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10 Insights on Energy Transition in Vietnam

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10 Insights on Energy Transition in Vietnam



Outline

- 1) Who are we ? Zoom on USTH Energy department
- 2) Insights on the Energy Transition in Vietnam
- 3) Concluding remarks

1) University of Science and Technology of Hanoi





Đại học Khoa học và Công nghệ Hà Nội



USTH factsheet

Vietnamese public

New Model University

Created in 2010

Supported and
accredited by France

All PhD lecturers

450 Bachelor, 105 Master
(academic year 2018/2019)

60 % do internships abroad

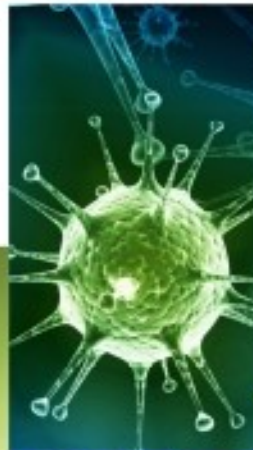
Not HUST - Bac Khoa

8 MASTER TRAINING PROGRAMS



**INFORMATION AND
COMMUNICATION TECHNOLOGY**

BIOTECHNOLOGY



ENERGY



**AIR TRANSPORT
OPERATIONS
MANAGEMENT**



AIRBUS



**WATER -
ENVIRONMENT -
OCEANOGRAPHY**



**ADVANCED MATERIALS
SCIENCE AND
NANOTECHNOLOGY**



**QUANTITATIVE
COMPUTATIONAL
FINANCE**



SPACE

Energy department

2+6 PhD trained in France, 5 grad students, ...



Missions

Teach

3yr Bachelor in Energy

2yr Master in Energy

3yr PhD

Research



<http://cleaned-usth.com>

Engage society

Consulting in solar energy and other domains

Vietnam Sustainable Energy Alliance

Vietnam Initiative for the Energy Transition



Timeline

Becoming a leading academic lab
on clean energy and
sustainable development
in Southeast Asia



VIET vision to 2020

Vietnam Initiative on Energy Transition

Research and advocacy think tank with:

- Capacity to produce original visions of the energy system, quantified and justified based on scientific and technical knowledge
- In house expertise on all relevant energy sources : biomass, wind, solar, hydro, gas, coal, CO2 capture and storage.

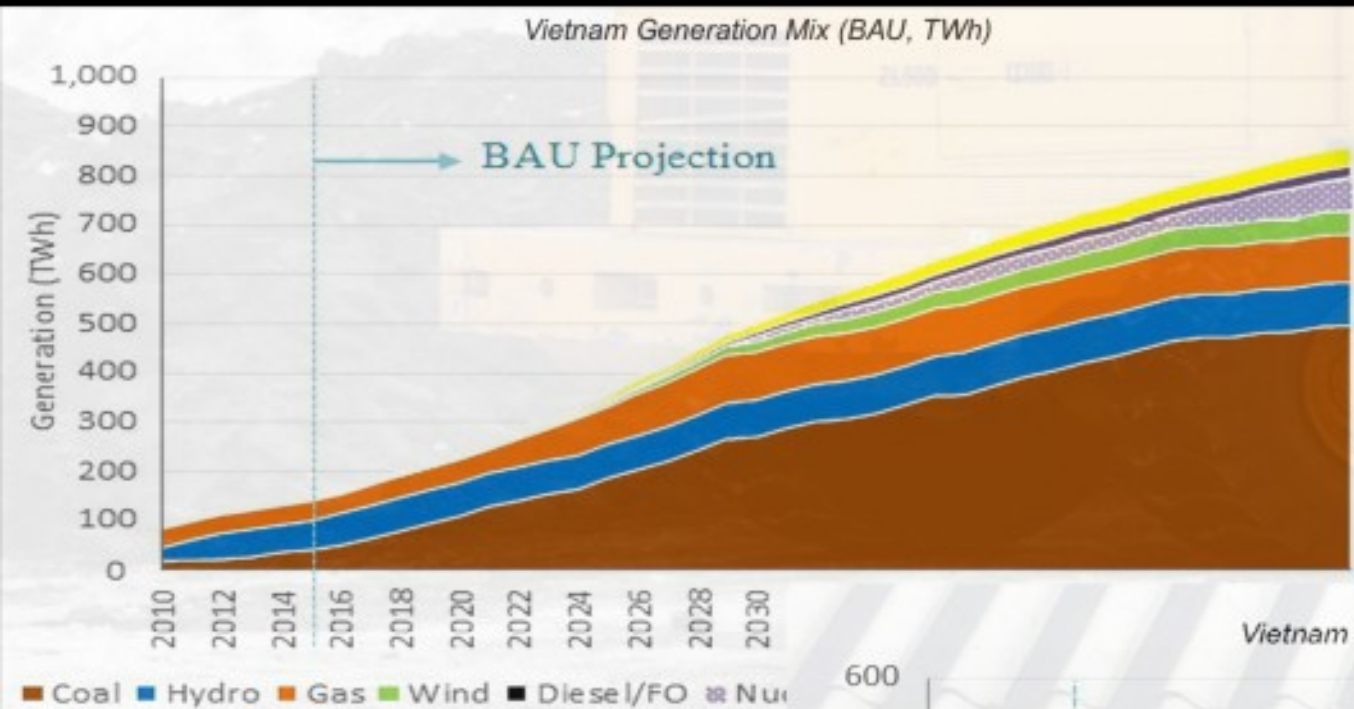
Thanks to our partners



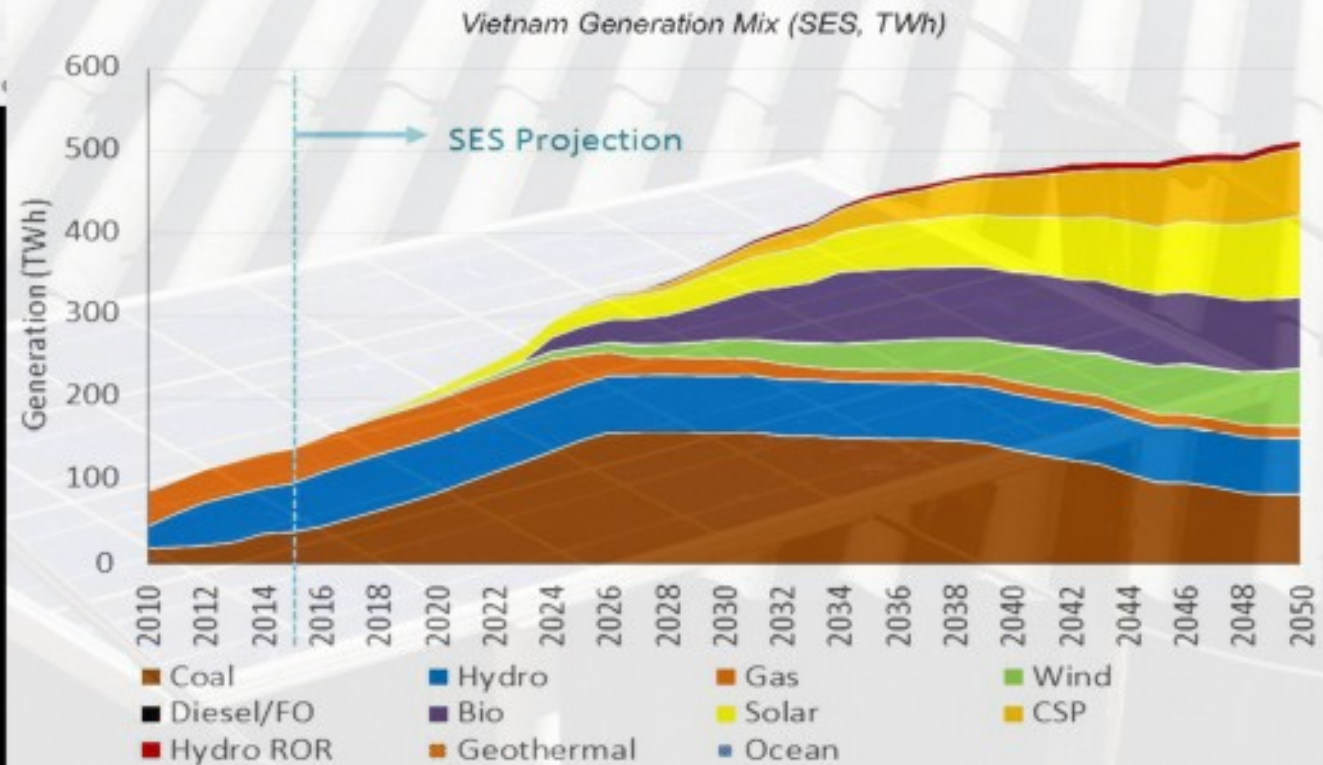
ENVIDATEC



2) Insights on VN energy transition



Above, BAU scenario PDP7A.



