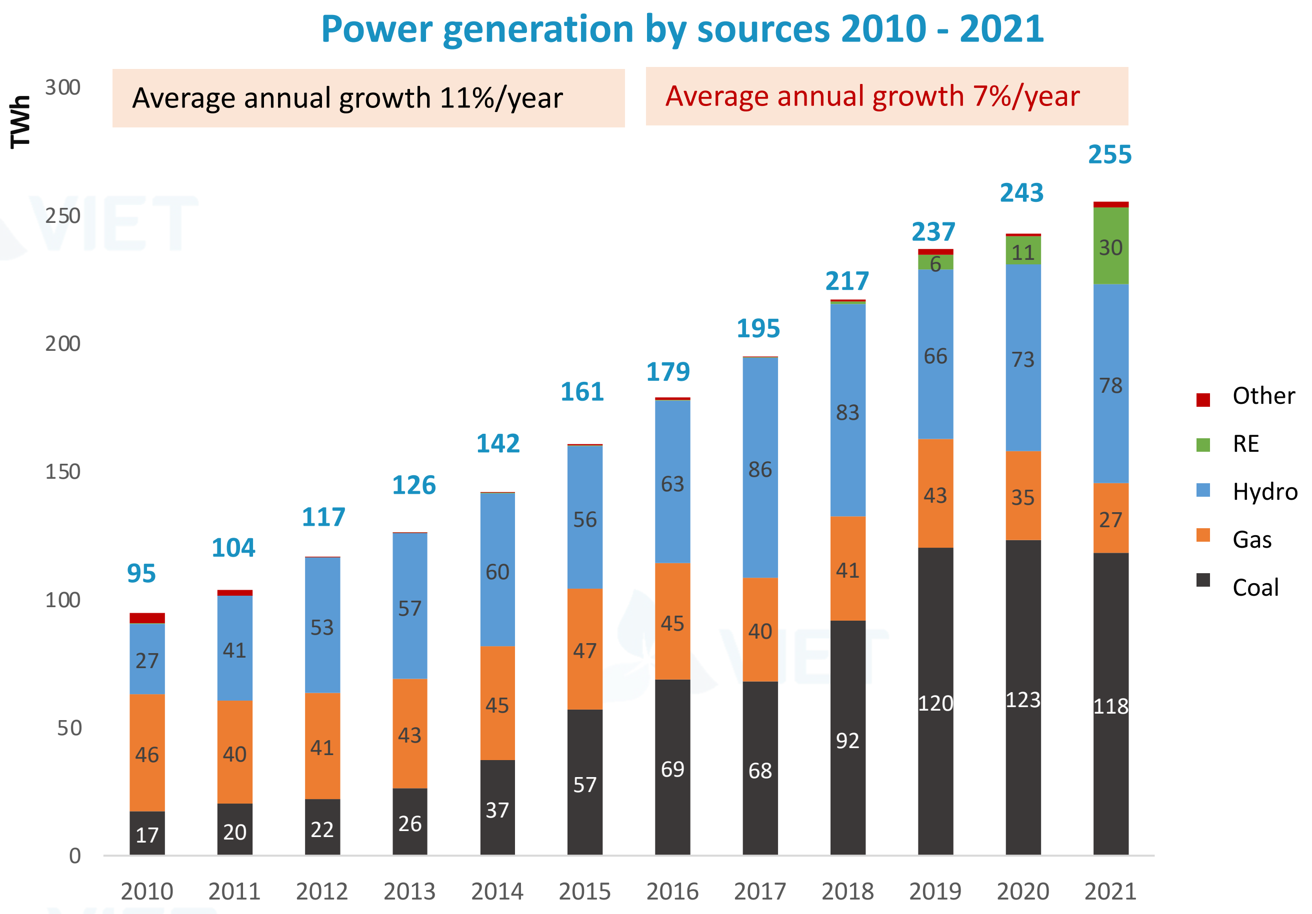
Installed capacity in 2021 (77.361 MW)

