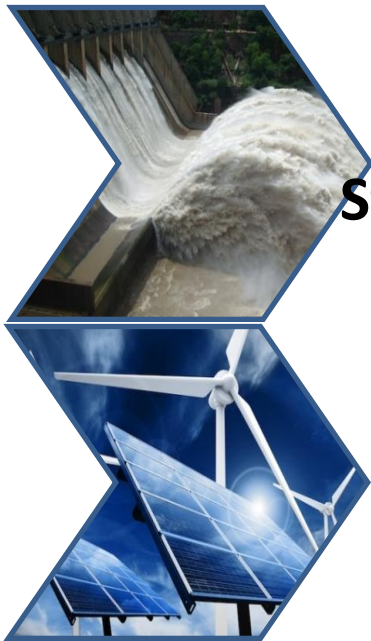


# Macro-Economic Benefits of Bangladesh- India Electricity Trade

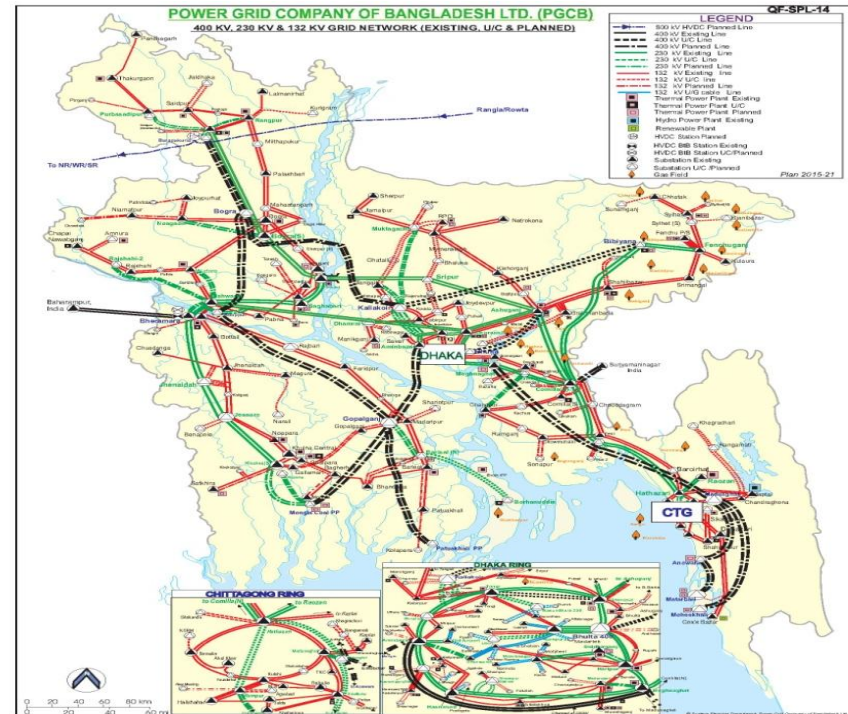
**Anjana Das and Probal Ghosh**

**Stakeholder's Consultation Workshop  
Dhaka, May 17, 2017**



# Status of India - Bangladesh Cross Border Electricity Trade (CBET)

- 500 MW through West Bengal (since 2013/14)
- 100 MW from Tripura (since April 2016)