Right, Sustainable Energy Sector scenario in WWF VN and VSEA (2016) *Alternative Vision for Vietnam's power sector*. Policy Brief.

1. Vietnam energy transitions differ from the global historical model

Traditional decarbonization trajectory :

Biomass → Coal → Oil → Carbon Free

Vietnam trajectory :

Biomass → Hydro → Natural gas → Coal ??

Rapid development: the Power Development Roadmap

Fuel types	2015	2020	2030
Natural gas	7,998	8,940	19,037
Coal	12,903	25,620	55,167
Nuclear		-	4,600
Hydro (large, PSH)	14,636	18,060	21,886
Oil	875	-	-
Solar	5	850	12,000
Wind	135	800	6,000
Other (Diesel, Small HH, biomass, waste to energy)	2,006	4,290	9,195
Import	500	1,440	1,554
Total	39,058	60,000	129,500

PDP VII revised:

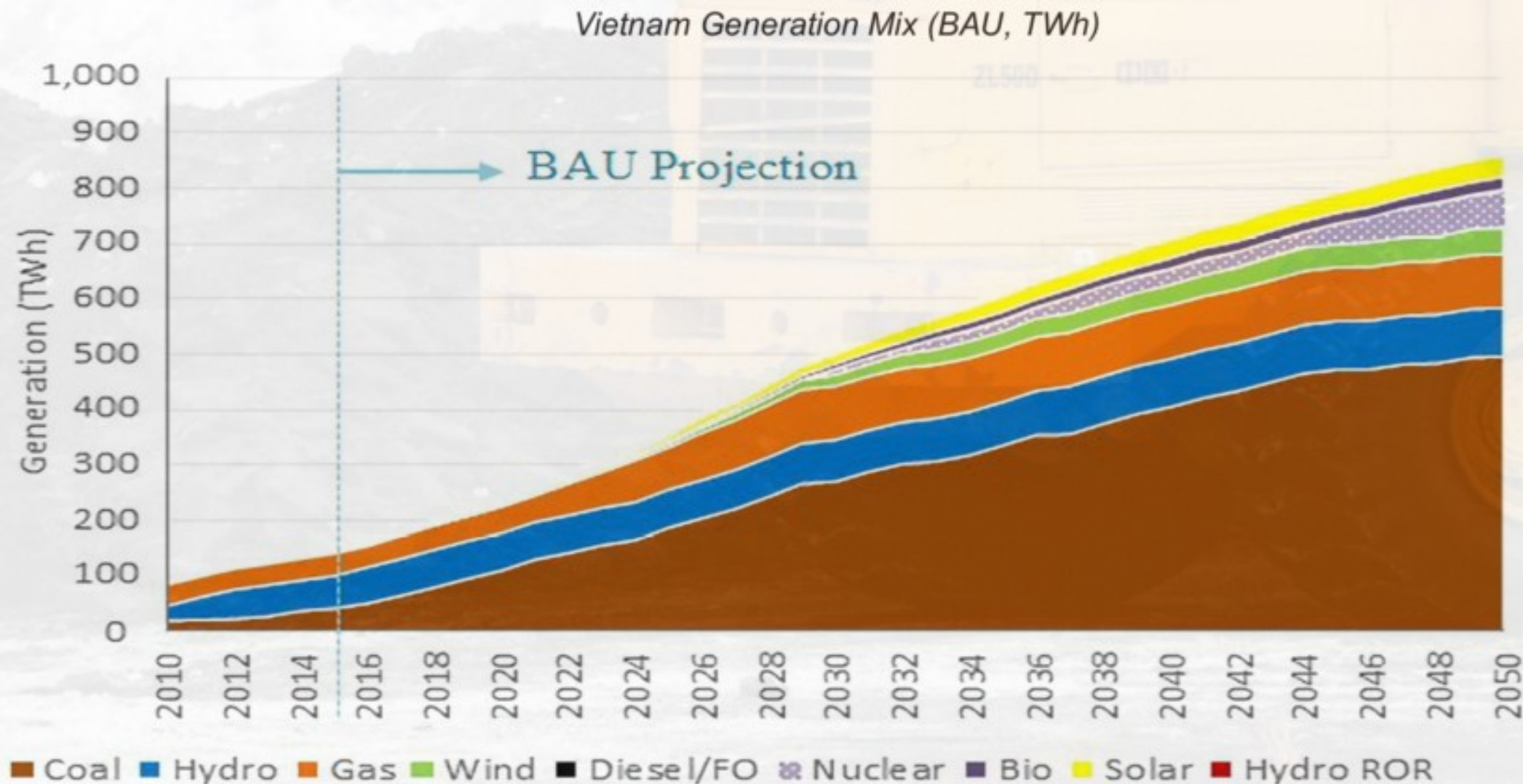
Cut 20,000 MW of coal,
but coal share still
planned to grow to 43% in
2030

2GW Wind, 4 GW PV by 2025

Power Development Plan 7 revised

BAU : Business as Usual

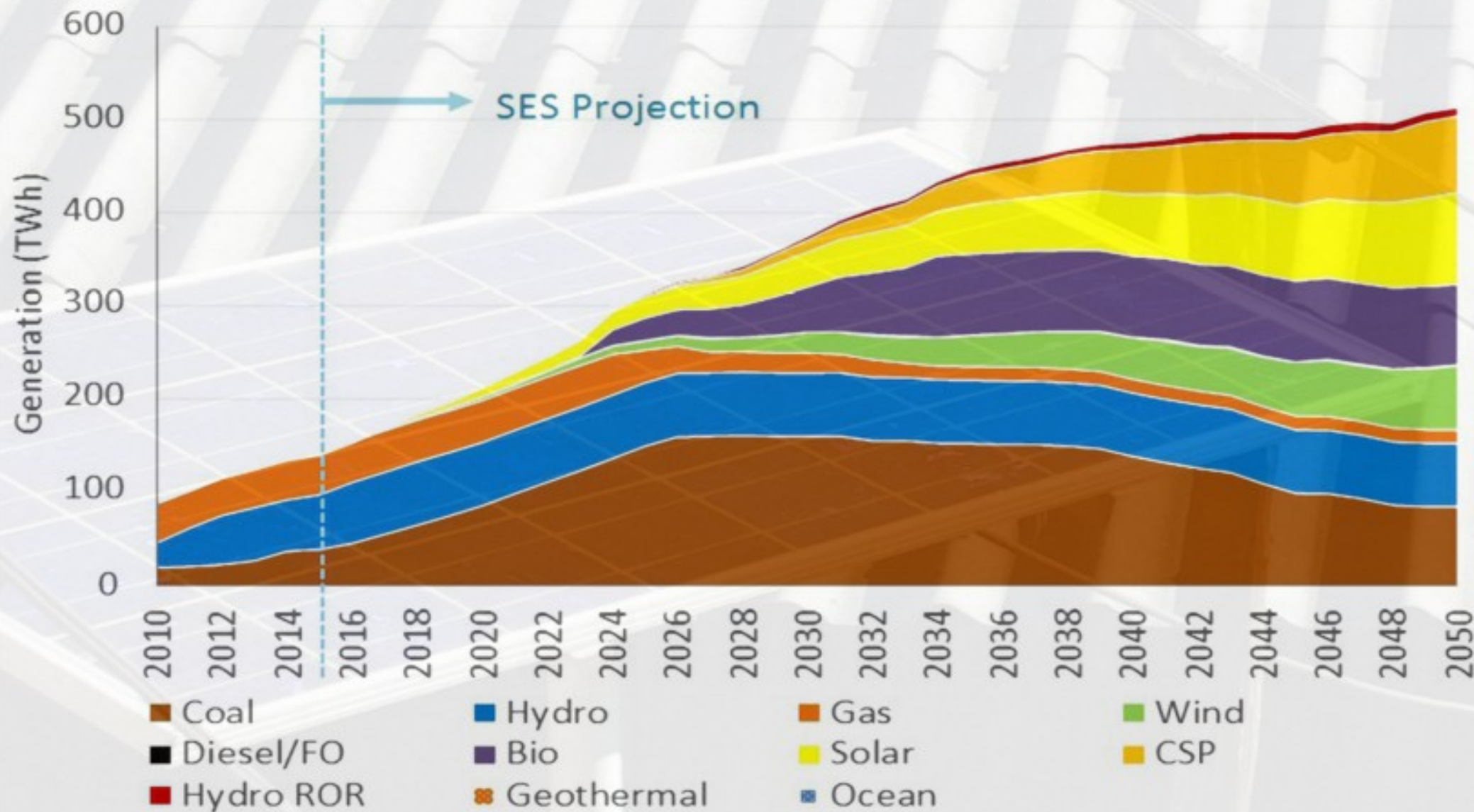
The Plan is an administrative tool authorizing investment. It says what *can be*.