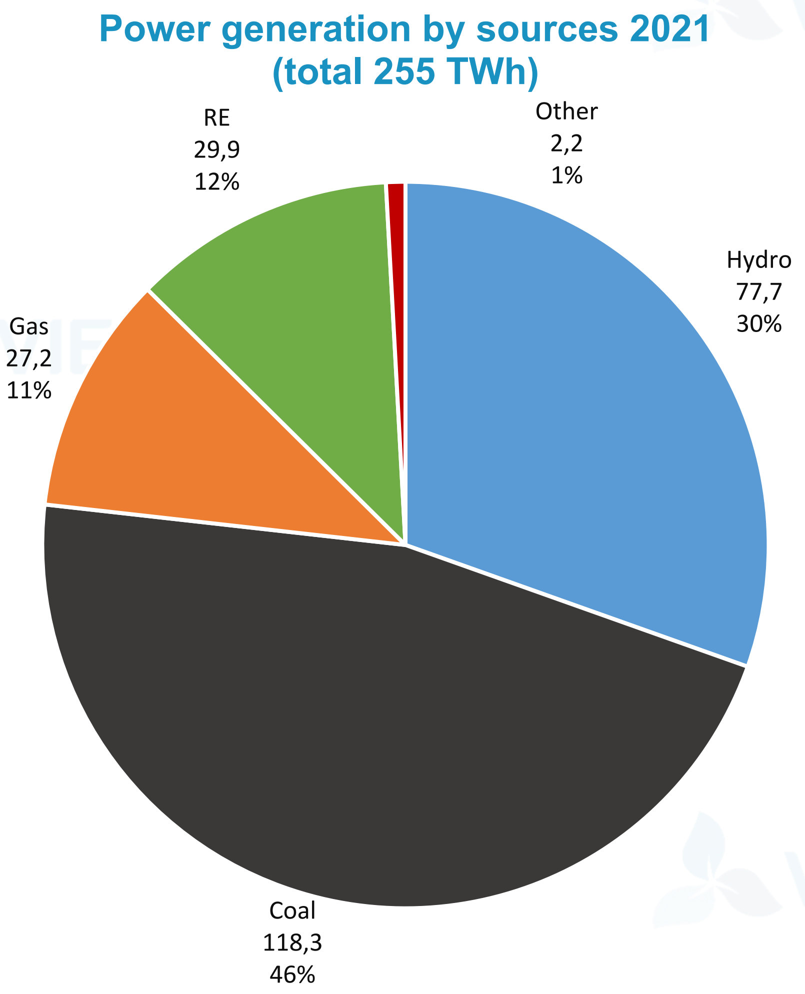


56% includes hydro, wind & solar

Source: VIET's analyze based on the data published by EVN NLDC Jan 2022

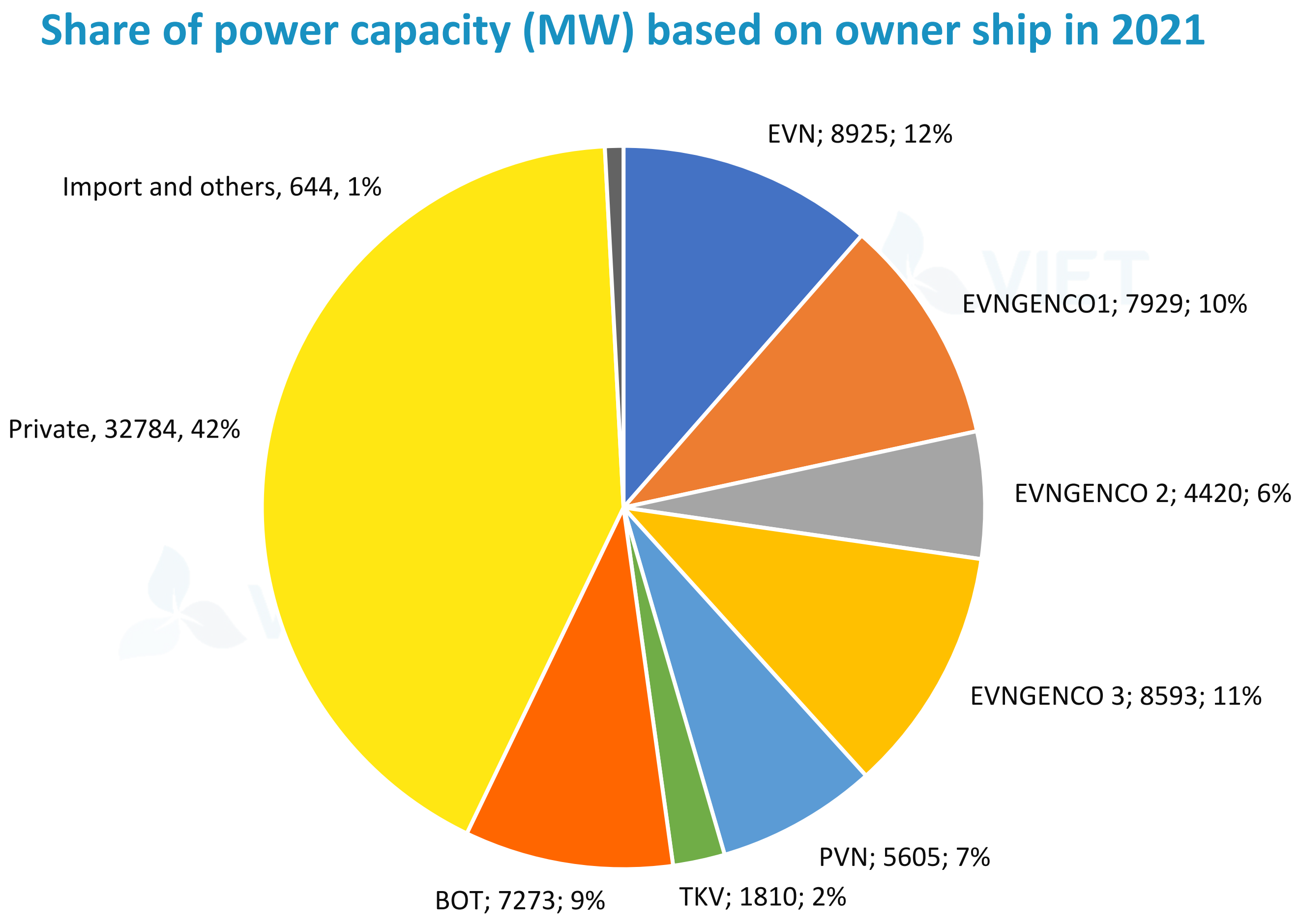
Power Generation





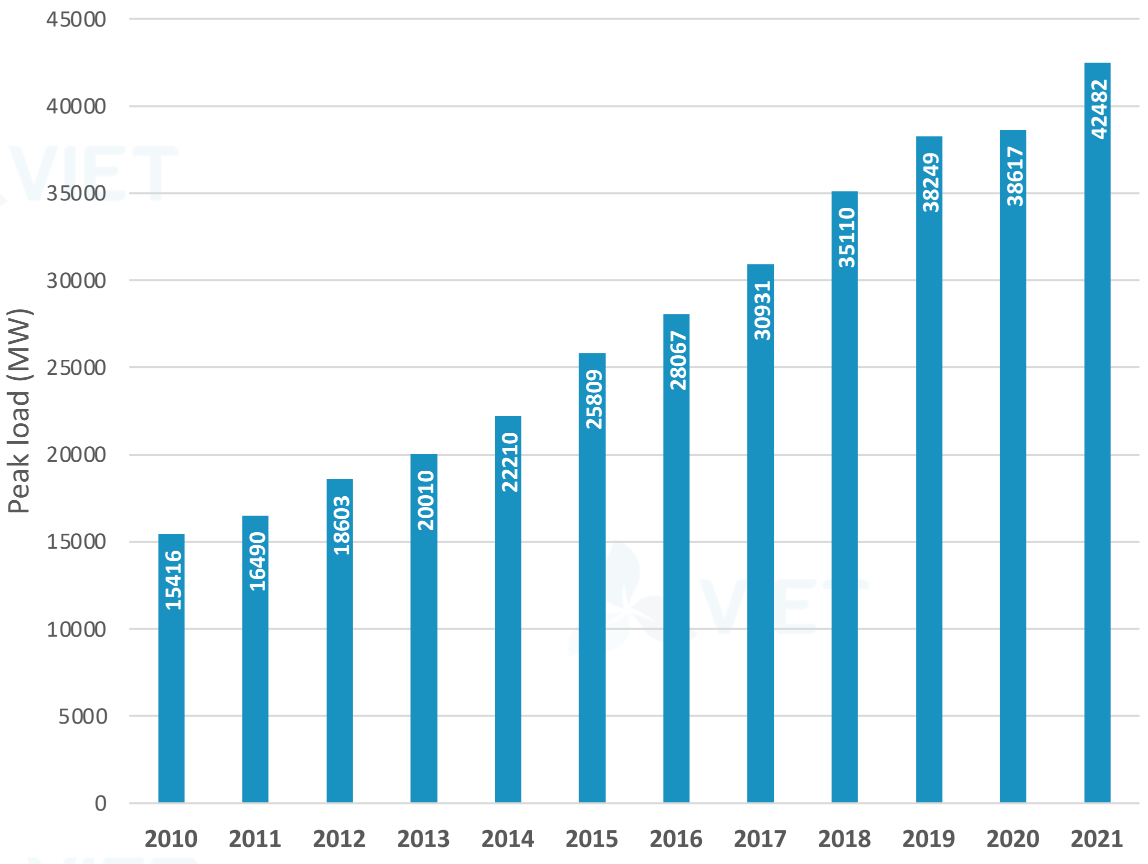
Source: VIET's analyze based on the data published by EVN NLDC Jan 2022

