



# 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

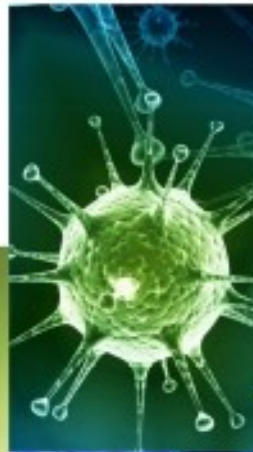
Not HUST - Bac Khoa

# 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

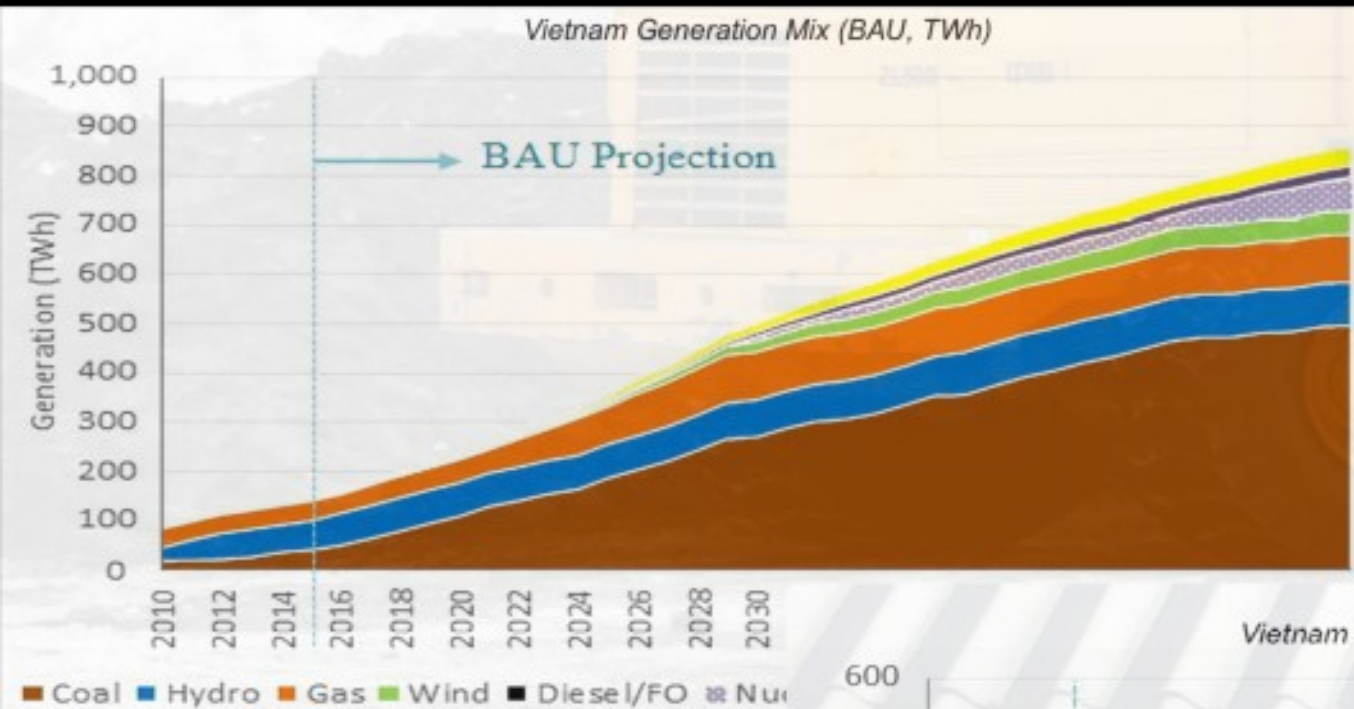


ENVIDATEC



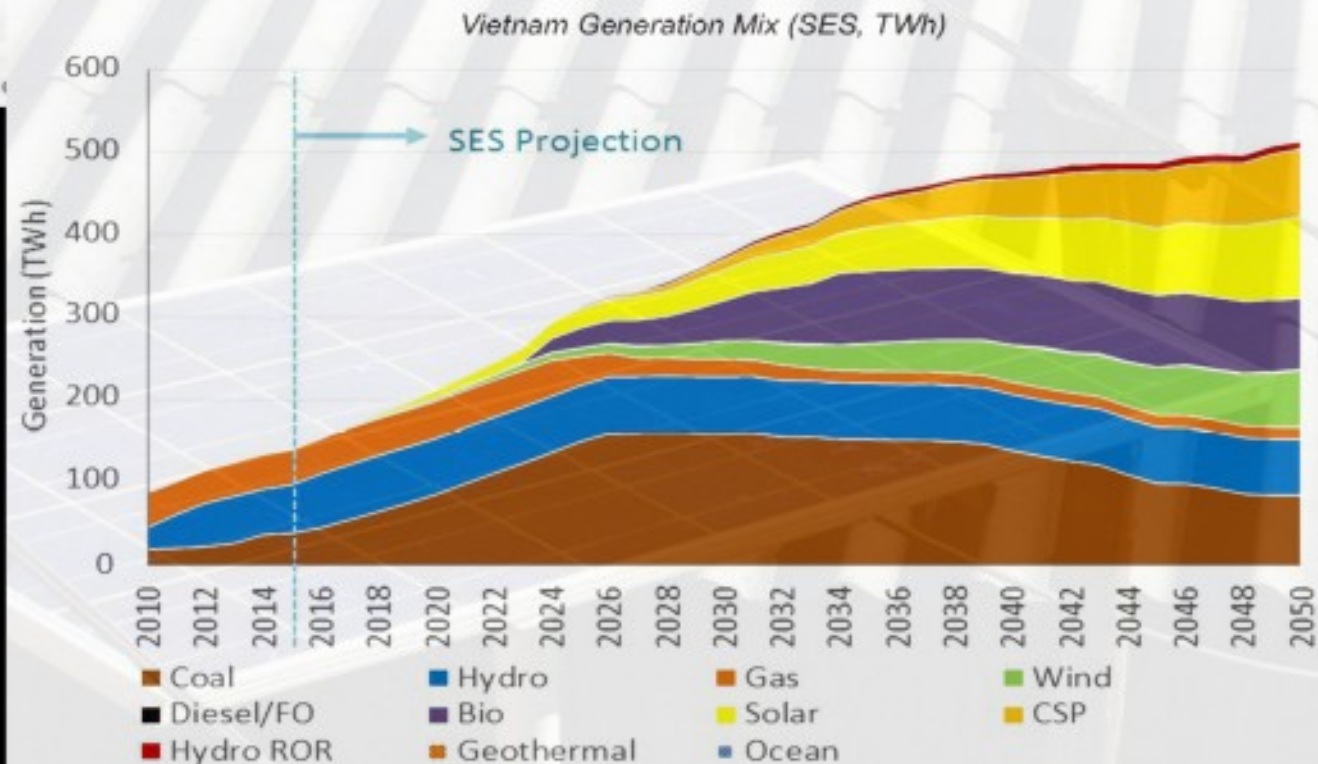


## 2) Insights on VN energy transition



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          |
| <b>Total</b>                                       | <b>39,058</b> | <b>60,000</b> | <b>129,500</b> |