SES : Sustainable Energy Sector scenario

WWF VN and VSEA (2016) *Alternative Vision for Vietnam's power sector*. Policy Brief.
The vision is an advocacy tool. It argues what *could be*.

Vietnam Generation Mix (SES, TWh)



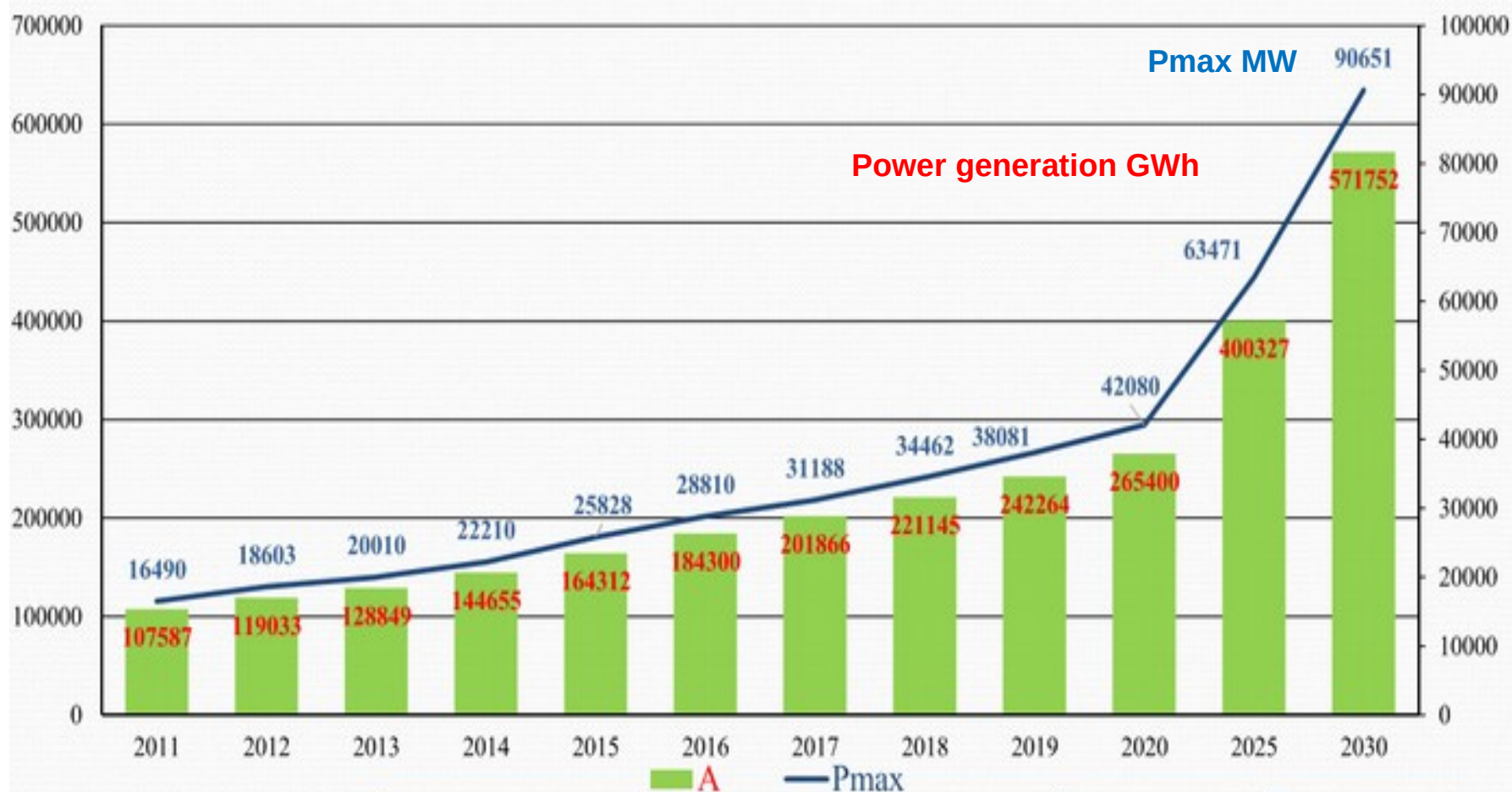
2. Power demand can be moderated without undermining growth

Specific plans are available

- Vietnam Green Growth Strategy describes
 - 22 MtCO₂ mitigation profitable technological options. Most are power saving by efficient appliances.
 - 41 MtCO₂ at less than 10 US\$/ton CO₂
- Vietnam Nationally Determined Contribution (NDC)
 - 8 % below BAU (unconditional)
 - GDP emission intensity -20% for 2010 → 2030

The planning process never ends

Electricity demand history and forecast



Average growth rate (%)

	2011-2015	2016-2020	2021-2025	2026-2030
Peak Load	11.9	10.5	8.6	7.4

Source: NLDC annual report, 2015 and Revised Master Plan VII.

Saving energy is saving money.

Table 3.12. GHG emission reduction options in energy sector implemented by domestic funding

No	Option	Mitigation potential in 2030 (ktCO ₂ e)
1	E3. High efficiency residential lighting	4,567.1
2	E5. Cement-making technology improvements	2,183.3
3	E6. Brick-making technology improvements	2,052.6
4	E9. Freight transport switch from road	3,601.7
5	E10. High efficiency commercial air conditioning	1,120.8
6	E1. High efficiency residential air conditioning	2,305.7
7	E8. Passenger transport mode shift from private to public	1,190.9
8	E12. Small hydropower plants	7,994.9
9	E4. Solar water heaters	2,570.4
10	E2. High efficiency residential refrigerators	1,694.7
11	E13. Wind power plants by domestic funding	180.2
Total GHG emission reduction		29,462.3

These are more expensive.