RE growth → private share in power sources increased

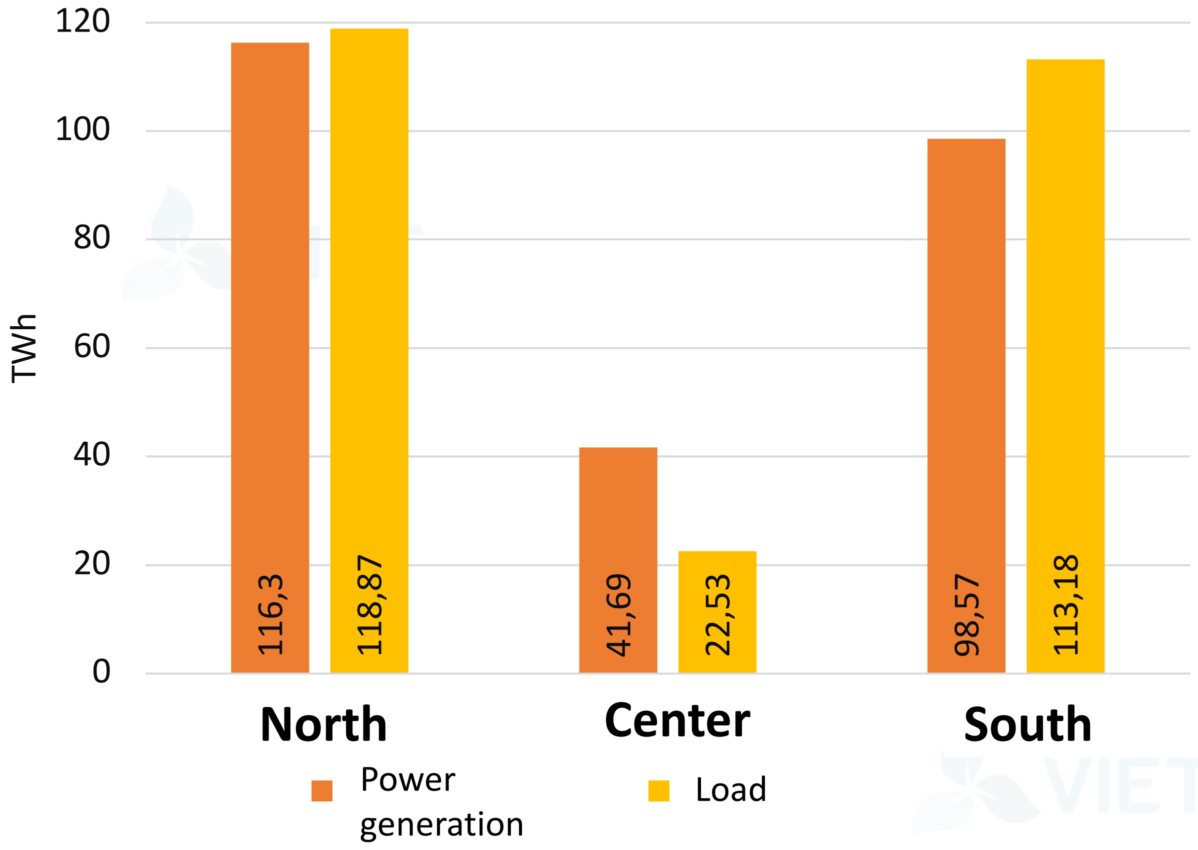


Source: VIET's analyze based on the data published by EVN NLDC Jan 2022

Growth of peak load 2010-2021

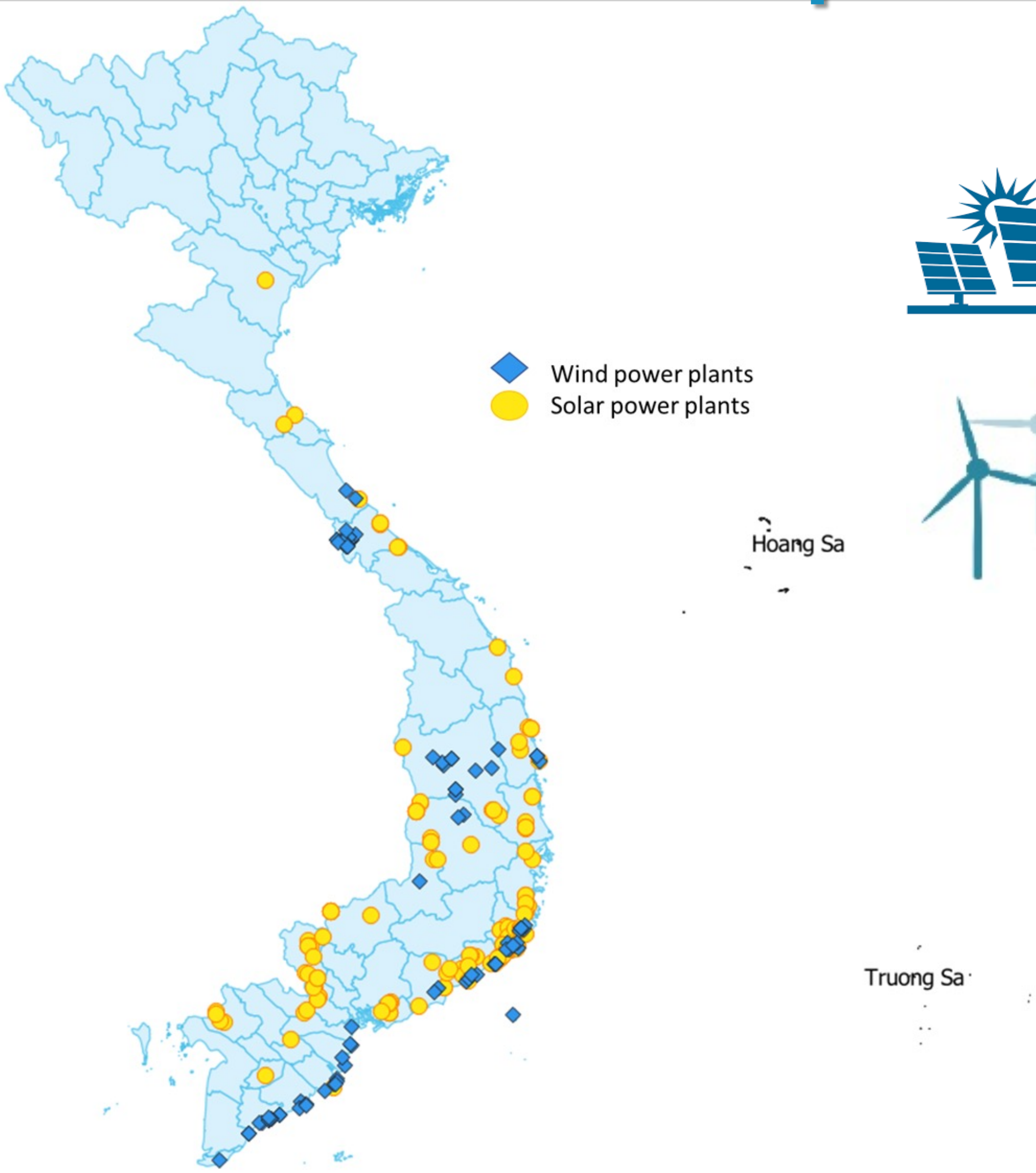


Power generation and load by region 2021



Source: VIET's analyze based on the data published by EVN NLDC Jan 2022

Wind and solar in operation (1/2022)