## **PDP VII revised:**

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

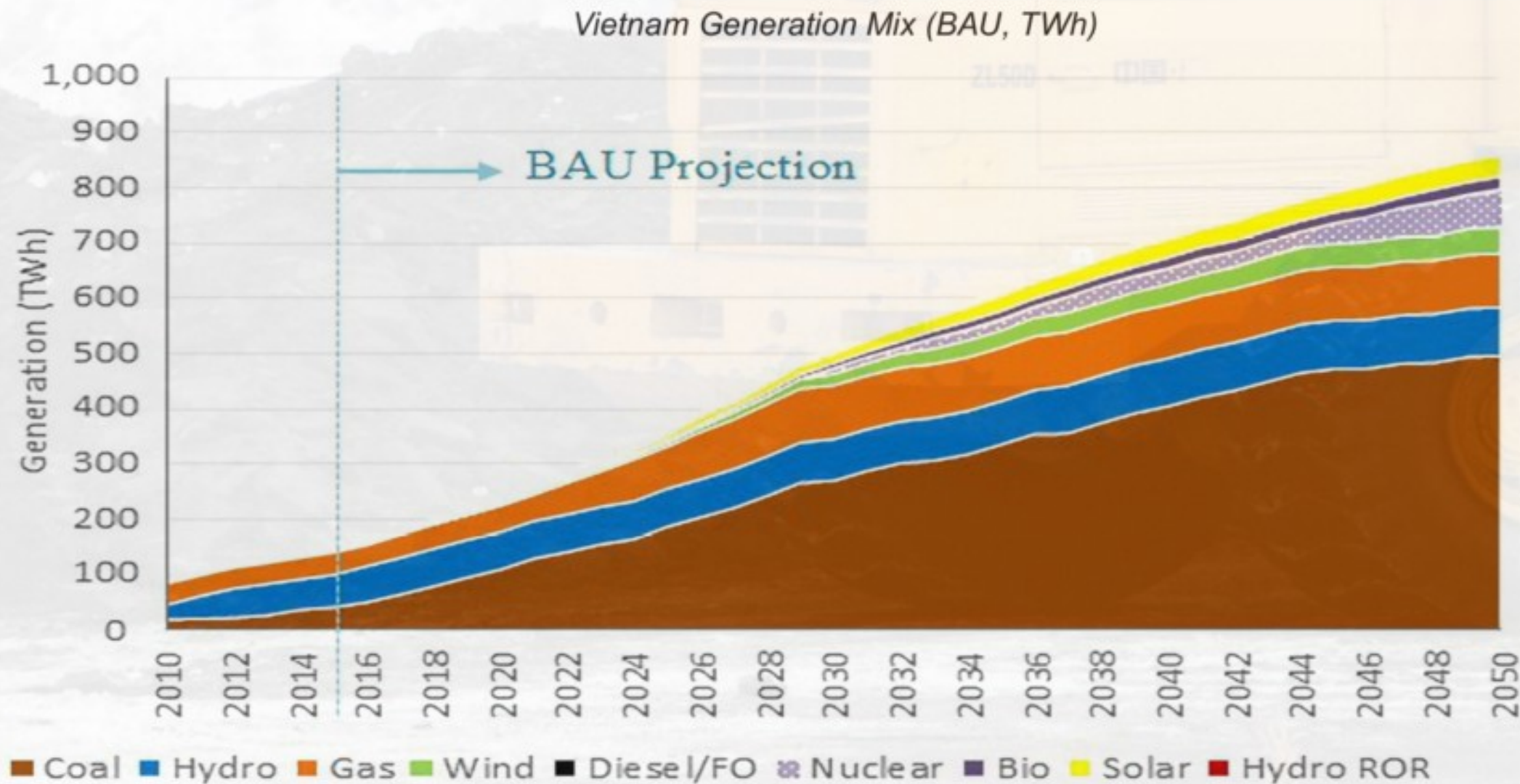
2GW Wind, 4 GW PV by 2025



# Power Development Plan 7 revised

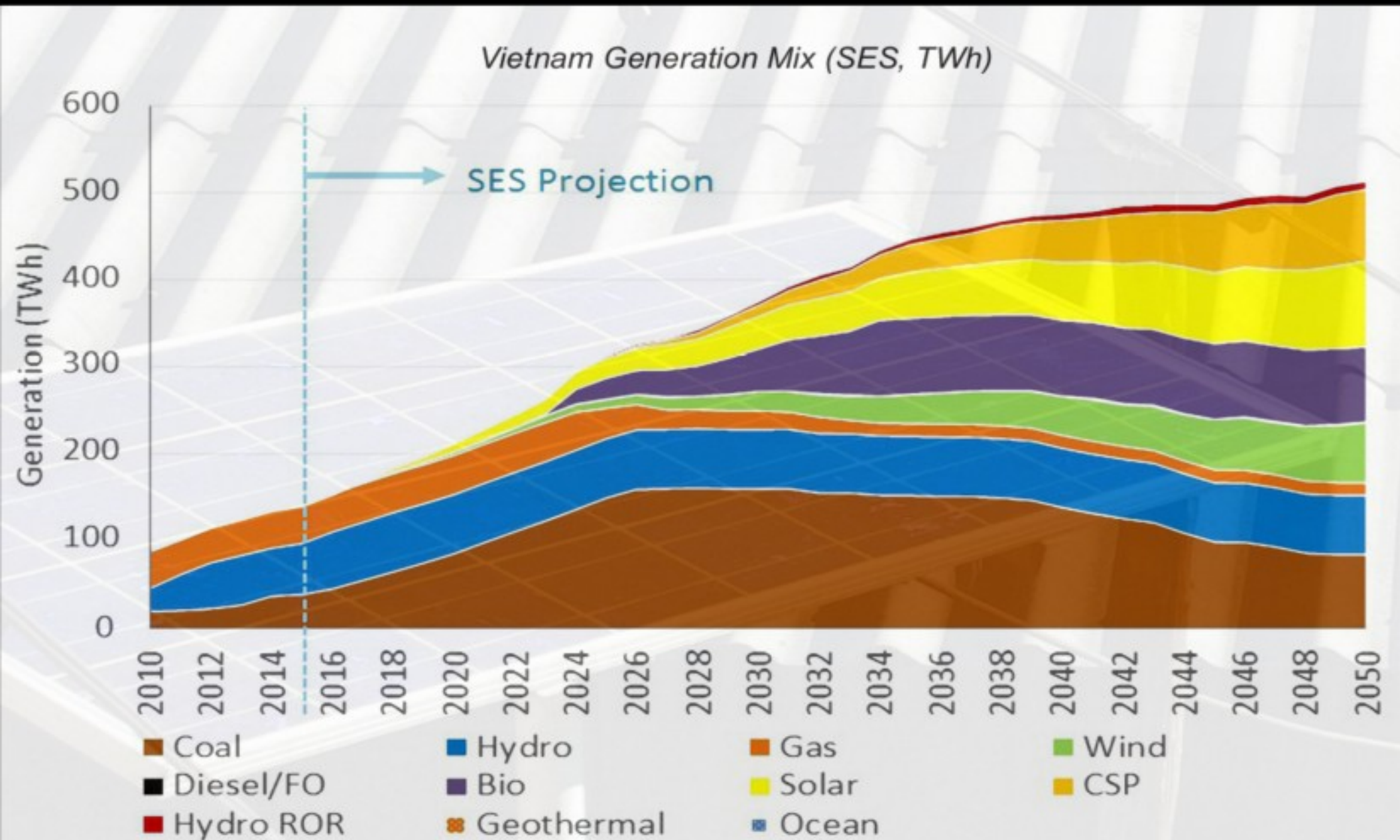
BAU : Business as Usual

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*.



## 2. Power demand can be moderated without undermining growth

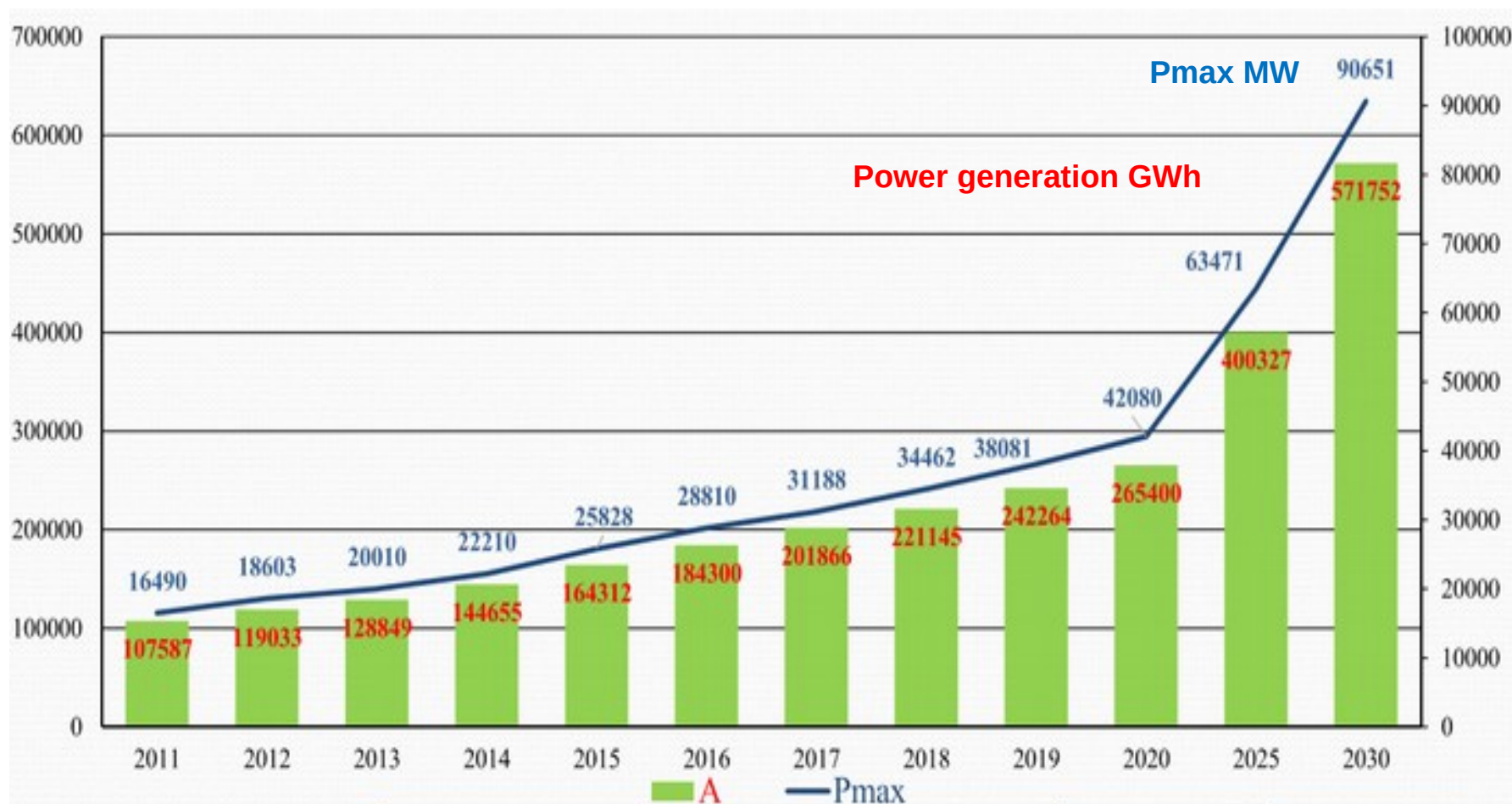
Specific plans are available

- Vietnam Green Growth Strategy describes
  - 22 MtCO<sub>2</sub> mitigation profitable technological options. Most are power saving by efficient appliances.
  - 41 MtCO<sub>2</sub> at less than 10 US\$/ton CO<sub>2</sub>
- 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<br>(ktCO <sub>2</sub> 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   |
| <b>Total GHG emission reduction</b> |   | <b>29,462.3</b>                                       |