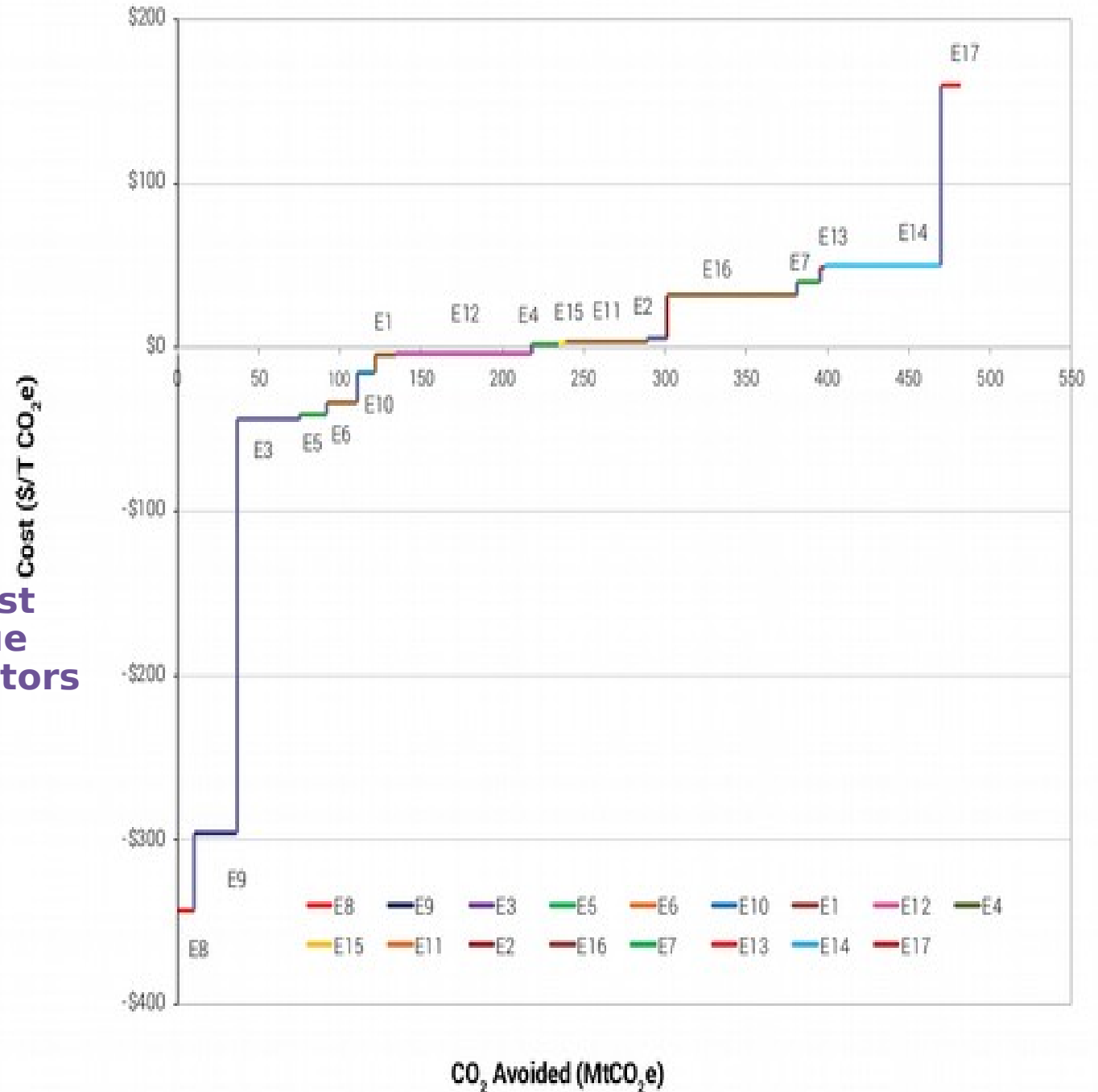
Table 3.13. GHG emission reduction options in energy sector implemented by international support

	Option	Mitigation potential in 2030(k _t CO ₂ e)
1	E11. Biomass power plants	7,002.2
2	E14. Wind power plants by international support	10,926.4
3	E16. Ultra-supercritical coal power plants	14,222.8
4	E7. Substitution of ethanol for gasoline in transport	1,547.1
5	E15. Biogas power plants	611.1
6	Solar PV power plants	2,162.4
	Total mitigation potential	36,472.0

Options sorted from cheapest to most expensive :

Marginal Abatement Cost Curve - MACC

2030 Cost Curve

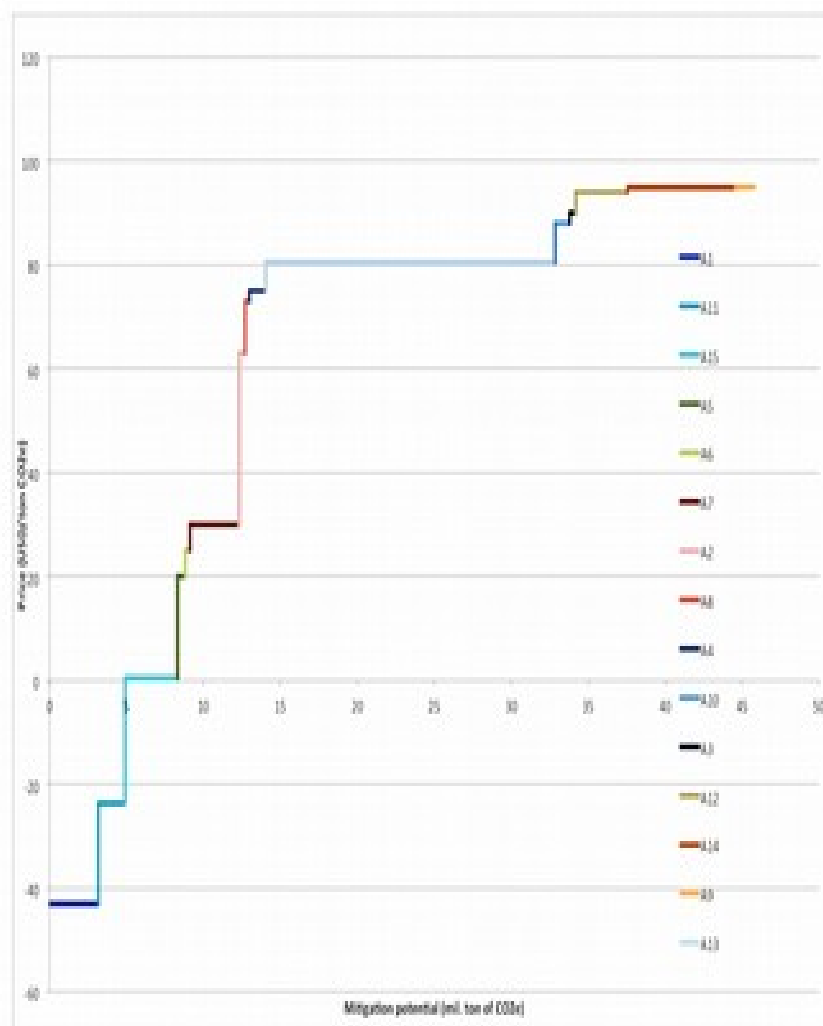


The optimal plan is
To do everything that cost
Less than the social value
of mitigation, across sectors

NDC & MACC OPTIONS IN AGRICULTURAL SECTOR

Table 1. Costs and mitigation potential of mitigation options in the agricultural sector

Option	Potential for emission mitigation by 2030 (Million metric ton of CO ₂ equivalent)	Cost for emission mitigation* (\$/tCO ₂)
A1. Increased use of biogas	-3.17	-43.00
A2. Reusing of agricultural residues	-0.36	63.02
A3. Alternate wetting and drying, and improved rice cultivation	-0.94	88.00
A4. Introduction of biochar	-1.07	75.00
A5. Integrated Crop Management (ICM) for rice	-0.50	20.00
A6. Integrated Crop management (ICM) for upland annual crops	-0.32	25.00
A7. Substitute of Urea fertilizer by Sulfate amon-(NH ₄) ₂ SO ₄	-3.2	30.00
A8. Reusing of agricultural residues	-0.29	73.02
A9. Alternate wetting and drying, and improved rice cultivation	-7.02	94.90
A10. Introduction of biochar	-18.80	80.45
A11. Improving diets for cattle	-1.75	-23.63
A12. Improve quality and services of variety, food and input material for aquaculture	-0.41*	90.00
A13. Revise technologies for aquaculture and waste treatment of aquaculture	-1.21*	95.00
A14. Revise technologies of food processing and waste treatment for crop, forestry, livestock and aquaculture	-3.36**	94.00
A15. Optimal irrigation for coffee	-3.39	0.46



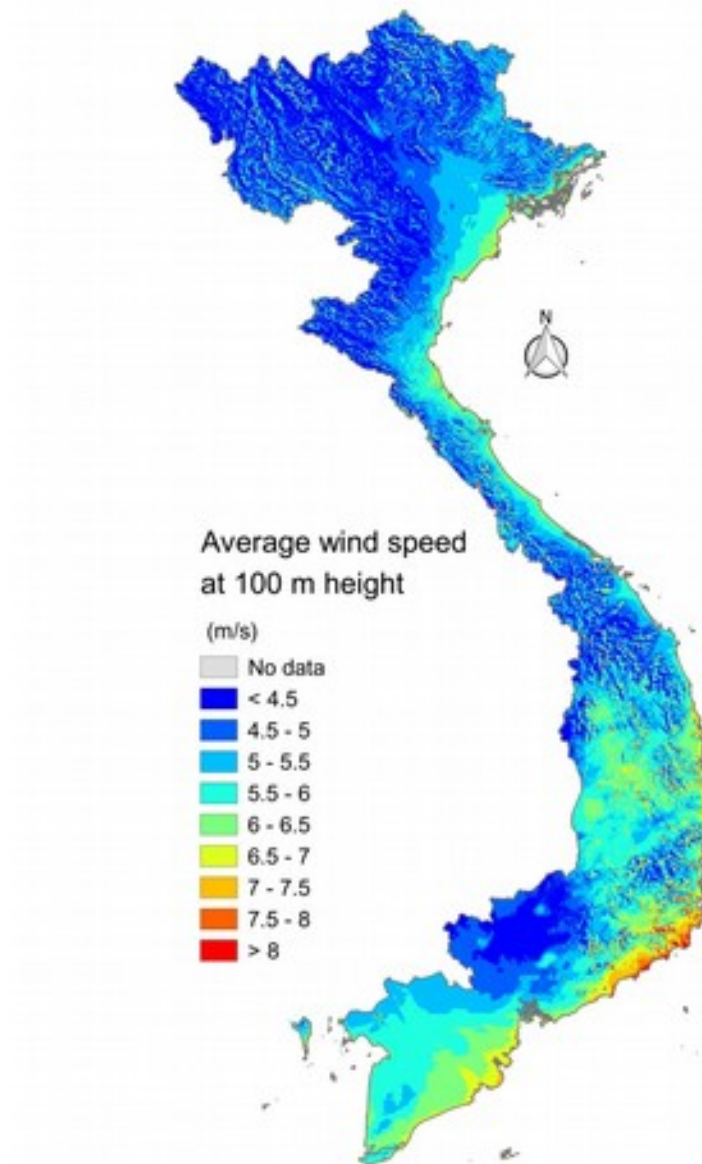
- Reduce 6.63 mil. tonnes of CO₂ by 6 options
- Continue to reduce 39.422 mil. tonnes of CO₂ by 9 extended options with intl support