- **147** Solar plants ~ **8.87 GW**
- **104 k** Rooftop Solar System ~ **7.75 GW**

84 wind plants– **4.6 GW**

2011
FIT for Wind: 7.8 $c/kWh

2017
FIT solar: 9.35 $c/kWh
End 30/06/2019

2018
FIT 2 wind ($c/kWh)
Onshore 8.5
Offshore 9.8
End 31/10/2021

2020
FIT 2 solar ($c/kWh)
Ground: 7.09
Floating: 7.69
Rooftop: 8.38
End 31/12/2020

Source: VIETSE analyzed based on official documents issued by the goverment

Challenges

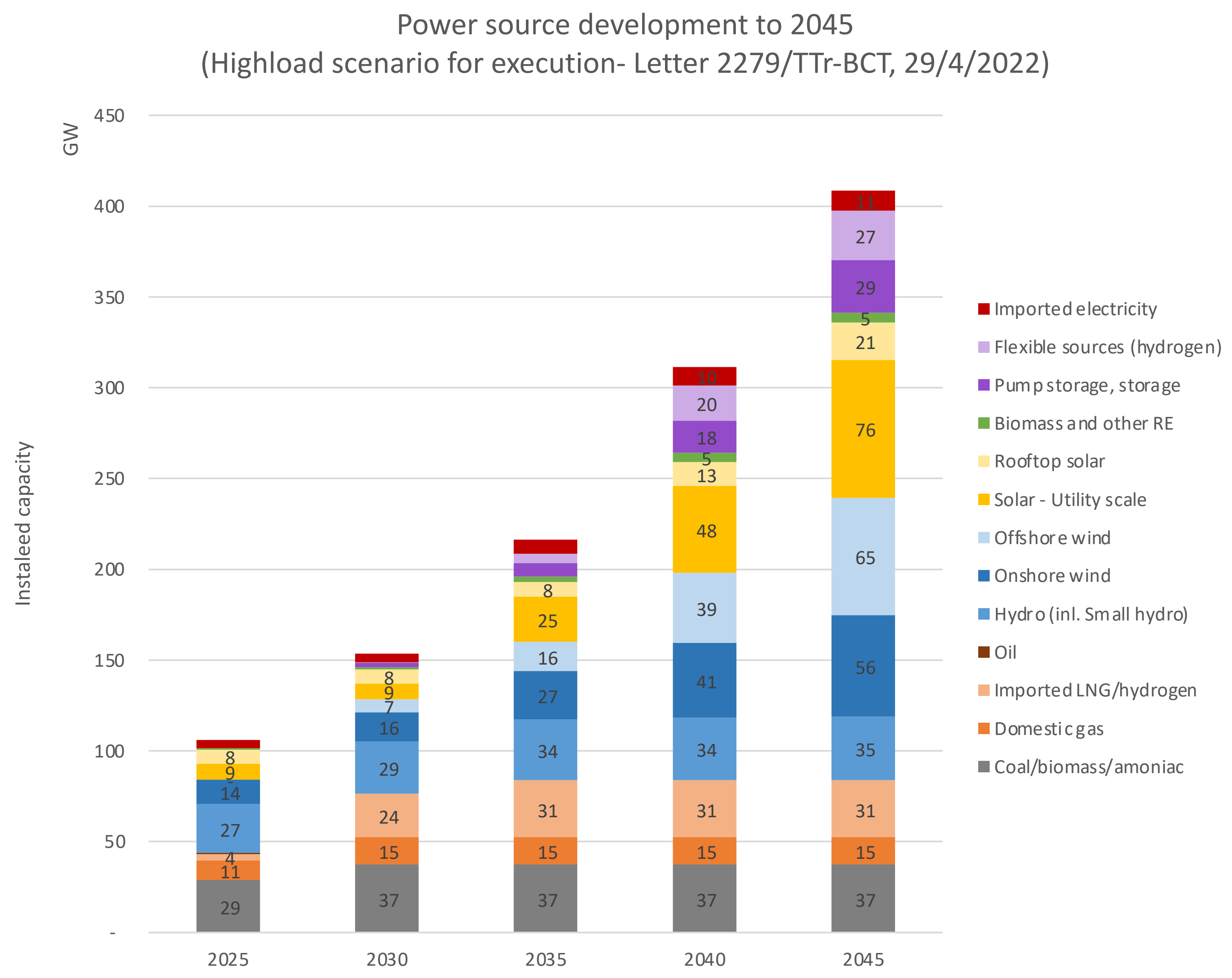
- Transmission overload:
  - 20 lines/MBA 220/110kV is overloaded
  - 159 plants are facing generation restriction
  - Impact to 500kV lines
- Low system's inertia
  - Risk of affecting system's stability
- Forecasting errors
  - Generation forecasting errors
  - Load forecasting errors ➔ difficulties for grid planning
- Share of VRE in total installed capacity ~ 25% → challenges for system operation
- Pricing mechanism
  - Incentives for auxiliary services are not yet attractive → Lack of reserves for RE sources (due to increasing share of intermittent VRE sources)
  - Incentives for BESS are not yet in place