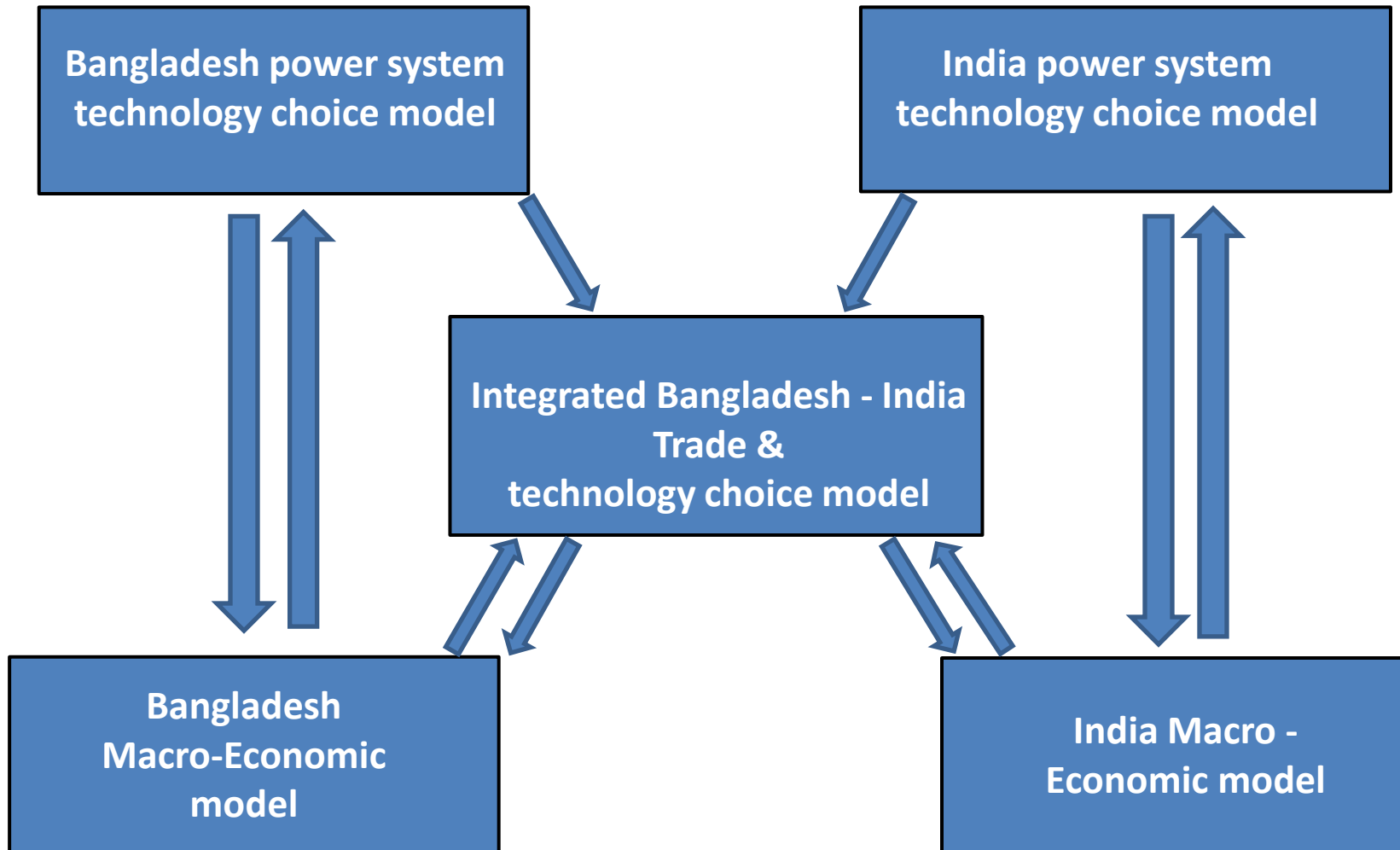
# Study Objective

Providing information to the policy and decision makers for building consensus on CBET between countries and within countries through informed dialogues and negotiations

# Key Questions

- Why to trade ? Are there socio-economic benefits of electricity trade ?
- What would be the hourly tradable electricity potential and price agreeable to both buyer and seller ?
- What would be the capacity savings and investment potential ?
- What are the macro-economic benefits to Bangladesh and India ?
- What are the consequential environmental benefits ?

# Methodology & Models - Overview



# Expected Outcomes

- Long term electricity demand and supply scenarios for Bangladesh and India ;
- Socio-economic benefits to both the Nations from CBET ;
- Power trade potential on yearly, seasonal and daily basis ;
- Price effects of power trade (off peak and peak) ;
- Evidence for the decision makers for consensus building



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# Future Power Sector Development in Bangladesh

# Analysing Bangladesh Power System with TIMES

- ❖ TIMES, a technology-rich least-cost dynamic linear programming model
- ❖ Model Inputs : electricity demand, time variant load profile and potential supply options ( resource, technology, various costs, etc. )
- ❖ Model Outputs : new investment requirement in generation and transmission (Grid) including interconnection, time variant optimal generation and trade, price, emissions etc.