3. Renewable energy sources are an economical alternative to coal

- Biomass, solar, wind have high growth potential (unlike Hydro)
- Falling wind and solar costs
 - Already below coal with external pollution costs.
 - In few years, competitive on financial costs.

Wind power potential

- ▶ With a coastline of 3,000 km, and average wind speeds of 5.6 m/s in coastal regions, and up to 8 m/s on certain islands, the potential for wind power generation is high.
- ▶ The theoretical wind energy capacity in Vietnam is approximately 513 GW.



Wind power situation

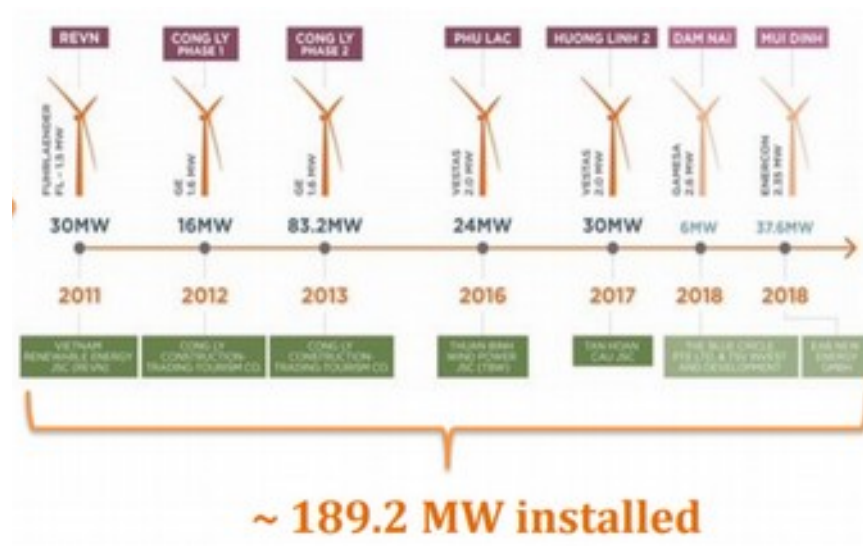
▶ **Legal Rules:** Decision 37/2011/QĐ-TTg, dated 20/6/2011 issued by Prime Minister and Circular 32/2014/BCT issued by MOIT.

✓ Electricity Tariff (FIT):

7.8 USCents/kWh	Decision 37/2011/QĐ-TTg
8.5 USCents/kWh	Onshore projects (Decision. 39/2018/QĐ-TTg dated 10 Sept 2018)
9.8 USCents/kWh	Ofshore projects (Decision. 39/2018/QĐ-TTg)

✓ Power Purchase Agreement :
based on sample PPA

▶ So far, there have been 9 projects signed PPA with EVN with total installed capacity of 403.9 MWp and around **189.2 MW in commercial operation**

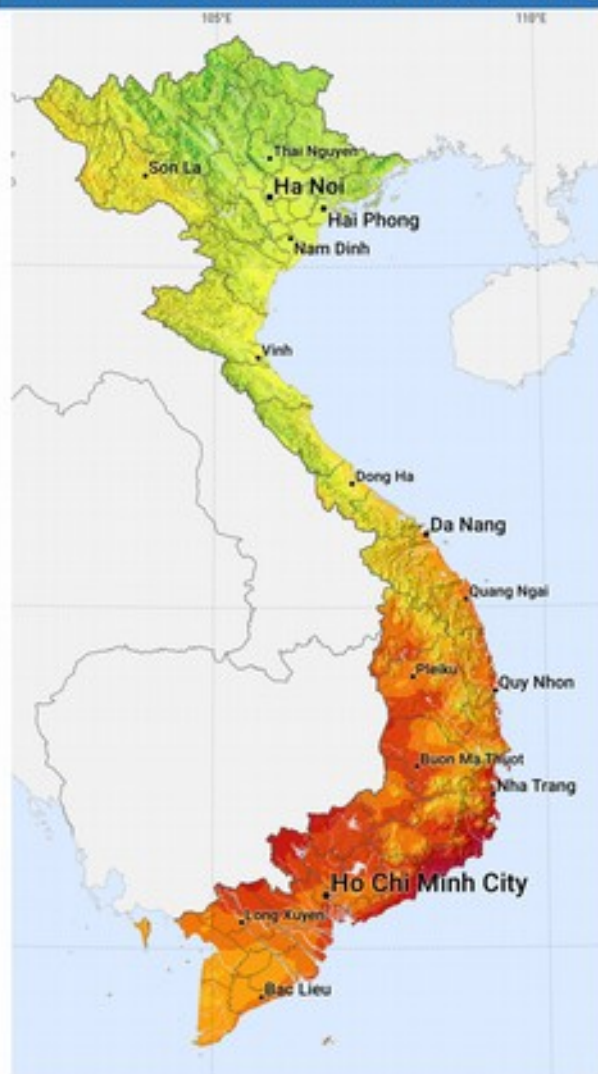


Solar Power potential

Vietnam solar power potential

© 2017 The World Bank, Solar resource data: Solargis.

GHI – Global horizontal irradiation [kWh/m²]



Long term average of GHI, period 2007-2015

Daily totals: 3.2 3.6 4.0 4.4 4.8 5.2 5.6 kWh/m²

Yearly totals: 1168 1314 1461 1607 1753 1899 2045

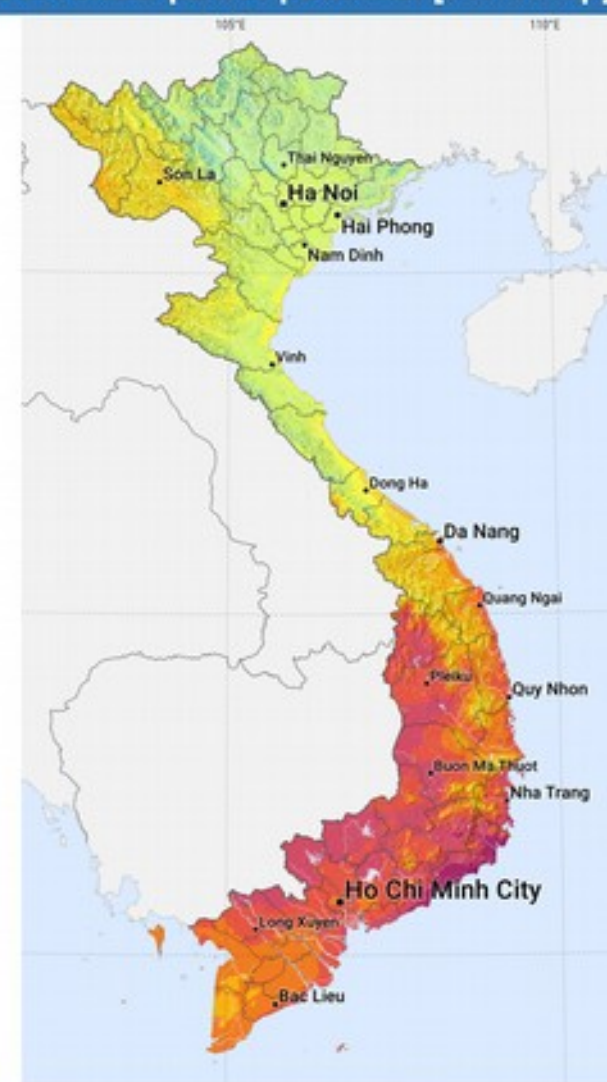
Long term average of PVOUT, period 2007-2015