Power Development Plan

Hanoi, 7 June 2022

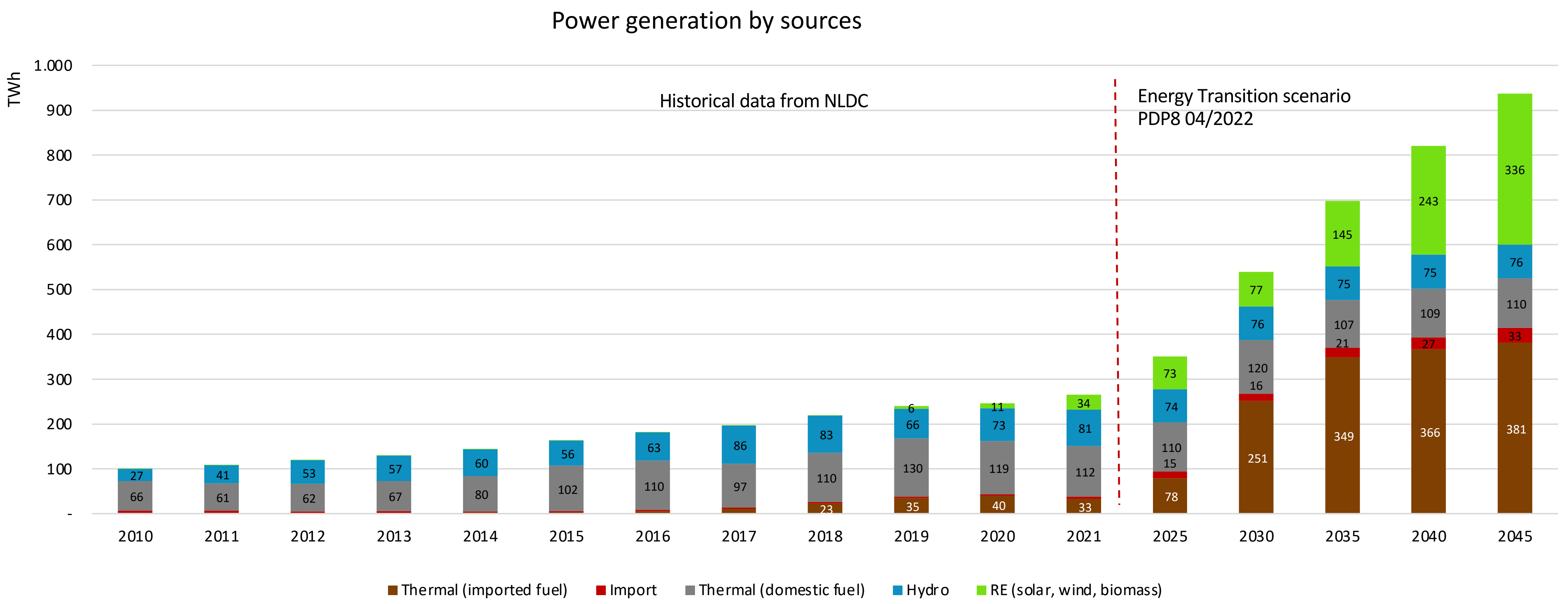
Power mix – Executing scenario

	Added capacity 2022-2030 (GW)	Added capacity 2031-2045 (GW)
Coal/biomass/amoniac	12.8	0
Domestic gas	5.9	0
Imported LNG/hydrogen	23.9	7.5
Oil	0	0
Hydro (inl. Small hydro)	6.8	6.2
Onshore wind	11.5	39.8
Offshore wind	7.0	57.5
Solar - Utility scale	0	67.3
Biomass and other RE	0.9	4.0
Pump storage, storage	2.5	26.5
Flexible sources (hydrogen)	0.15	27.2
Imported electricity	4.4	6.0
Rooftop solar	0	12.9
TOTAL	**75.8**	**254.9**



Source: PDP8 version 29/4/2022 (Letter 2297/TTr-BCT)

Electricity from domestic/import sources



Source: PDP8 version 29/4/2022 (Letter 2297/TTr-BCT)

Coal abatement scenarios

Hanoi, 7 June 2022

Priority Principle

Ensure energy security + Affordable + Better emission reduction = CO_2 Abatement scenarios for power sector in Vietnam

Method to develop CO2 Abatement Scenarios

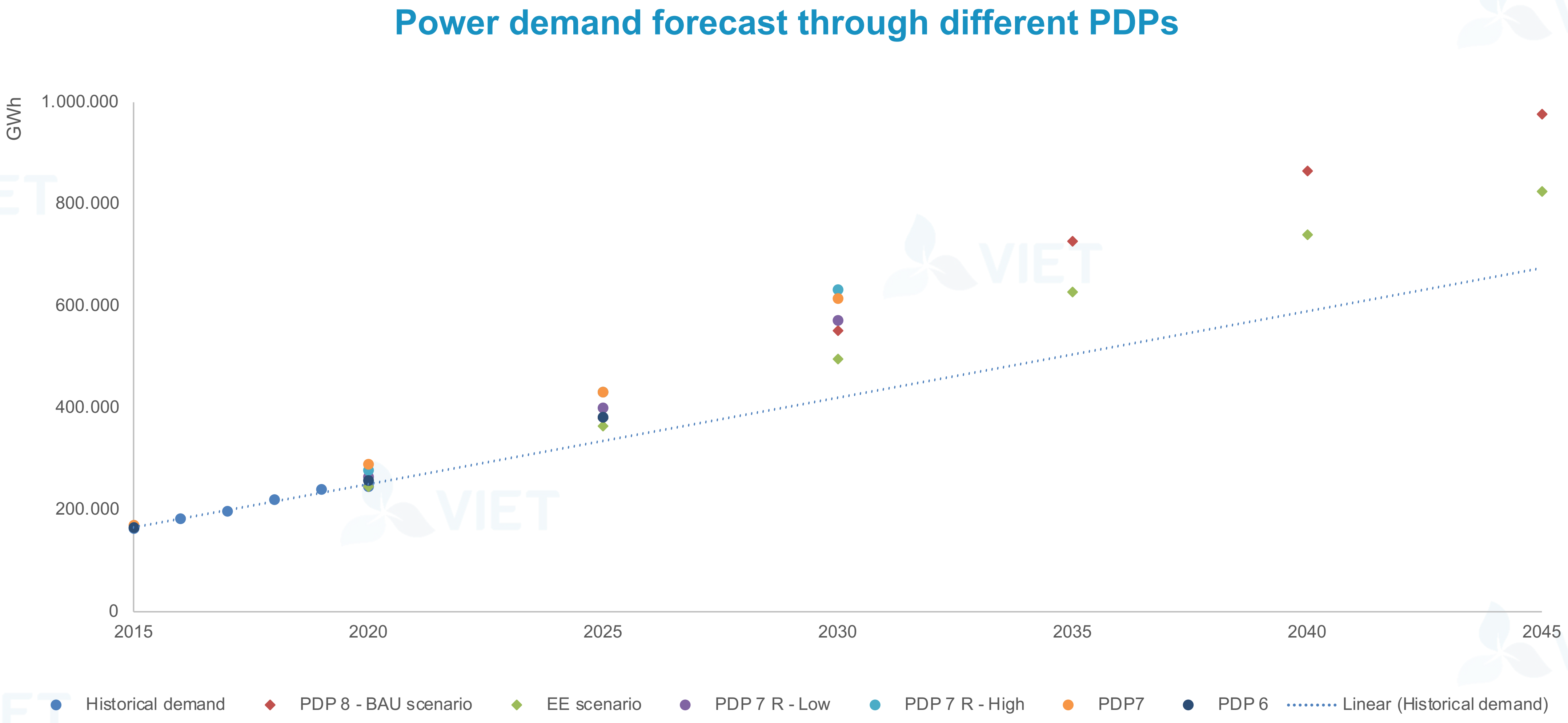
Technical modeling → Economic assessment → Social & Environmental Assessment