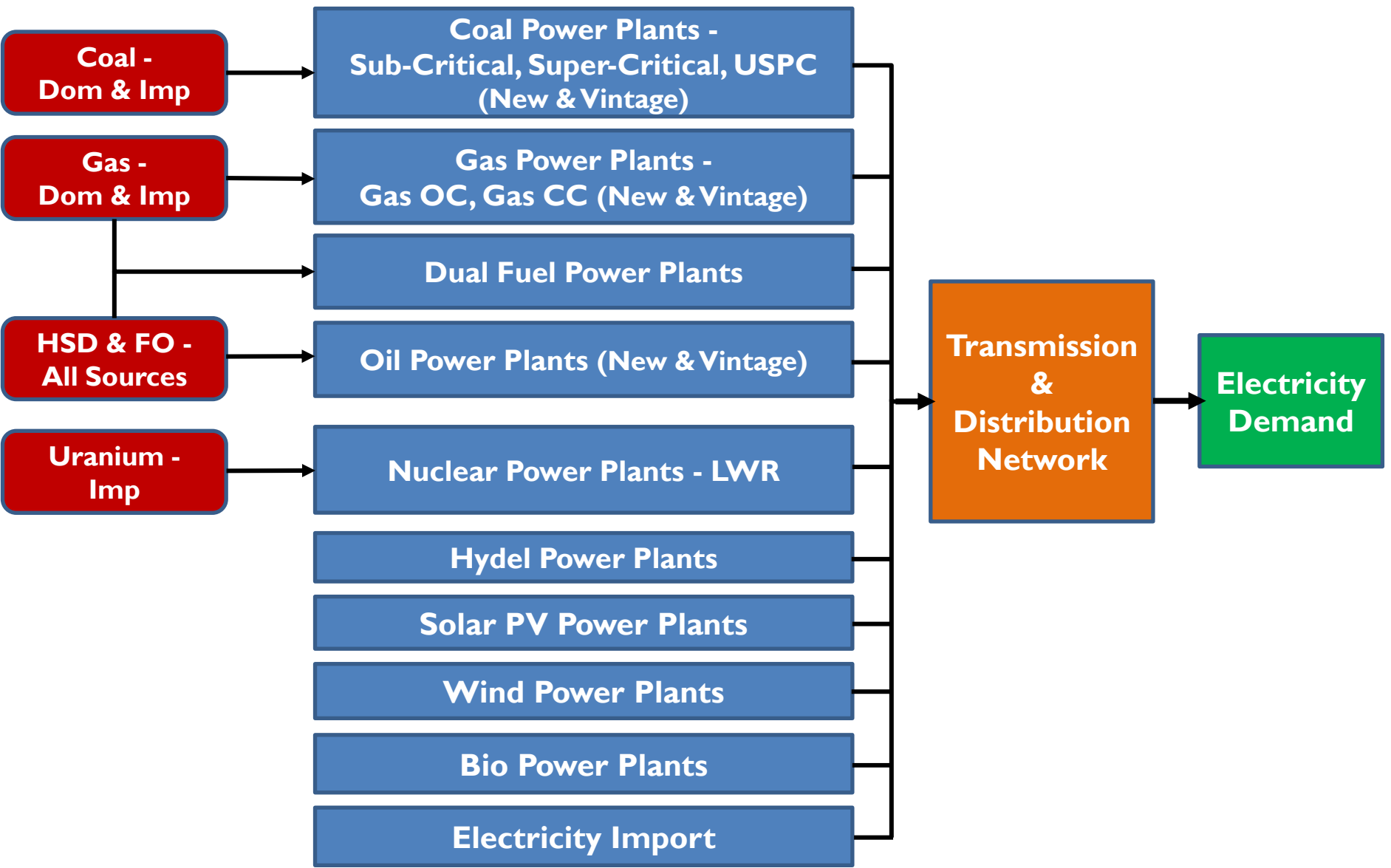


## Future Options for Expansions

- ❖ Negligible reserves for oil
- ❖ Declining gas reserves
- ❖ Difficulties in coal resource development
- ❖ Limited Renewable energy resources
  
- ❖ Options for expansions :
  - Domestic plants using imported coal and gas
  - Nuclear plants (imported fuel and technology)
  - Electricity import from neighbouring countries



# Reference Energy System (Electricity)



## Bangladesh Model Assumptions

- ❖ Time Horizon : 2012-2052
- ❖ Reporting period : 2015-2050
- ❖ Discount rate : 4%

