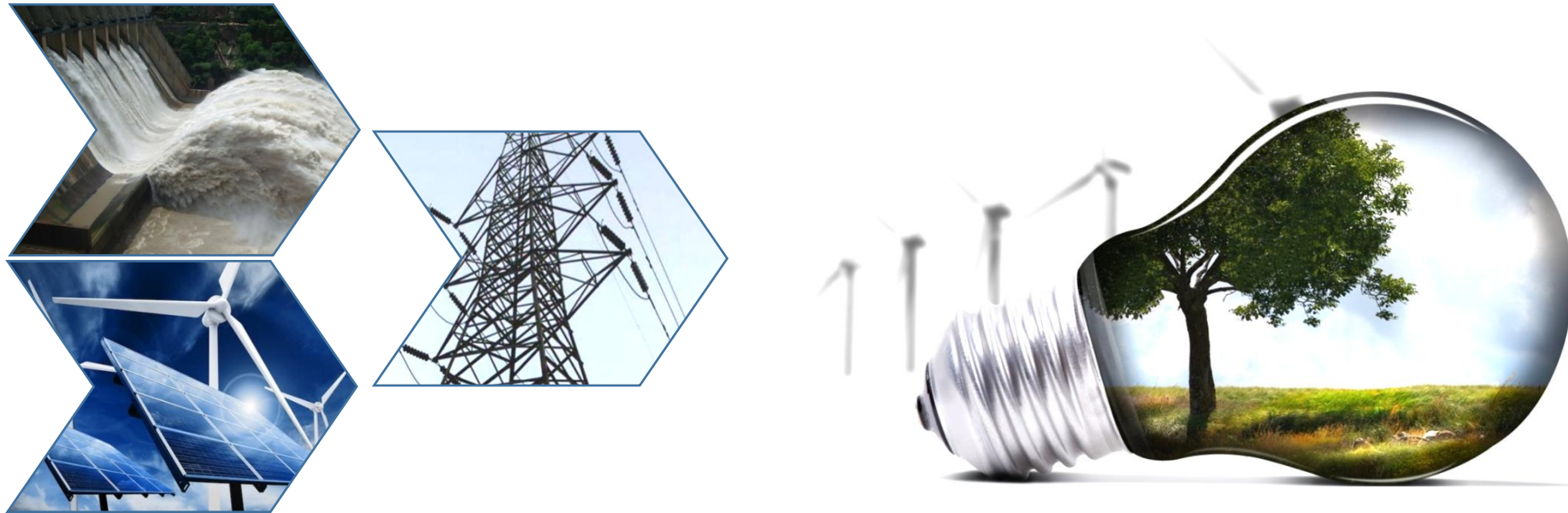


Gains from Nepal-India CBET IRADe Study for SARI

South Asia Regional Initiative for Energy Integration(SARI/EI)
Nov, 2016 | New Delhi



The Objective

- Assess Techno economic Feasibility of CBET
- What are the economic gains to NEPAL and INDIA of such trade taking in to account earnings from export and its macro-economic impact on the economy