Daily totals: 2.6 3.0 3.4 3.8 4.2 4.6 kWh/kWp

Yearly totals: 949 1095 1241 1387 1534 1680

Areas	Sunshine Hours	Solar Radiation Intensity (kWh/m ² /day)	Remark
North East	1600 – 1750	3,3 – 4,1	Fair
North West	1750 – 1800	4,1 – 4,9	Fair
Middle North	1700 – 2000	4,6 – 5,2	Good
Central Highlands and South Central Region	2000 – 2600	4,9 – 5,7	Very good
South	2200 – 2500	4,3 – 4,9	Very good
Country on average	1700 – 2500	4,6	Good

PVout – Photovoltaic power potential [kWh/kWp]



Solar Power status

Vietnam solar power project

▶ Target

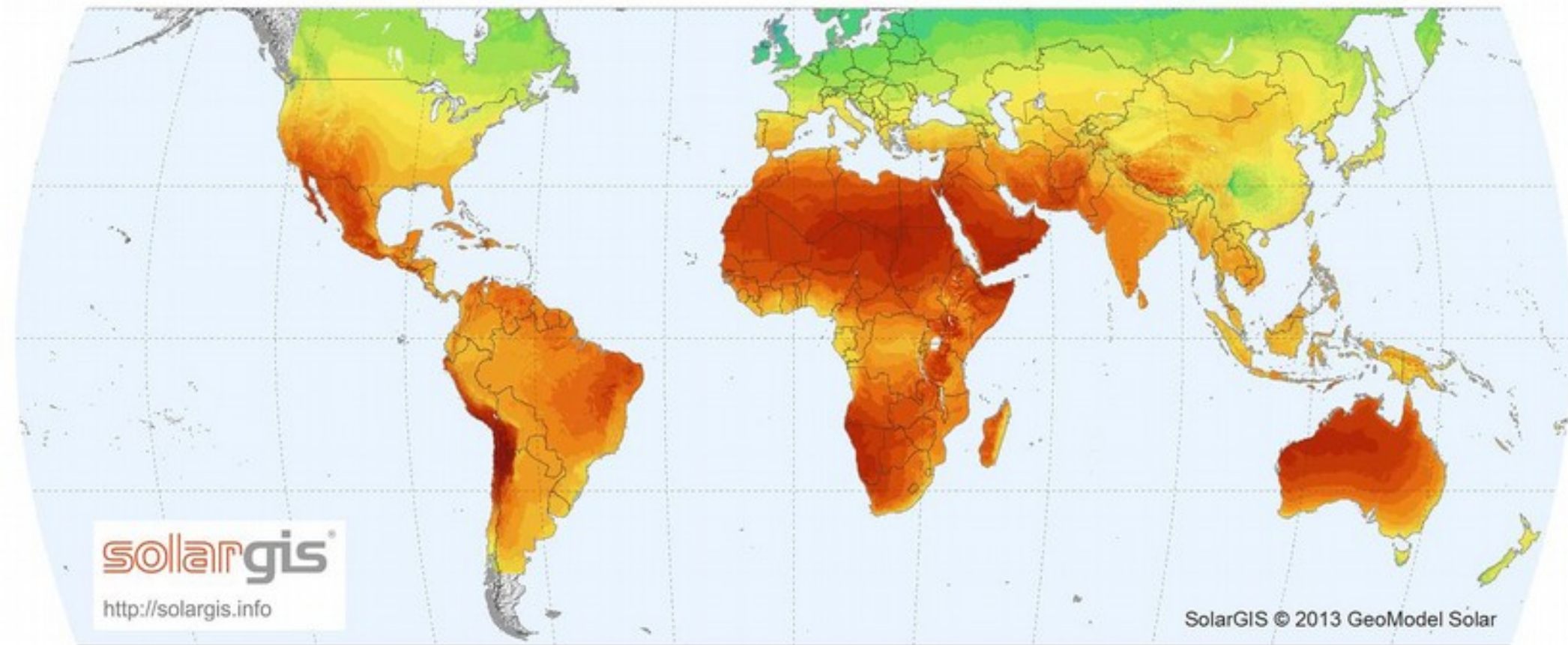
- ▶ According to the National Power Development Plan (**PDP VII revised, March 2016**), Viet Nam aims to increase its renewable energy share in power production substantially

Year	Capacity (MWp)
2020	850
2025	4,000
2030	12,000

▶ Legal Rules

- ▶ **Decision n°11/2017/QĐ-TTg** dated on 11/04/2017 issued by Prime Minister.
- ▶ Electricity Tariff:
 - ✓ 9.35 Uscents/kWh for both solar farm and surplus of rooftop projects
 - ✓ Project in delivered before end of June 2019
- ▶ Power Purchase Agreement (PPA): based on sample PPA based on Circular **n°16/2017/TT-BCT** dated on 12/09/2017 ; PPA template for 20 years

When I hear about 4 cents/kWh

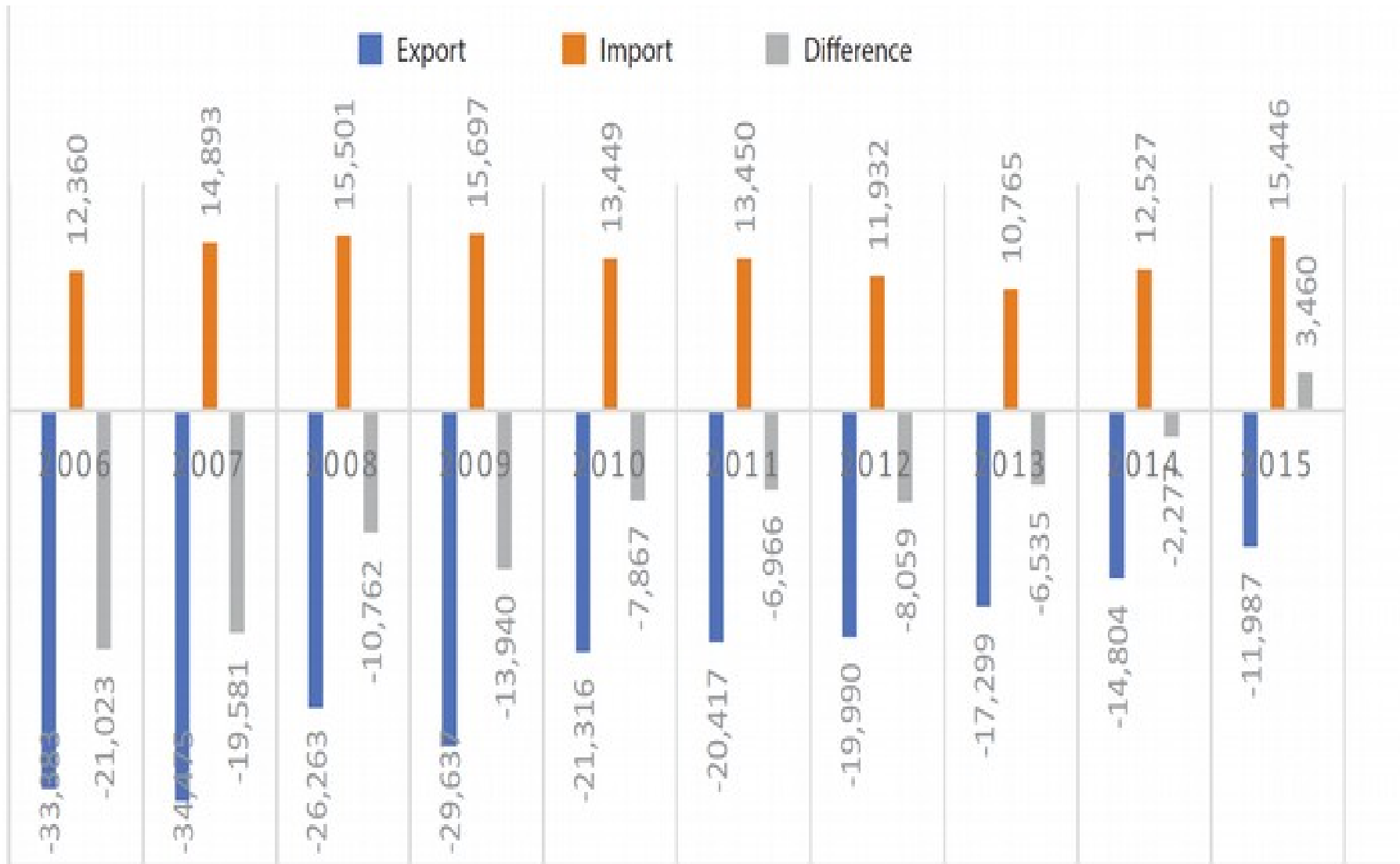


4. Green energy technologies benefit the national economy

- Reduces import dependency
- Create local jobs
- Compete in a growing manufacturing and services industry sector

Some energy planning models are used to quantify these effects.