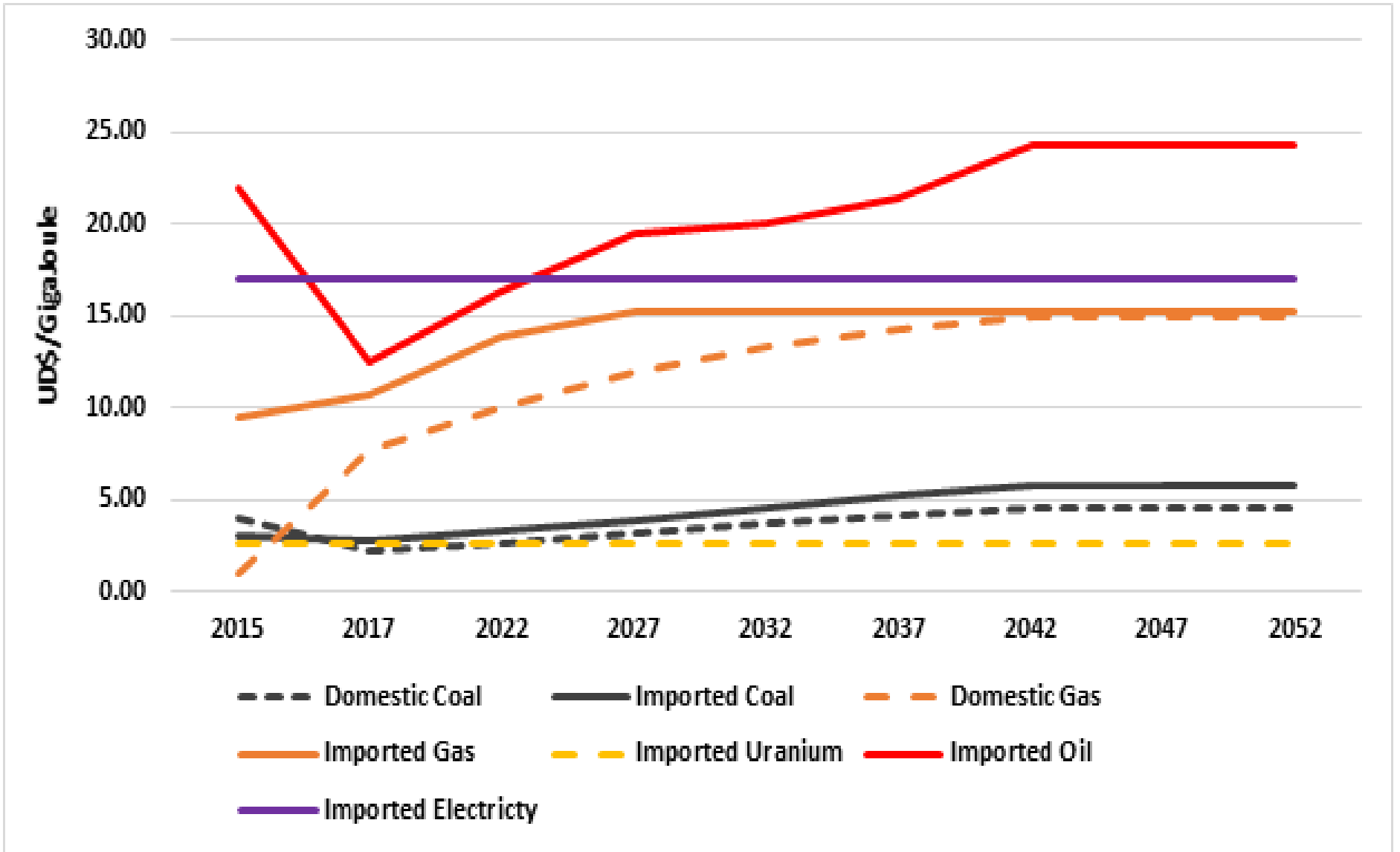
### Time Sub-Periods / Time Slices & Energy Fraction

- ❖ Seasonal and daily variations of load as well as supply of certain sources are modelled
- ❖ 8760 hourly load/supply are arranged into 288 time slices comprising of 12 seasons and a typical 24-hourly daily representation of each season
- ❖ The model balances the demand and supply for each time slice