Approach

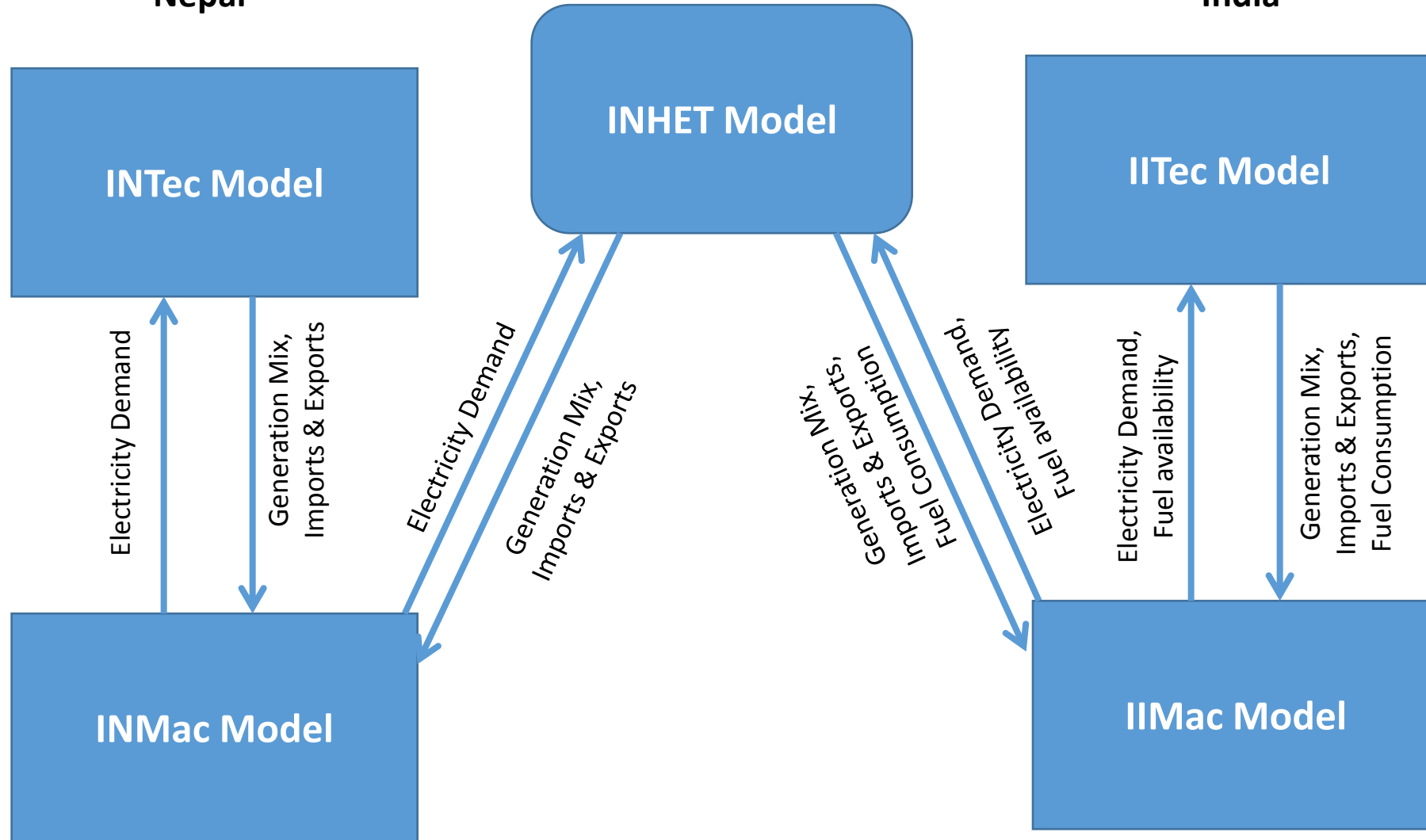
- Power sector development strategies from 2012 to 2047
- Technology Model solved for every 5th year simultaneously
- Detailed Technology model with 288 time slices per year
- For each time slice demand must equal supply
- Technology model for each country has detailed plant wise data and options of different types of new plants
- Solution minimizes cost to meet specified demand and provides optimal solution and trade levels and prices for each 288 time slices for all the years

Approach (Continued)

- However, trade will affect economic development and level of demand particularly true for NEPAL
- A macro- economic SAM based model covers the whole economy balances supply and demand for each sector, also investment and savings, balance of payment for each year, etc.
- So earnings from electricity export increases flexibility to import and resources to invest
- Higher Growth and higher domestic demand for electricity
- Iterate between the two models to get economically viable and technically feasible scenarios.