**These are more expensive.**

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

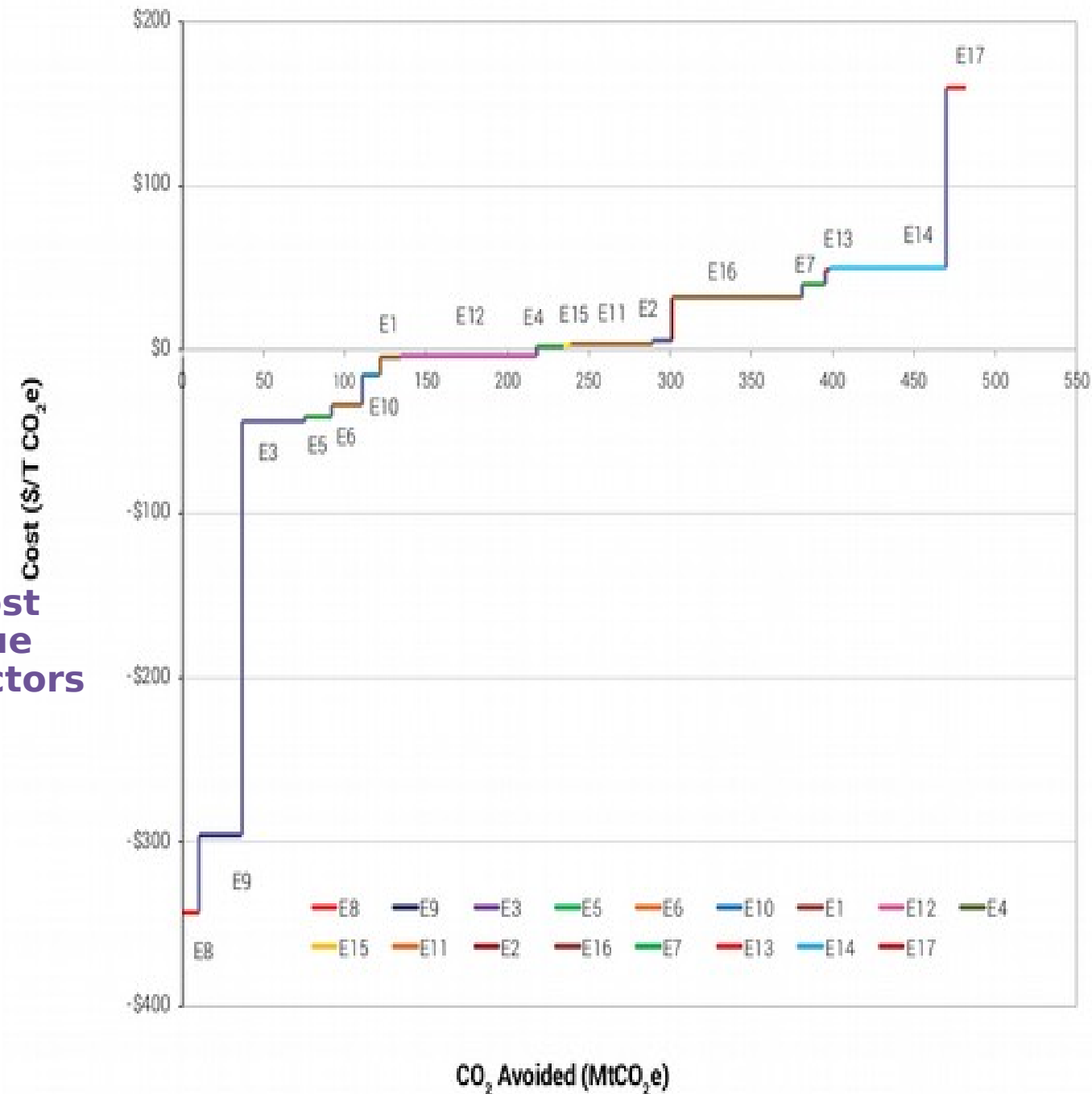
|   | Option  | Mitigation potential in<br>2030(k <sub>t</sub> CO <sub>2</sub> e) |
|---|---|---|
| 1 | E11. Biomass power plants                             | 7,002.2   |
| 2 | E14. Wind power plants by international support       | 10,926.4  |
| 3 | E16. Ultra-supercritical coal power plants            | 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

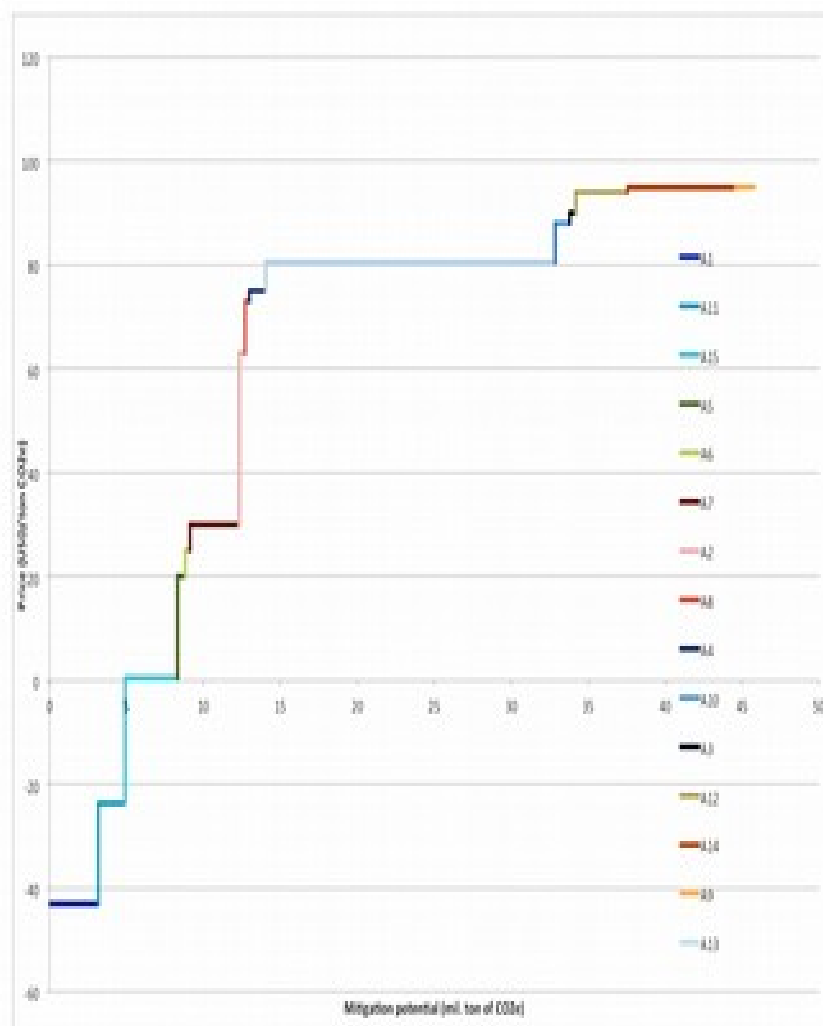


The optimal plan is  
To do everything that cost  
Less than the social value  
of mitigation, across sectors

# 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<br>(Million metric ton of CO <sub>2</sub> equivalent) | Cost for emission mitigation*<br>(\$/t.CO <sub>2</sub> ) |
|---|---|--|
| 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 <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>             | -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   |