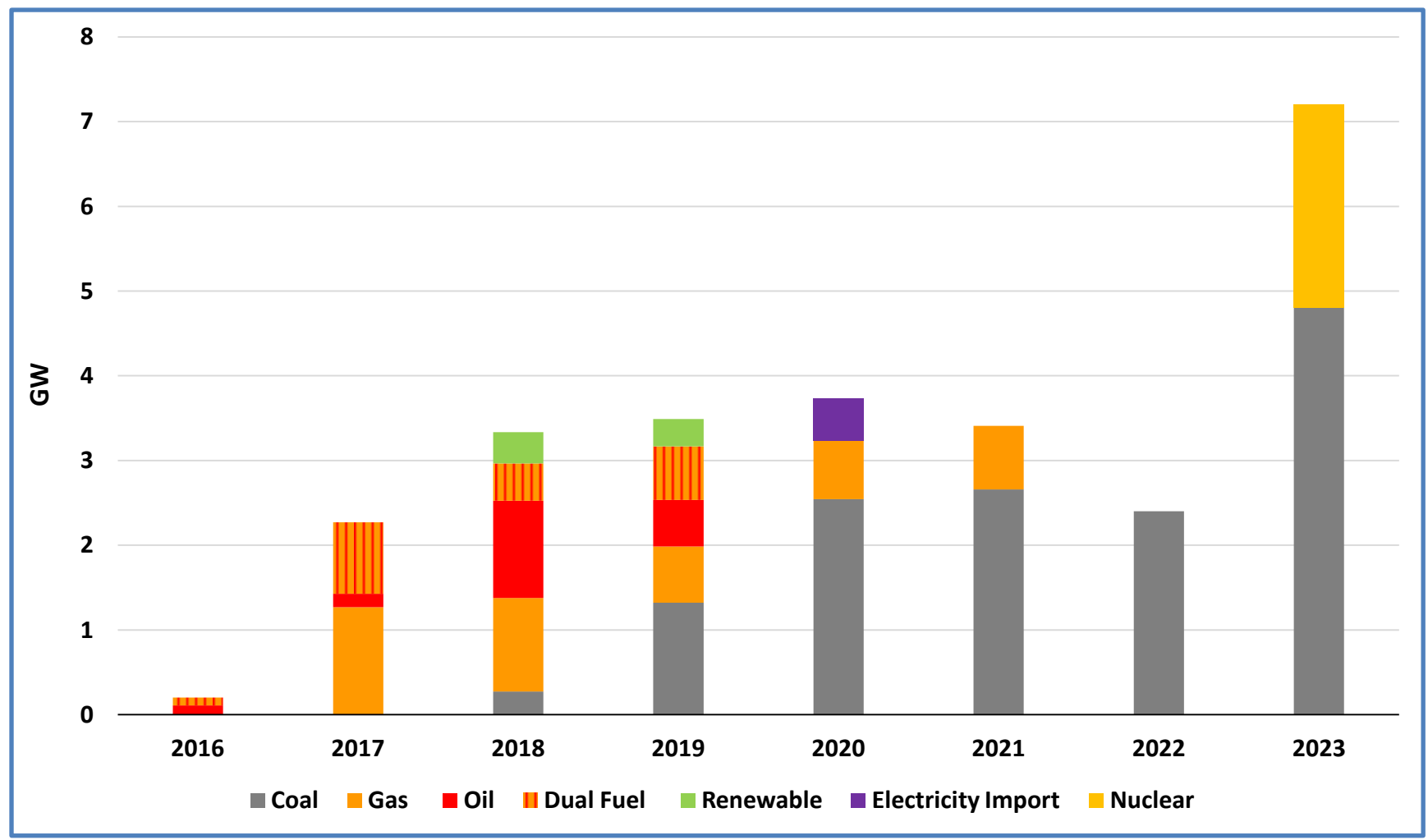
# Technical & Economic Assumptions of New Power Plants

	Gas (CC)	Gas (OC)	Oil	Dual Fuel	Nuclear PP	Coal (Sub) PP	Coal (SC) PP	Coal (USC) PP	Wind PP	Solar PV	Biomass	Hydro
<b>Technology Data</b>												
Thermal Efficiency	0.57	0.38	0.35	Gas - .45 Oil - .43	0.35	0.35	0.37	0.43	--	-	0.30	
Fuel Type	Gas	Gas	Oil	Gas and Oil	Uranium	Coal	Coal	Coal	--	-	Rice husk	
Annual Availability Factor	< .85	< .90	< .80	< .85	< .90	< .80	< .80	< .80	< .21	< .18	< .60	< .50
Operational Life Time (Year)	25.00	20.00	20.00	25.00	60.00	30.00	30.00	30.00	25.00	25.00	20.00	80.00
Construction Period (Year)	3.00	2.00	2.00	3.00	8.00		5.00	5.00	2.00	2.00	2.00	6.00
<b>Economic Data</b>												
Overnight Cost (\$/kW)	667.00	899.00	899.00	667.00	5000.00		1038.30	1400.00	1812.50	1551.00	2059.00	1861.21
Fixed O&M Cost (\$/kW/yr)	30.00	30.00	30.00	30.00	78.00	23.51	25.47	39.00	35.00	26.00	125.00	18.61