Assumptions CO2 Abatement scenarios

Assumption	Unit	2021 - 25	2026 - 30	2031 - 35	2036 - 40	2041 - 45
GDP growth rate	%/year	6.8	6.4	6.0	5.6	5.5
Electricity demand growth rate	%/year	9.09	7.95	5.8	3.66	2.61
Elasticity per GDP – BAU scenario		1.35	1.24	0.96	0.64	0.46
Electricity Generation – BAU scenario	TWh	378.3	551.3	727.0	864.9	977.0
Elasticity per GDP – EE scenario		1.2	1.0	0.8	0.6	0.4
Electricity Generation – EE scenario	TWh	364.0	496.4	627.5	740.2	825.3

Source: Drafted PDP8, 09/2021 and authors' calculation

Assumptions CO2 Abatement scenarios



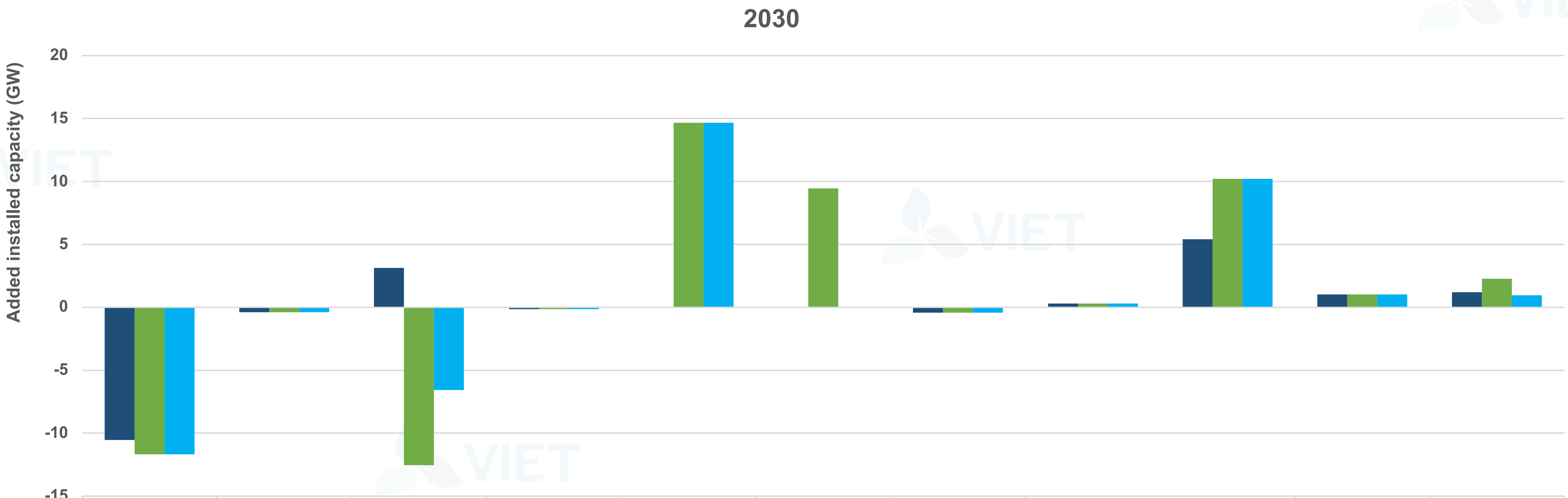
Source: Power Development plans

Power mix in 2030

Scenario Power mix	Solar (GW)	Wind (GW)	Biomass & other RE (GW)	Hydro power (GW)	Coal (GW)	Oil & Gas (GW)	Storage (GW)
BAU (PDP8)	**18.6**	**11.8**	**1.2**	**25.5**	**40.6**	**27.5**	**1.2**
Blue (No new coal)	**18.6** (draft PDP8)	**11.8** onshore wind + **5.4** offshore wind	**1.2**	**25.5** Increased operation efficiency by 10%	Existing capacity **22.1** + Under construction projects **7.4**	**14.4** Existing capacity and Domestic gas plants + LNG balanced source at **15.7**	**2.4**
Green (Phase out coal)	**18.6** (draft PDP8) + **5** RTS + **9.68** FLS	**21.3** onshore wind + **10.2** offshore wind	**1.2**	**25.5** Increased operation efficiency by 10%	**22.1** Existing capacity - Old plants to be phased out* **1.14** + Under construction projects **7.4**	**14.4** Existing capacity + Domestic gas power plants	**3.5**
Cyan-EE (Real transition)	**18.6** (draft PDP8) + **5** RTS + **9.68** FLS	Onshore wind balanced source **11.8** + **10.2** offshore wind	**1.2**	**25.5** Increased operation efficiency by 10%	**22.1** Existing capacity - Old plants to be phased out* **1.14** + Under construction projects **7.4**	**14.4** Existing capacity and Domestic gas plants + **6** LNG	**2.15**

** 3 Old coal-fired power plants to be phased out: Ninh Binh (operated since 1976); Pha Lai 1 (operated since 1986) and Pha Lai 2 (operated since 2001).*

Modeling results – GAMS
Installed Capacity compared to BAU



	Coal	Gas	LNG	Oil	Solar	Wind	Biomass	Waste incineration	Offshore Wind	Hydro	Storage - Pumped Hydro
Blue	-10.540	-381	3.150	-138	-13	0	-409	295	5.400	1.029	1.200
Green	-11.680	-381	-12.550	-138	14.669	9.467	-409	295	10.200	1.029	2.259
Cyan_EE	-11.680	-381	-6.550	-138	14.669	0	-409	295	10.200	1.029	953