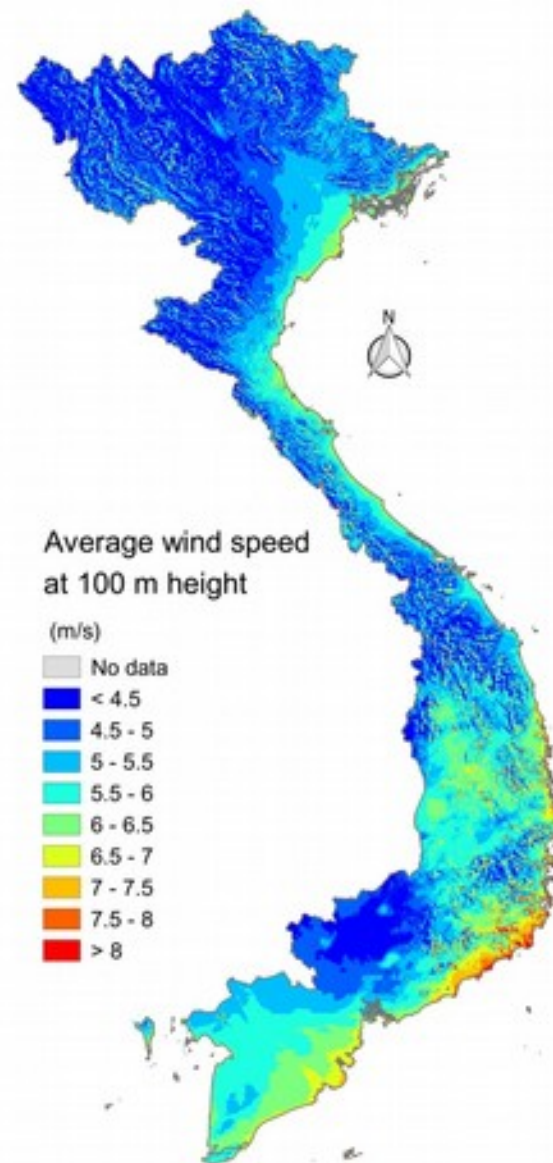
- Reduce 6.63 mil. tonnes of CO<sub>2</sub> by 6 options
- Continue to reduce 39.422 mil. tonnes of CO<sub>2</sub> by 9 extended options with intl support

### **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 US Cents/kWh | Decision 37/2011/QĐ-TTg  |
| 8.5 US Cents/kWh | Onshore projects (Decision. 39/2018/QĐ-TTg dated 10 Sept 2018) |
| 9.8 US Cents/kWh | Offshore 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**

## SHARE OF WIND ENERGY IN THE ENERGY MIX

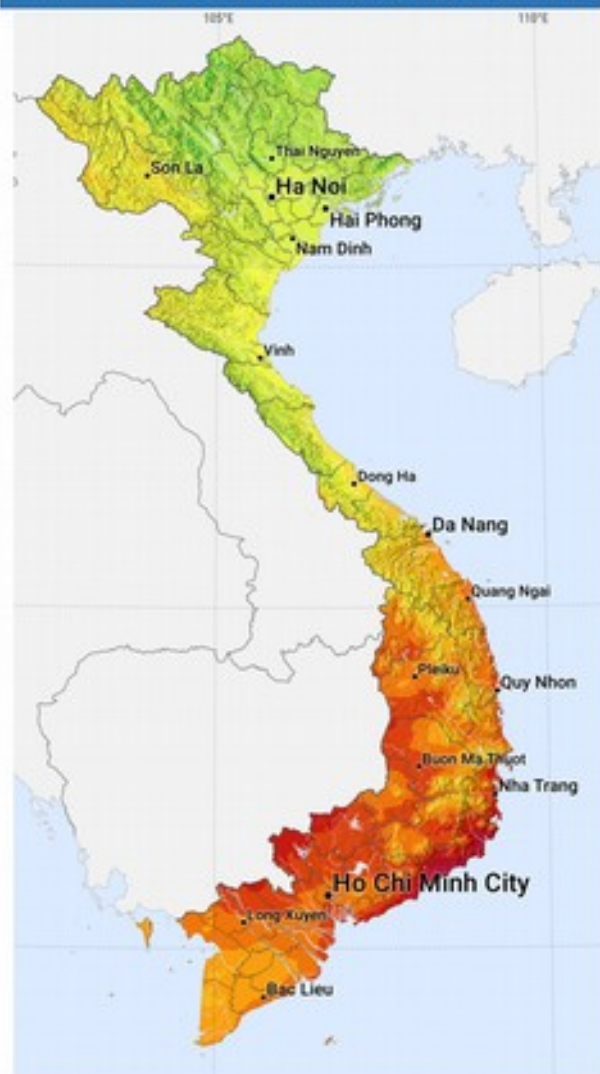


# Solar Power potential

## Vietnam solar power potential

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

GHI – Global horizontal irradiation [kWh/m<sup>2</sup>]



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/m<sup>2</sup>

Yearly totals: 1168 1314 1461 1607 1753 1899 2045

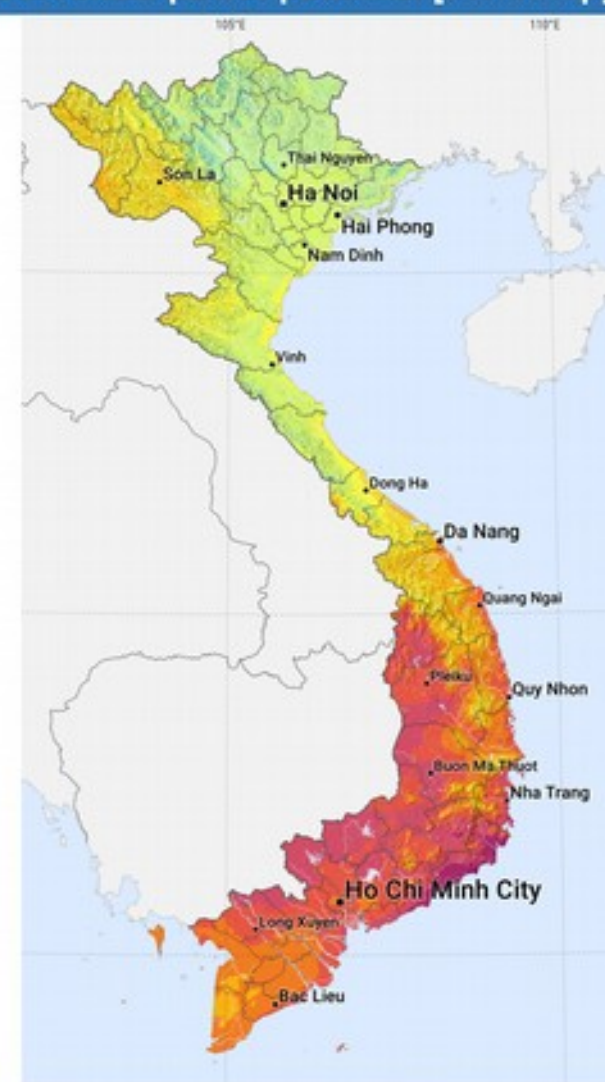
Long term average of PVOUT, period 2007-2015

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 <sup>2</sup> /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