# Fuel Price Assumptions

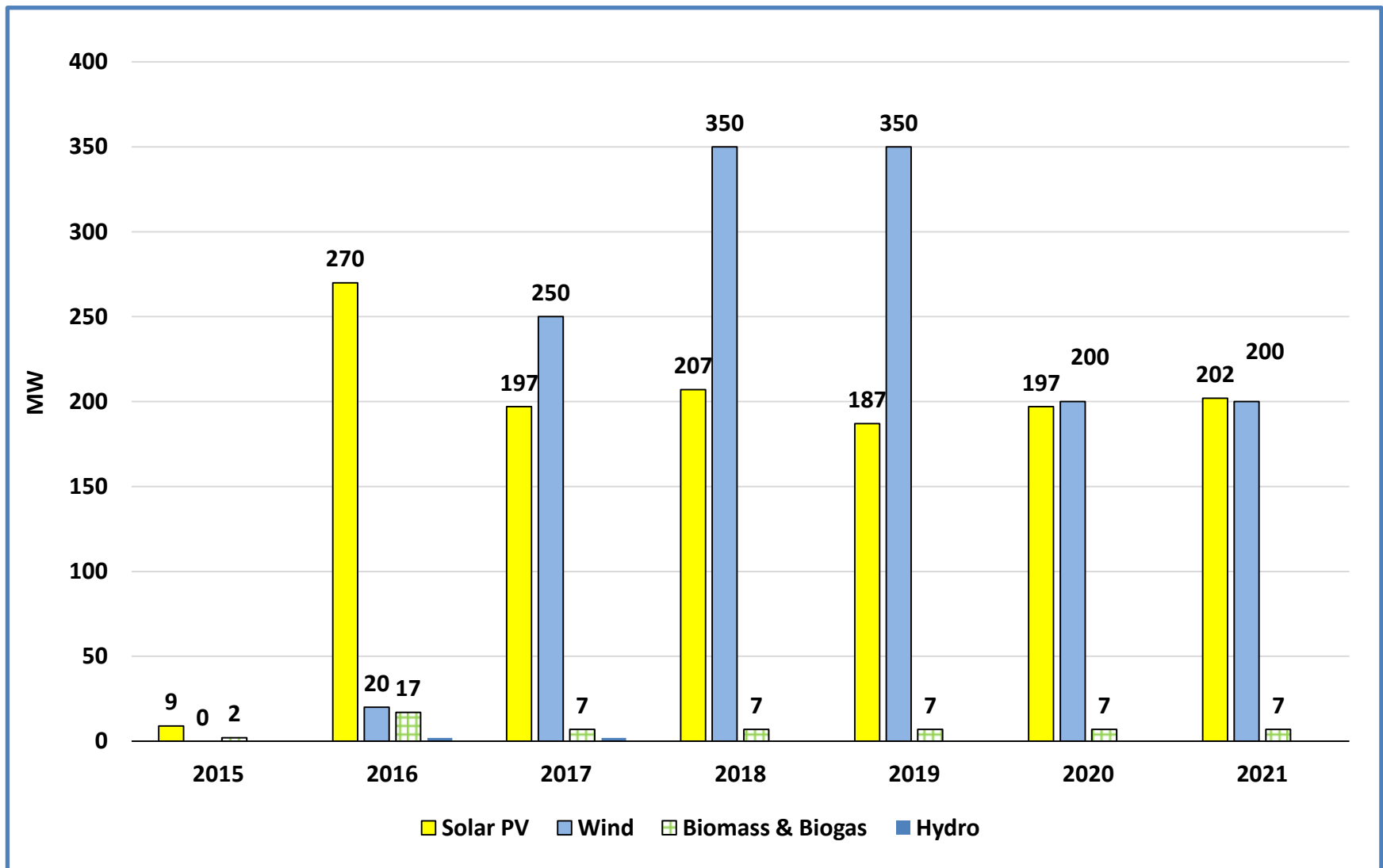


# Planned Capacity Addition



Source – BPDB (Bangladesh Power Development Board)

# Grid Connected Renewable Energy Target



Source – SREDA

## Other Model Assumptions

- ❖ Under construction Super Critical and Ultra Super Critical coal power plants operated on imported coal only
- ❖ Transmission and Distribution Losses ( In percentage ) :

2020	2025	2030	2035	2040	2045	2050
11.8	10.0	9.0	8.0	7.0	6.5	6.0





# Future Power Sector – Scenarios

## Scenarios Constructed

- **Restricted Trade Scenario (RT):**
  - Electricity import capacity restricted to 1.1 GW beyond 2019
- **Free Trade Scenario (FT) :**
  - No restriction on electricity import