Blue Green Cyan_EE

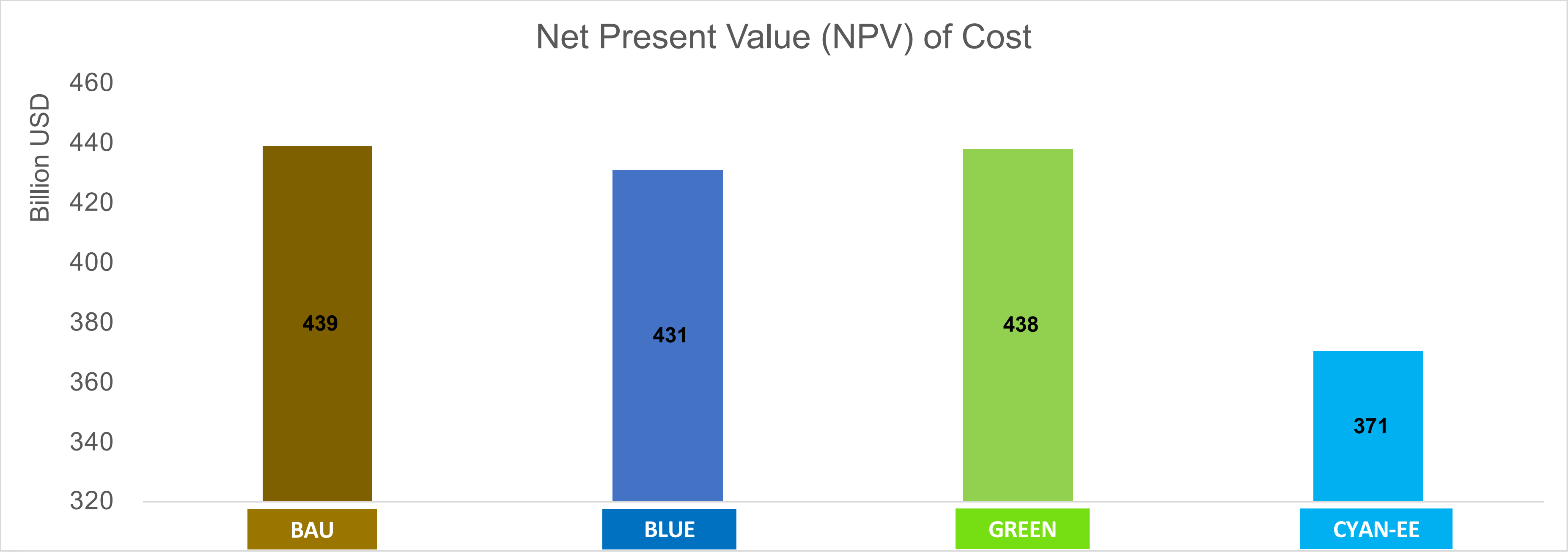
Source: VIETSE' study

Economic Assessment

Investment in ancillary activities to increase system flexibility, including grid upgrades → Increase in cost for generators and communities impacted by transition → Impact on state budget and balance of payments → Requirement for additional resources?

Total discounted scenario costs

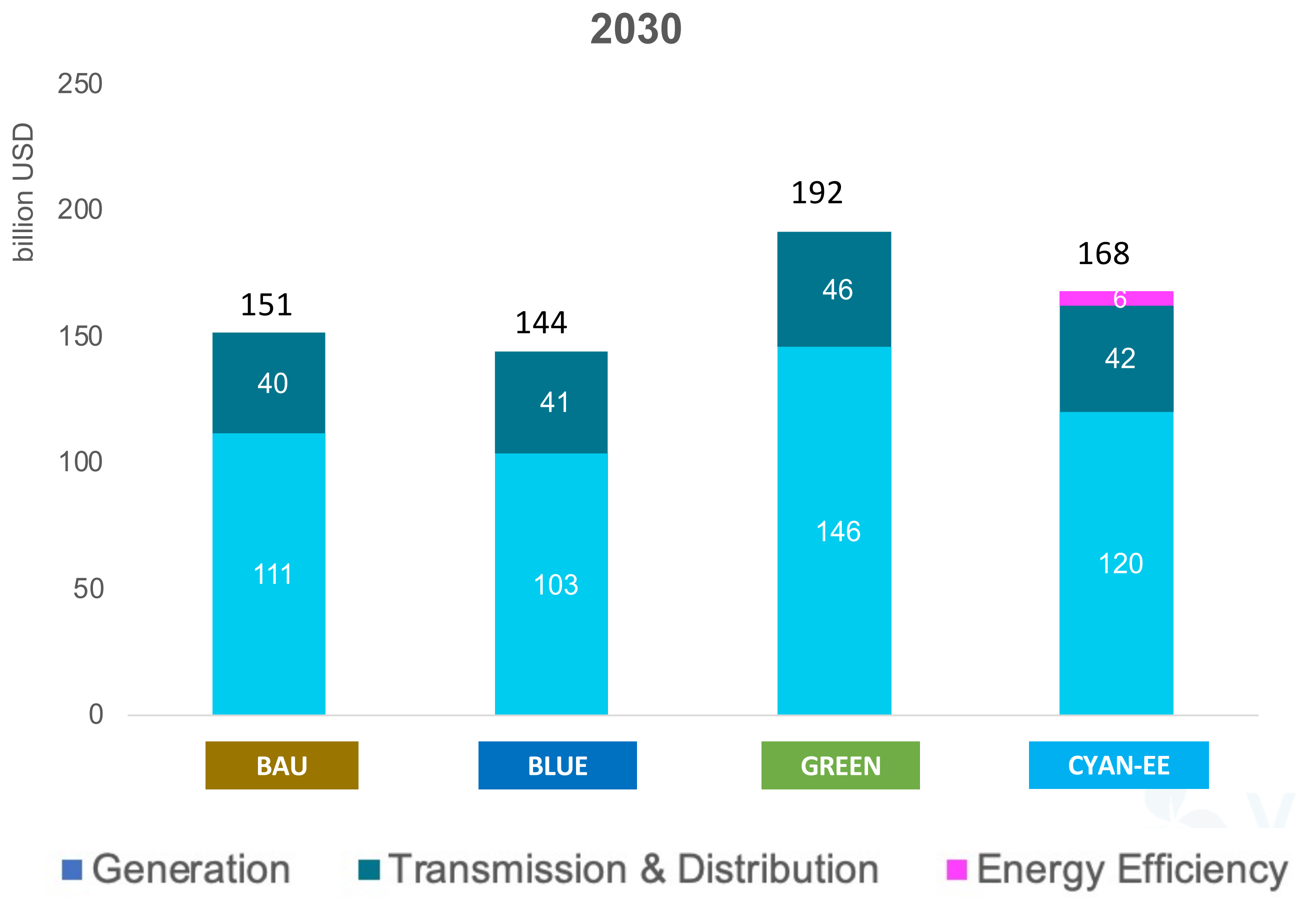
- Multiple scenarios offer improved economics for the power sector, with cost savings realized compared to BAU in the longer term out to 2045 through the Blue, Green and Cyan-EE scenarios
- Cyan-EE offers the most significant reduction in total costs (expressed in net present value) with 16% savings compared to BAU



These cost savings help Vietnam's electricity sector remain highly competitive and supports national economic development.