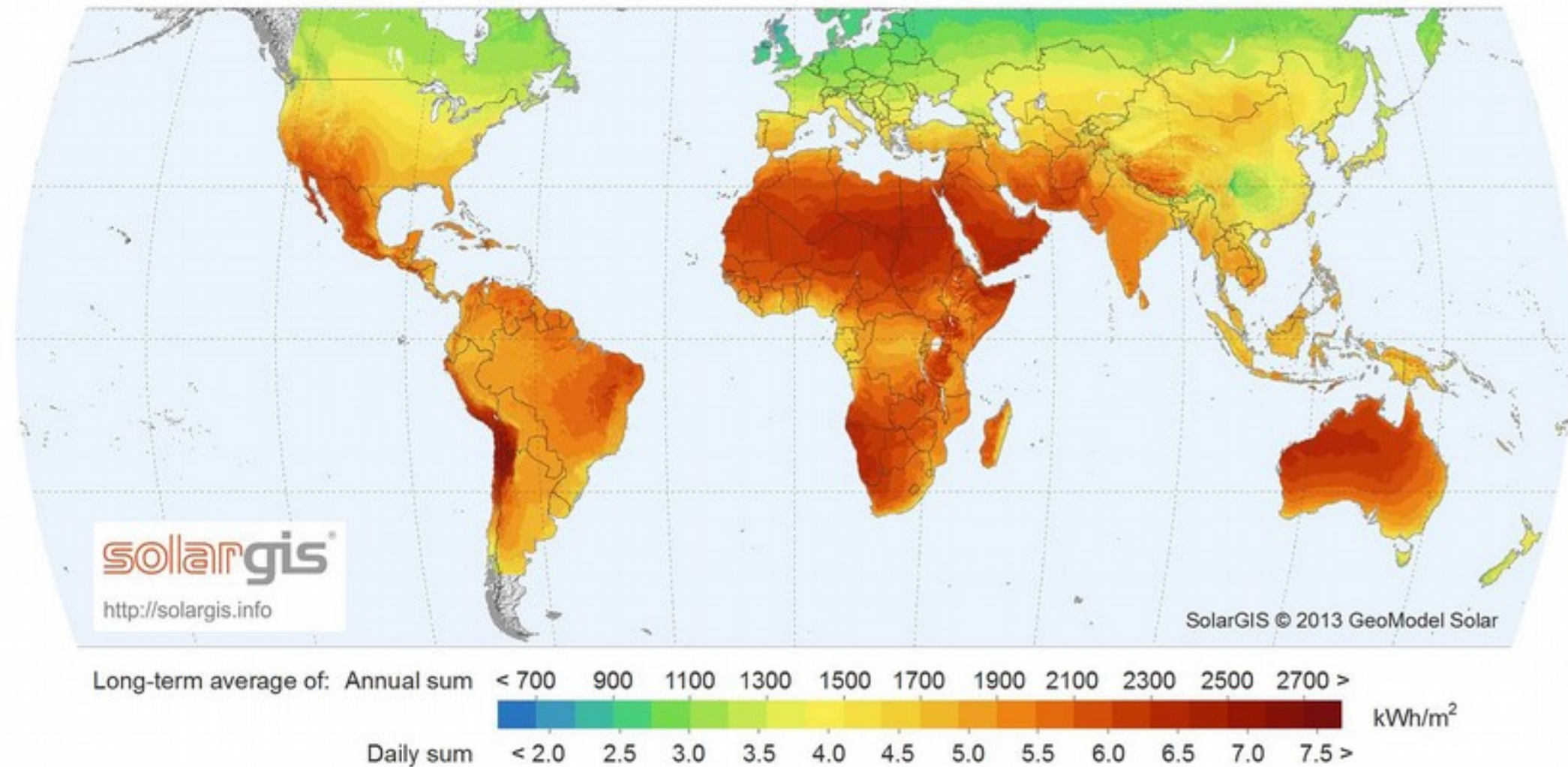
| Year | Capacity (MWp) |
|------|----------------|
| 2020 | 850            |
| 2025 | 4,000          |
| 2030 | 12,000         |

### ► 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



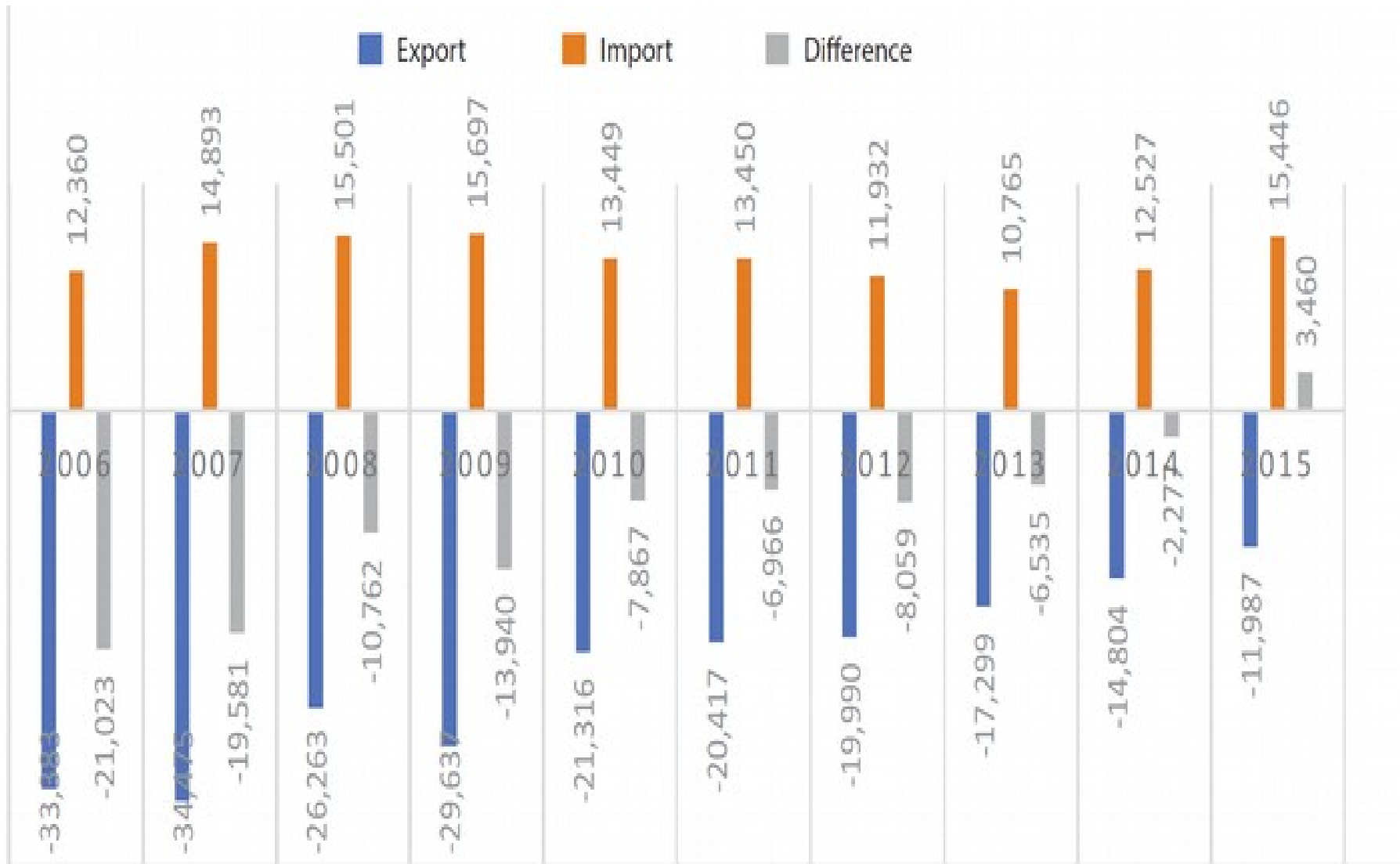


## **4. Green energy technologies benefit the national economy**

- 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 :