Vietnam net energy importer since 2015 (KOTE)



5. VN objectives for renewable energy still require incentives

Given the objectives :

Year	2020	2025	2030
Total Solar capacity (MW)	850	4 000	12 000

Models are used to compare costs and effectiveness of different incentives :

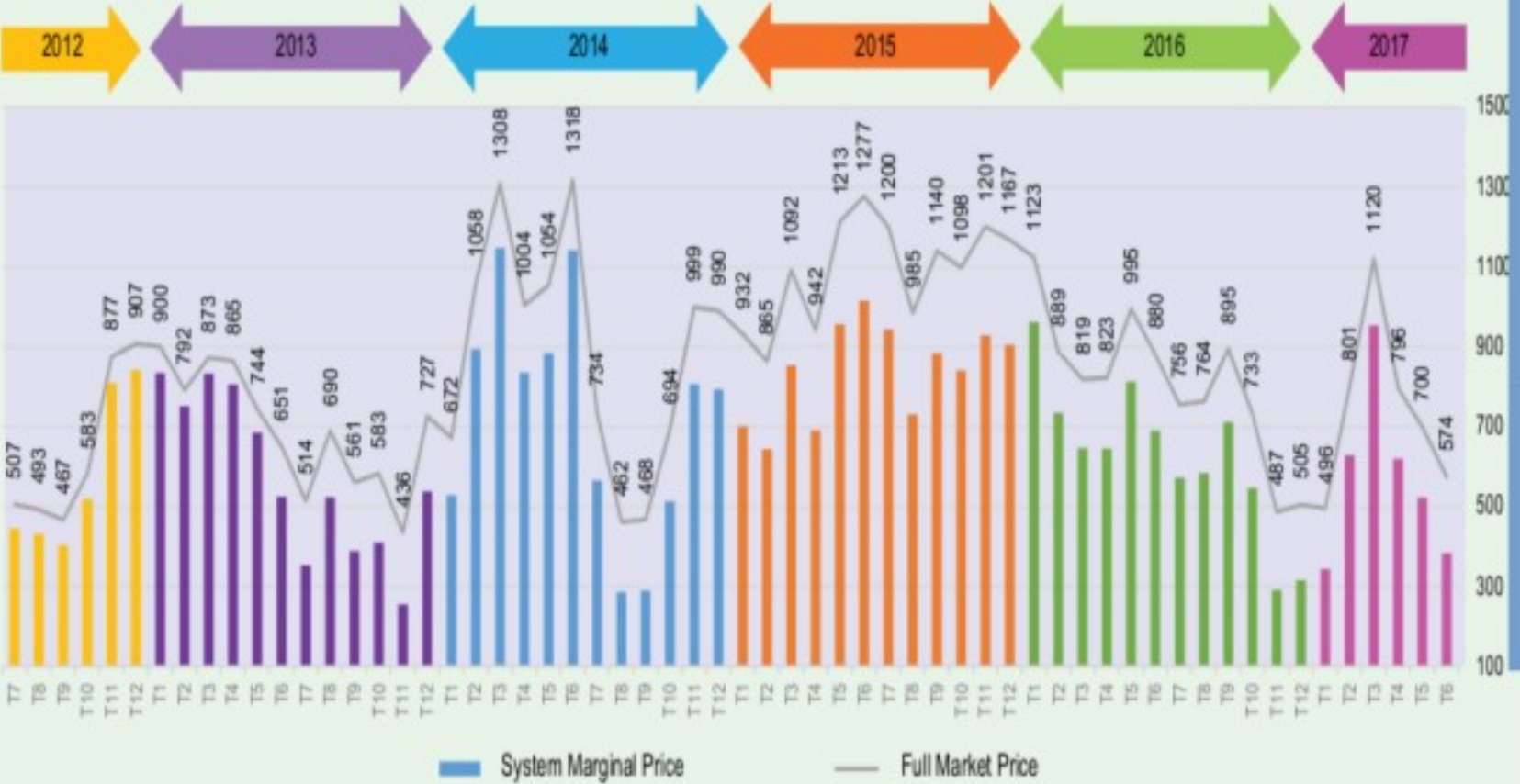
- Feed In Tariff (FIT).
- Auctions.
- Renewable Portfolio Standards.

The price that EVN has to pay to attract solar farm investors is way over the market price of electricity

Market price

Monthly Average System Marginal Price and Full Market Price (VND/kWh)

PV FIT
VND2.086/kWh



FIT for Renewable Energy in Vietnam

RE Source	Technology	FIT (US cent/kWh)	Decision
Solar	Grid-connected generation	9.35	No. 11/2017/QD-TTg of April 11, 2017
Wind	Electricity Generation (Onshore)	8.5	No. 39/2018/QD-TTg of September 10, 2018
	Electricity Generation (Offshore)	9.8	
Biomass	Electricity Production (North)	7.56	No. 942/QD-BCT of March 11, 2016
	Electricity Production (Central)	7.35	
	Electricity Production (South)	7.48	
	Co-generation	5.8	24/2014/QD-TTg of March 24, 2014
Solid Waste	Direct Burning	10.05	31/2014/QD-TTg of May 05, 2014
	Landfill for gas	7.28	

6. Innovative flexibility options afford power system reliability

Power systems can be reliable with lower reserve margin even with high shares of renewables

- Grid extension → grid reinforcement → smartgrid
- One more role for hydro
- Flexible and efficient thermal power