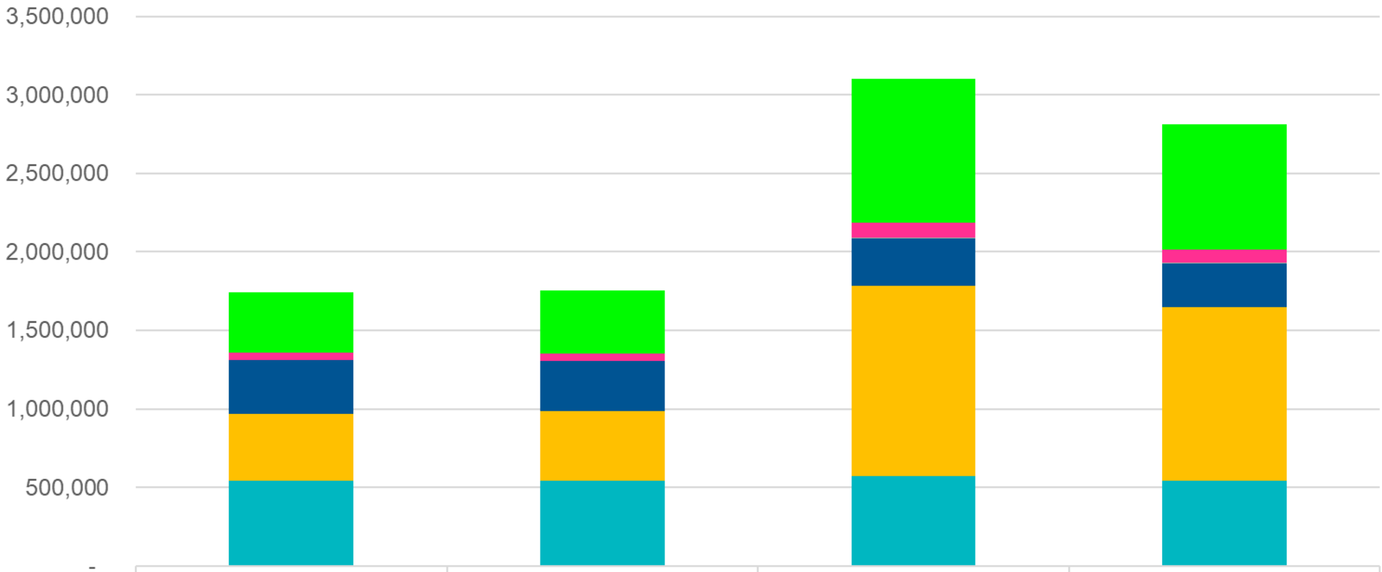
Total investment cost for
New generation resources and infrastructure

- **Overall, upfront investment costs for all scenarios are relatively similar (within 25%)**
    - Small amounts of savings can be realized with the Blue scenario compared to Business-as-Usual (5%)
    - Green and Cyan-EE scenarios require more investment than Business-as-Usual, however, these scenarios can provide savings in the longer term
- **Generation makes up about 75% of the total new generation investment cost for each scenario**



Job created by each scenario for 2025-2030

- The Green and Cyan EE scenarios create the most jobs in the coming years
- Across scenarios, most employment is created during the construction period; more RE generation in Green and Cyan EE account for major increase in construction jobs
- Transmission and distribution creates at least 540,000 jobs per scenario



	BAU	Blue	Green	Cyan EE
Manufacturing Jobs	384,684	403,331	913,435	800,074
Operations Jobs	50,028	45,281	96,683	82,338
Decommissioning Jobs	-	-	3,649	3,649
Fuel Supply Jobs	339,130	315,897	300,165	276,149
Construction Jobs	428,070	446,714	1,214,245	1,108,402
Transmission	541,745	541,745	572,058	541,745

Modelling results – Abatement Scenarios for Power sector in Vietnam

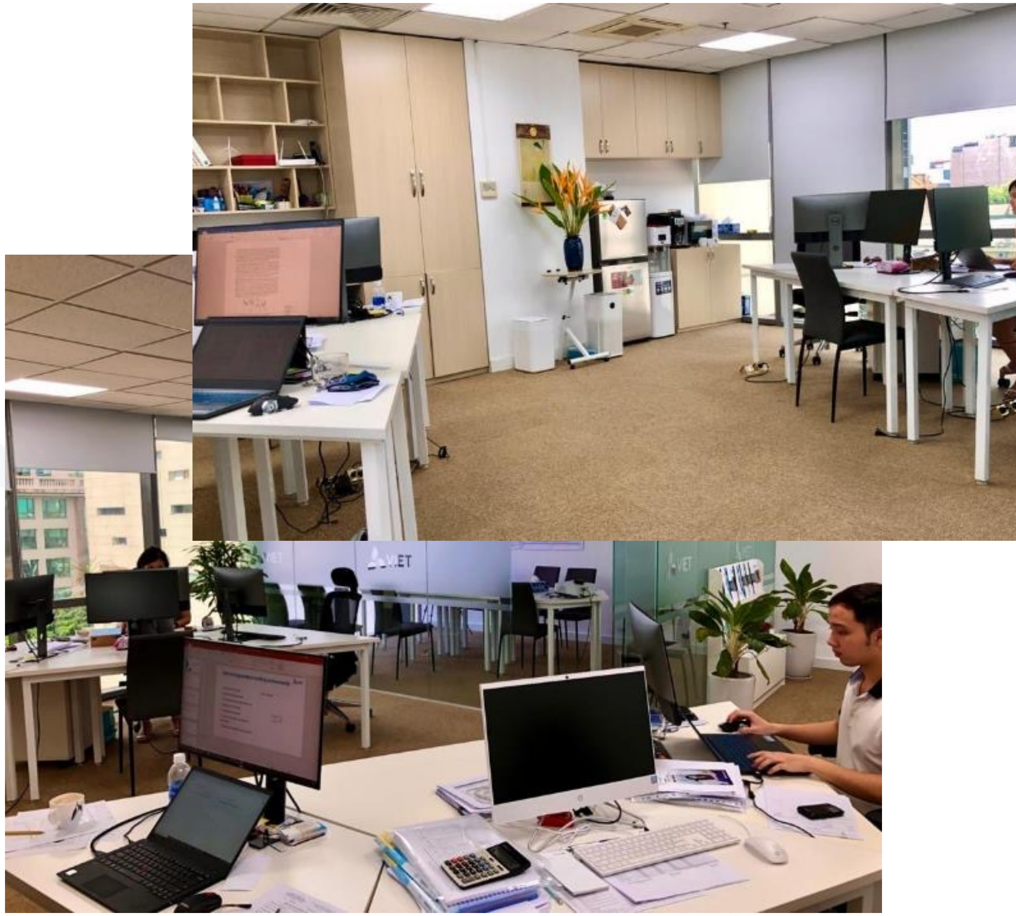
VIET

Metrics	2030	2045
Energy efficiency and DSM	↑ From 1.5% to 10%	↑ From 1.5% to 16%
Electricity generated from renewable sources	54%, ↑ VRE contribution from 4% in 2020 to 28%	60%, ↑ VRE contribution from 4% in 2020 to 42%
Share of generation from coal	↓ 30% from 50% in 2020	↓ 19.5% from 50% in 2020
Import dependency of power sector	↓ 27% vs 42% for BAU	↓ 25% vs 46% for BAU
Total investment cost (for power, infrastructure and EE measures)	USD155 billion	USD410 billion

Recommendations

- ✓ Address barriers to clean technology – embedded subsidies for fossil fuels and lack of curtailment protection for VRE
- ✓ Energy efficiency could dampen the demand trajectory by 16% in 2045, just in BAU
- ✓ Balancing and flexibility capacity for the grid
    - Improve flexibility of existing infrastructure, especially hydro and coal
    - Addition of new resources – gas and LNG, battery storage, demand side
    - Add transmission and distribution, upgrade of substations
- ✓ Market solutions – emissions trading systems, and integrated ASEAN power market
- ✓ Financial levers – curtailment insurance for VRE, capacity development in domestic debt markets
- ✓ Financial mechanisms for coal to clean transition

Thank you!



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