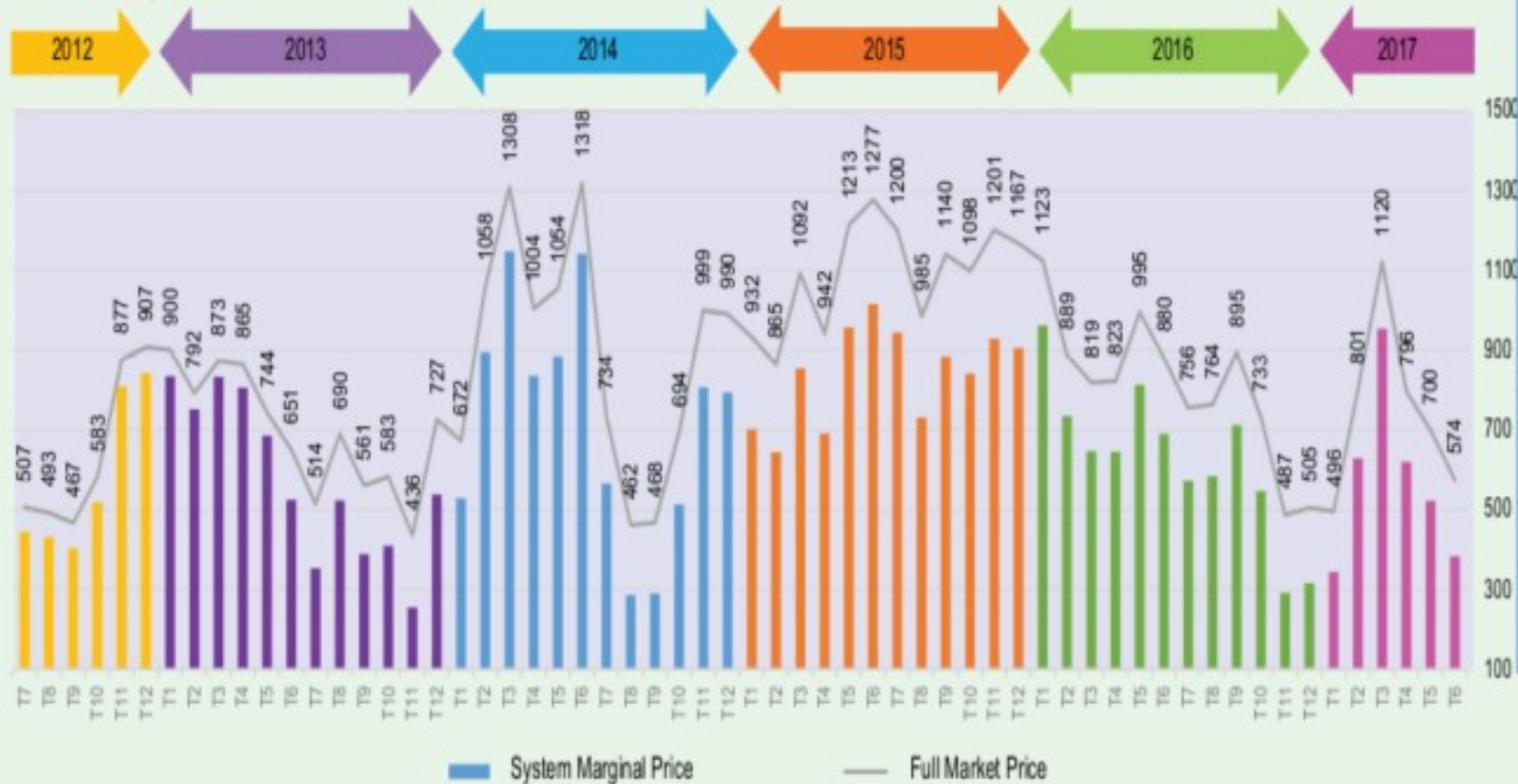
- Feed In Tariff (FIT).
- Auctions.
- Renewable Portfolio Standards.

# 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<br>(US<br>cent/kWh) | Decision   |
|-------------|--------------------------------------|-------------------------|--|
| Solar       | Grid-connected<br>generation         | 9.35                    | No. 11/2017/QD-<br>TTg<br>of April 11, 2017        |
| Wind        | Electricity Generation<br>(Onshore)  | 8.5                     | No. 39/2018/QD-<br>TTg<br>of September<br>10, 2018 |
|             | Electricity Generation<br>(Offshore) | 9.8                     |  |
| Biomass     | Electricity Production<br>(North)    | 7.56                    | No. 942/QD-BCT<br>of March 11,<br>2016             |
|             | Electricity Production<br>(Central)  | 7.35                    |  |
|             | Electricity Production<br>(South)    | 7.48                    |  |
|             | Co-generation                        | 5.8                     | 24/2014/QD-TTg<br>of March 24.<br>2014             |
| Solid Waste | Direct Burning                       | 10.05                   | 31/2014/QD-TTg<br>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