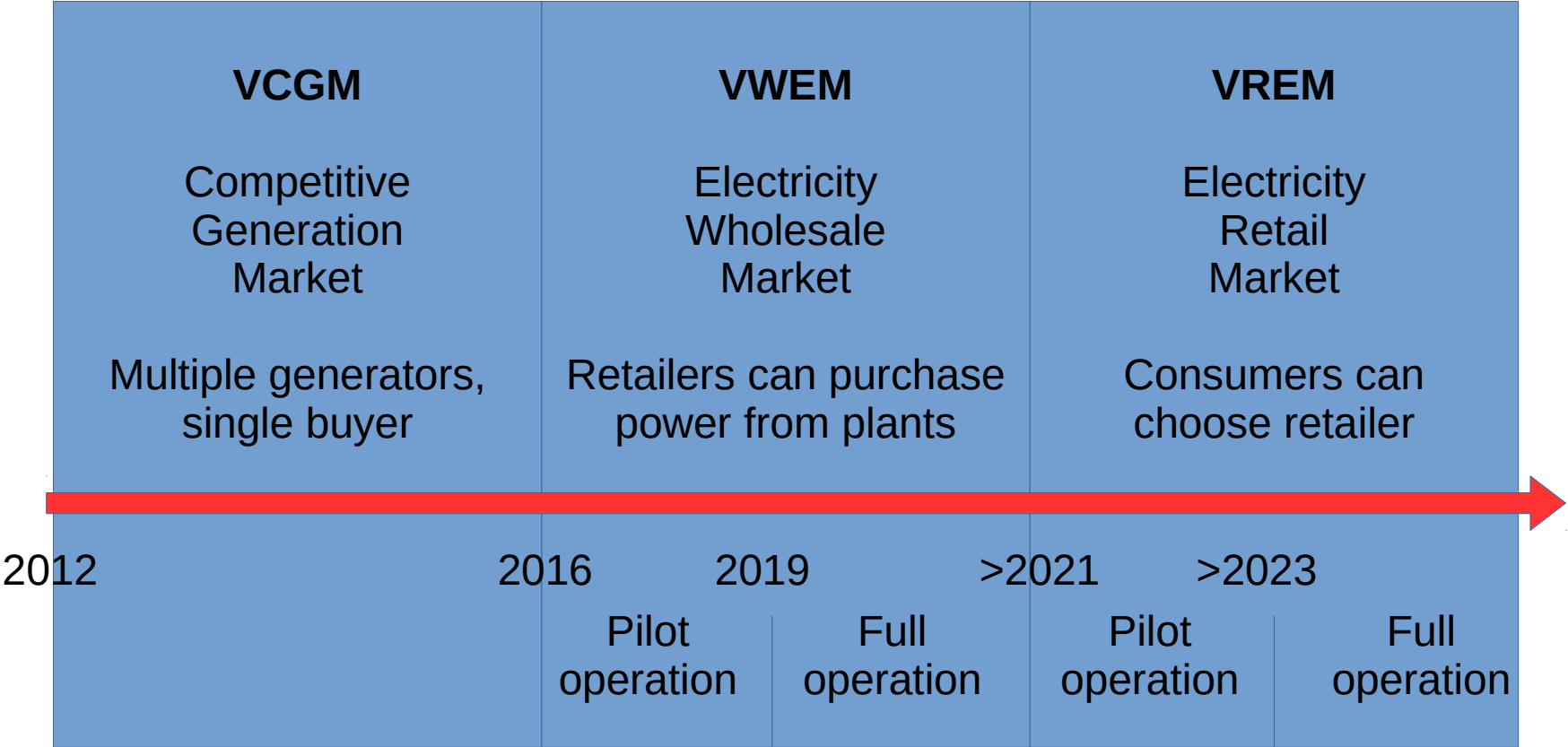
A suite of models is needed

Example	Time resolution	Questions studied
TIMES, LEAP	Annual / Seasonal	National energy security
BALMOREL	Hourly	Producing electricity in low or high wind/sun periods.
PLEXOS	5 mn	Reliability if a transmission line fails

7. Power market reform is compatible with a transition to clean energy

- Equitization and market opening to attract capital in the energy sector
- Electricity price increase to remove need for subsidies
- Decentralized decision making more efficient

Power sector reform timeline



VWEM : in paper simulation phase

Market reform is difficult

- Jan 18 : PV Power 20% IPO raise 308M\$ (30 % second round shelved)
- Feb 18 : EVN GENCO 3 IPO flop: debt, valuation, exchange risk, coal portfolio (GENCO1 and 2 in 2019?)
- VCGM : suspended during October 2017 to prioritize natural gas after wet but mild summer.
- Wind farms (even >30M) don't participate.
- Needs a balancing market if high variable renewable energy penetration

8. Utilities must prepare now, decentralization is coming

- Historically, decentralization was about rural electrification. Existing renewable projects are mostly small scale and community level
- In the future more and more people are going offgrid. Energy positive households with storage. Prosumers disrupt business models.

9. Financing is key

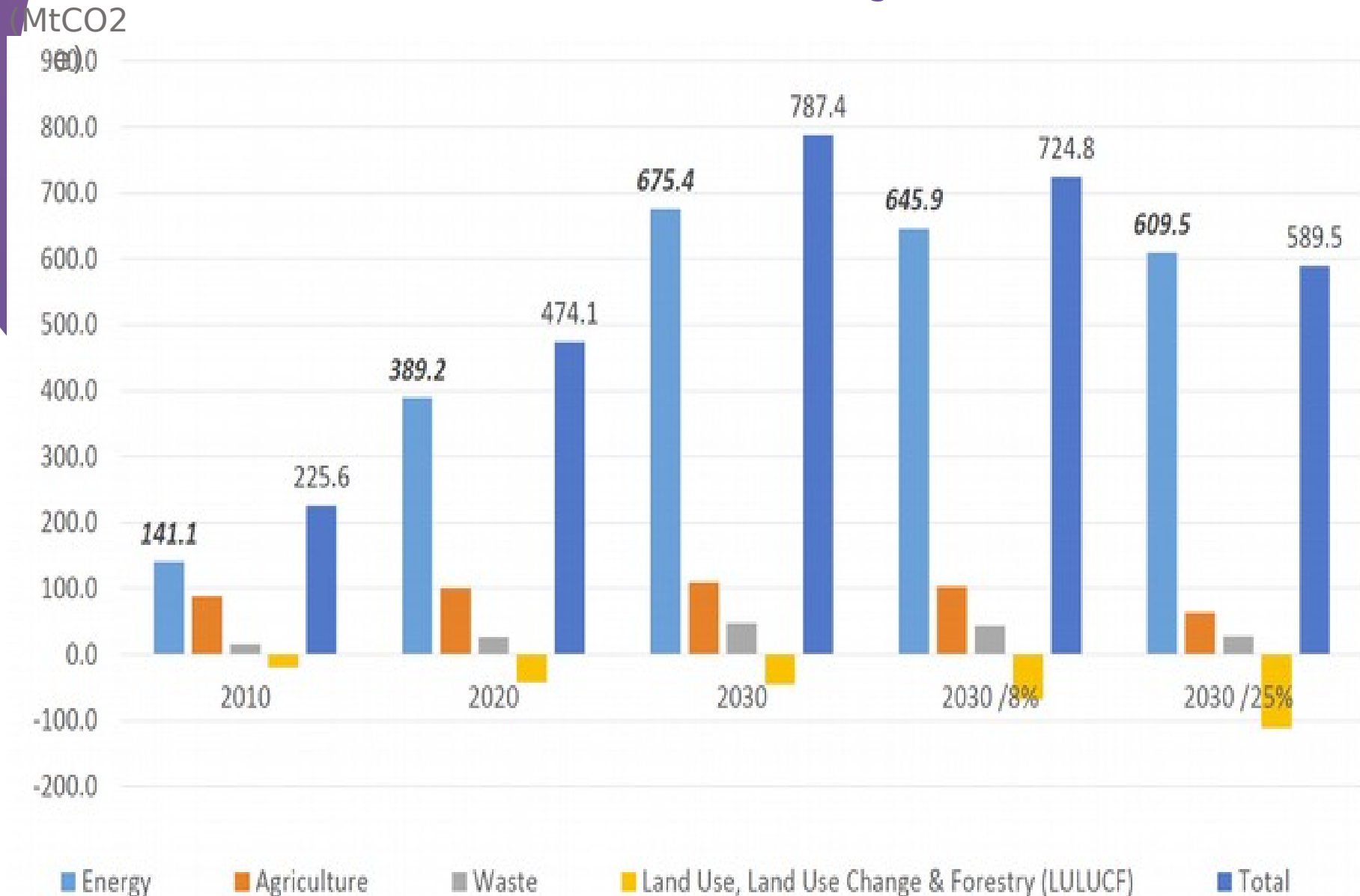
- Vietnam benefited a lot from Clean Development Mechanism
- Domestic banks active for PV farms
 - Vietcombank loaned for Srepok 1 in Dak Lak (50MW) ; loaned 785bnVND for BP Solar 1 (46MW, Ninh Thuan)
 - HD Bank 7000bnVND solar financing program
- Investors sought for the Bac Ai Pumped Storage Hydropower Project

10. The world is looking actively

- EU and MOIT Vietnam Energy Partnership Group
 - Vietnam Energy Information System
 - Renewable Energy Database System
- USAID Vietnam Low Emission Energy Program (V-LEEP) assisting
 - Bamboo Capital Group (BCG) for its 40.6 MW Bang Duong solar power project in Long An province
 - T&T Group, for its first solar power project in Ninh Thuan province
 - Sai Mai Group, for 210MW in Tinh Bien district
- US TDA granted ~USD750.000 to research energy storage in Vietnam (5/9/18)

Vietnam NDC's goals

GHG emission in 2010, and projection for 2020 & 2030 (BAU) and domestic and conditional target in 2030



3) Concluding remarks

About the energy transition

2018 starts a gold rush year for PV (and wind) in Vietnam, objectives will be exceeded.

Integration of renewables is the main question for the world. How to mitigate polluting emissions ?

Planning is more difficult in a decentralized system :
A transmission line may take 3 years to build, but a solar farm 9 months.

About energy planning

Security of supply remains the basic concern.
How to produce enough energy for everybody at affordable cost (EVN invested USD 6.5 billion last year) ?

« Failing to plan is planning to fail. »

An ecosystem of models is needed.

« All models are wrong, some are usefull. »