## Scenarios Constructed

- **PSMP Scenario (Energy security through diversification):**
  - Gas : 35% in Total supply by 2042
  - Coal : 35% in Total supply by 2042
  - Nuclear: 12% in Total supply by 2042
  - Hydro & Renewable (1%) + Electricity Import (16%) : in Total supply by 2042
  - Oil: 1% in Total supply by 2042

## Scenarios Constructed

- **Accelerated RE Scenario (ACCL-RE):**
  - 10 GW and 4.6 GW of potential assumed for solar and wind based generation capacity respectively (SREDA report, doctoral thesis (Mondal M.A.H (2010))
  - Other assumptions are same as PSMP scenario



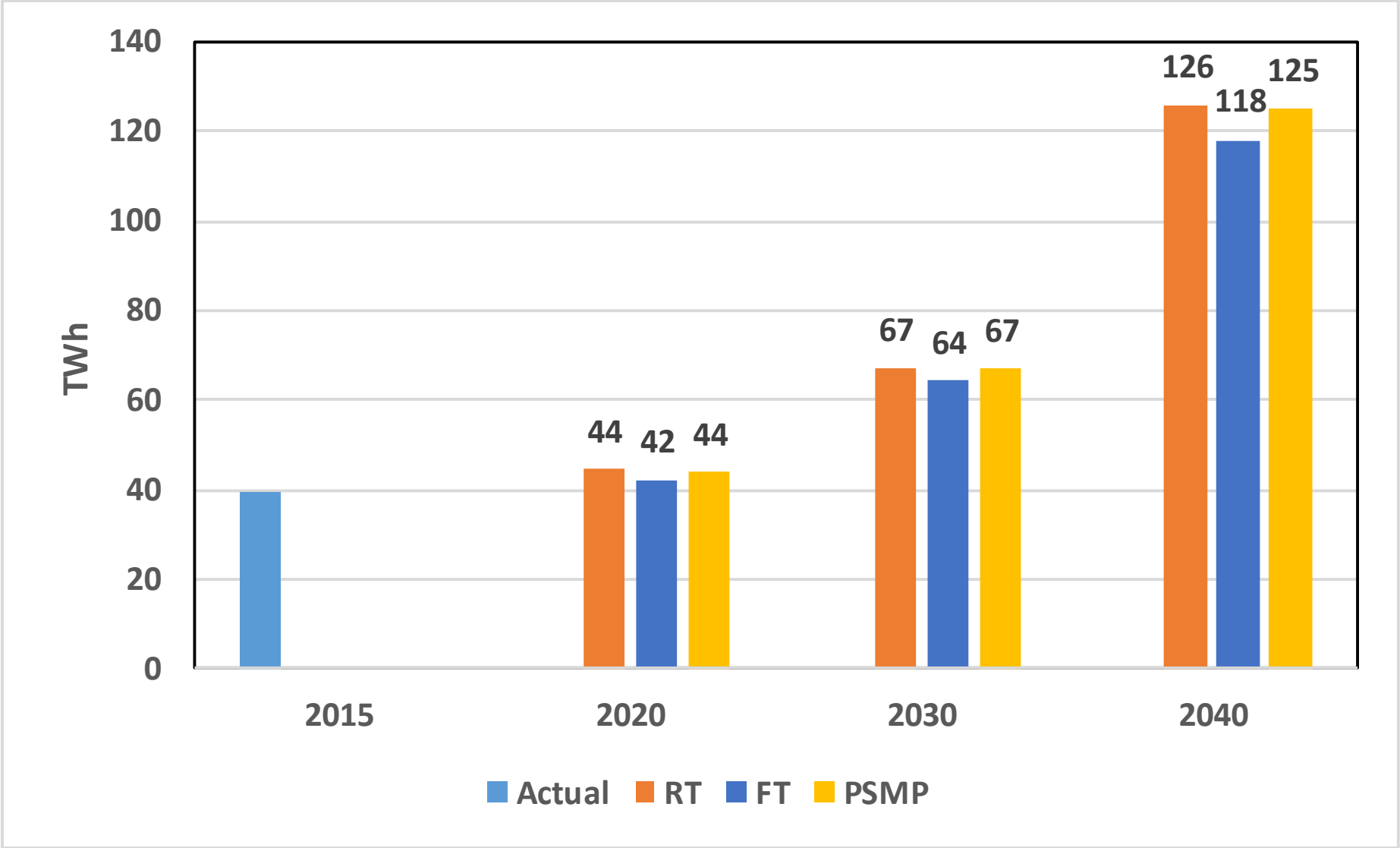
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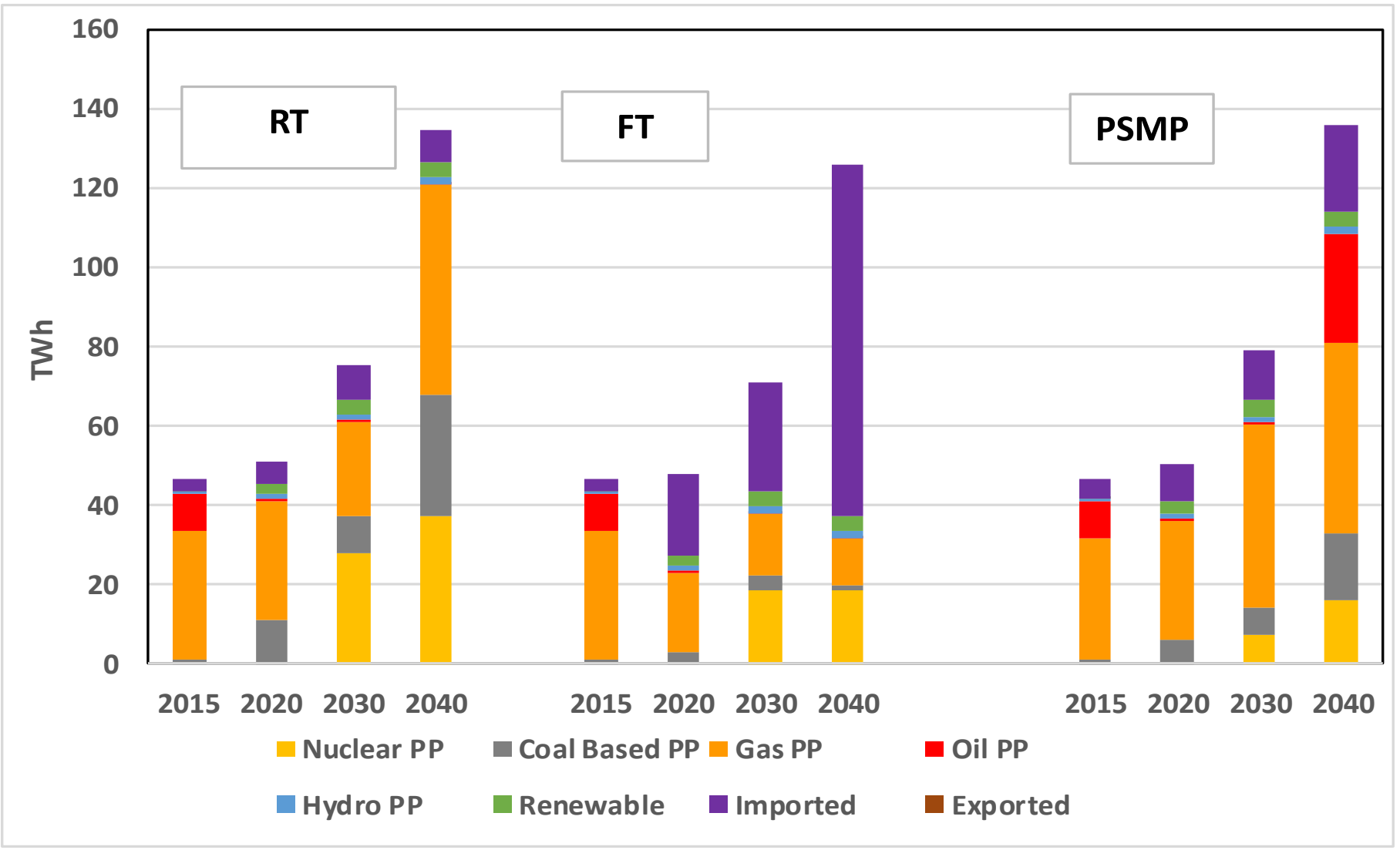
# Scenario Results and Analysis

# Electricity Demand (consumer end)





# Generation





## Conclusions

- Resources for power generation impose complex challenges
- Energy security is key concern
- PSMP energy diversification scenario is built on energy security concern
- Future power system will depend heavily on import (electricity or fuel)
- Electricity import brings economic gain
- Higher renewable development improves energy security and environment, although cost is high