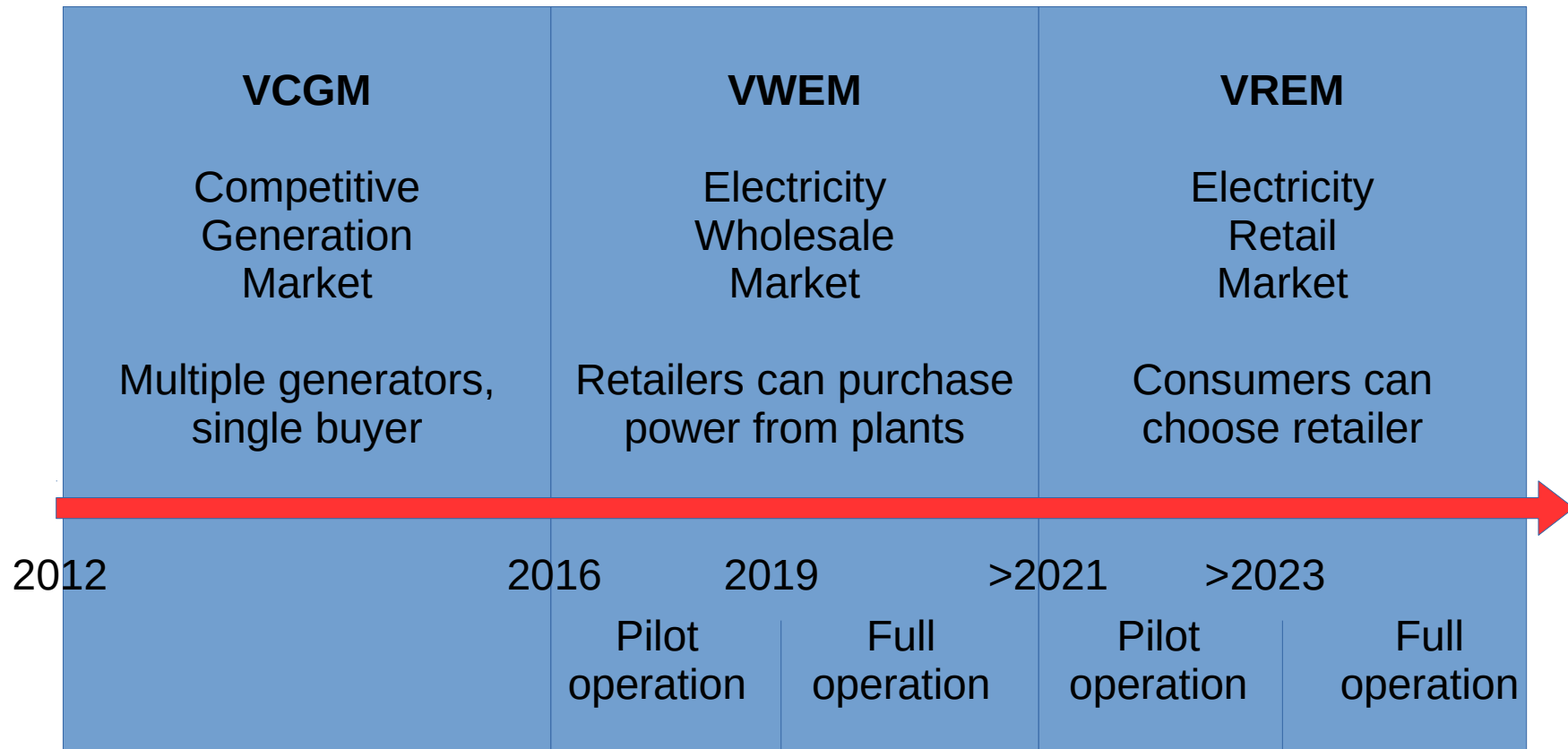
| Example     | Time resolution   | Questions studied                                      |
|-------------|-------------------|--|
| TIMES, LEAP | Annual / Seasonal | National energy security                               |
| BALMOREL    | Hourly            | Producing electricity in low or high wind/sun 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

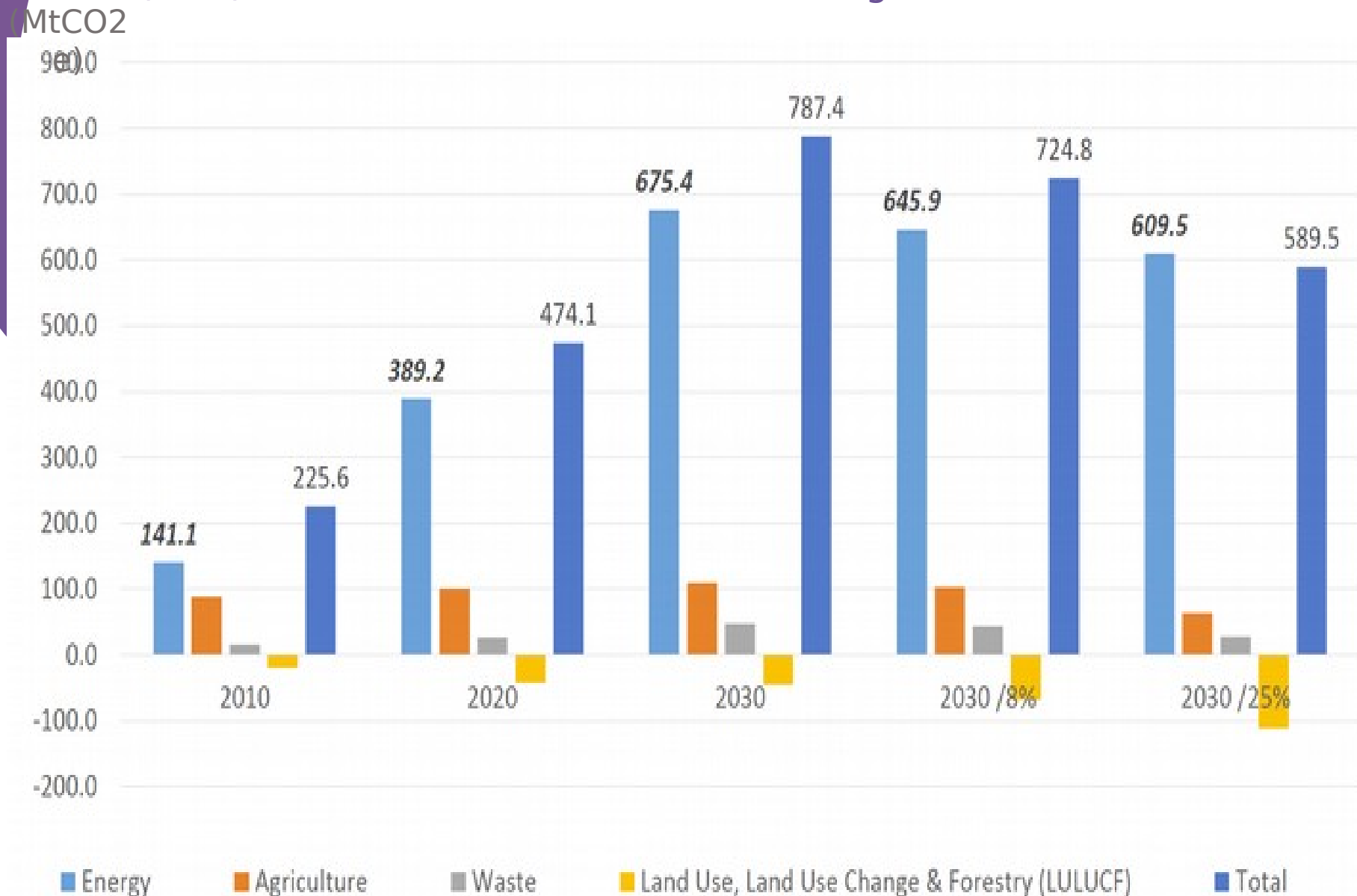
# 10. The world is looking actively

- 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. »*