Nepal

India



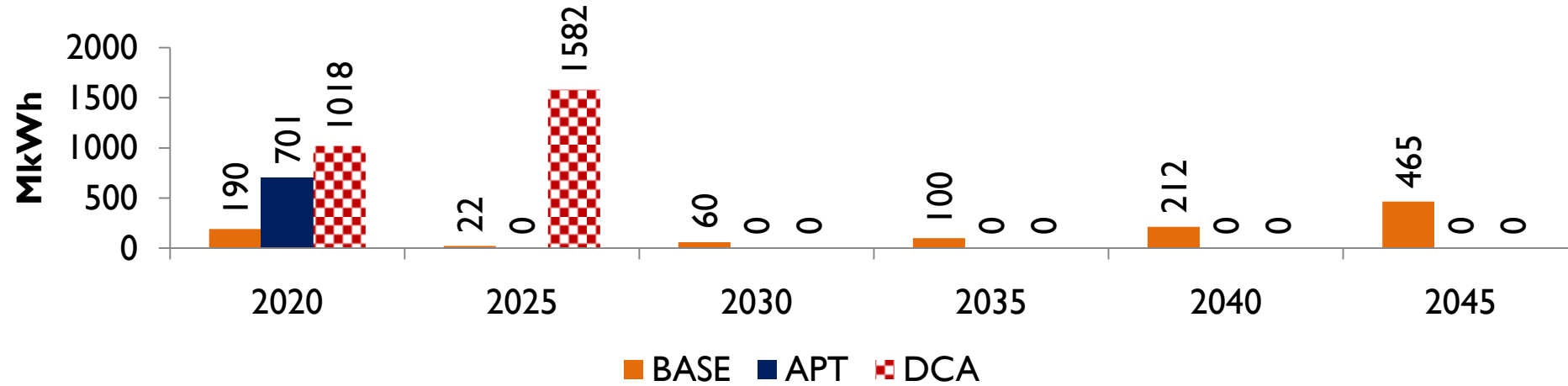
Macro Model Names:
 IIMac- IRADe India Macro
 INMac- IRADe Nepal Macro

Technology Model Names:
 IITec- IRADe India Technology
 INTec- IRADe Nepal Technology
 INHET- India-Nepal Hourly Electricity Trade Model

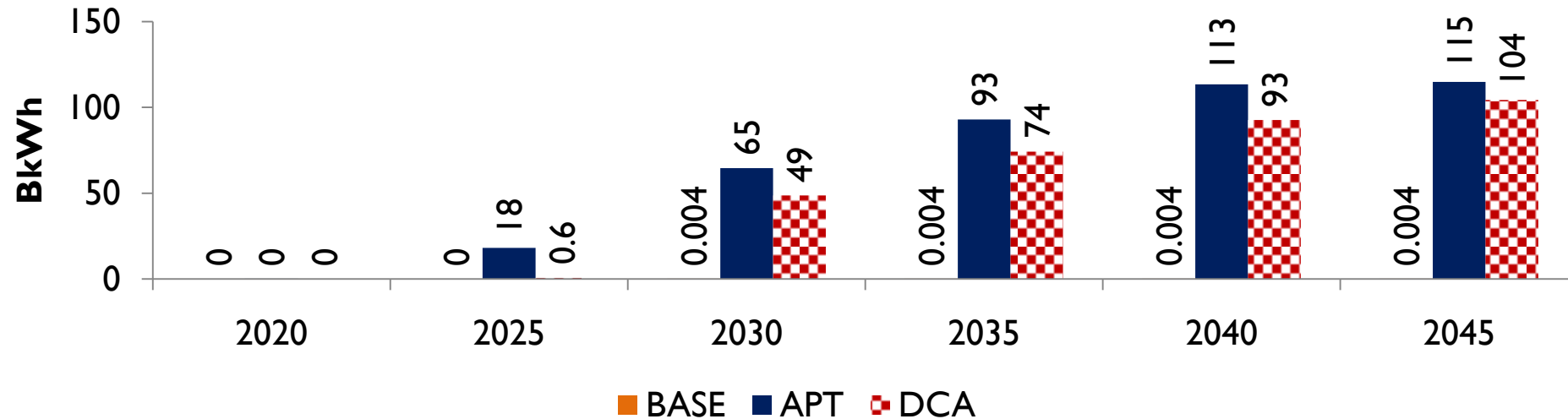
Impact of Electricity Trade on Nepal

Nepal's Imports/ Exports

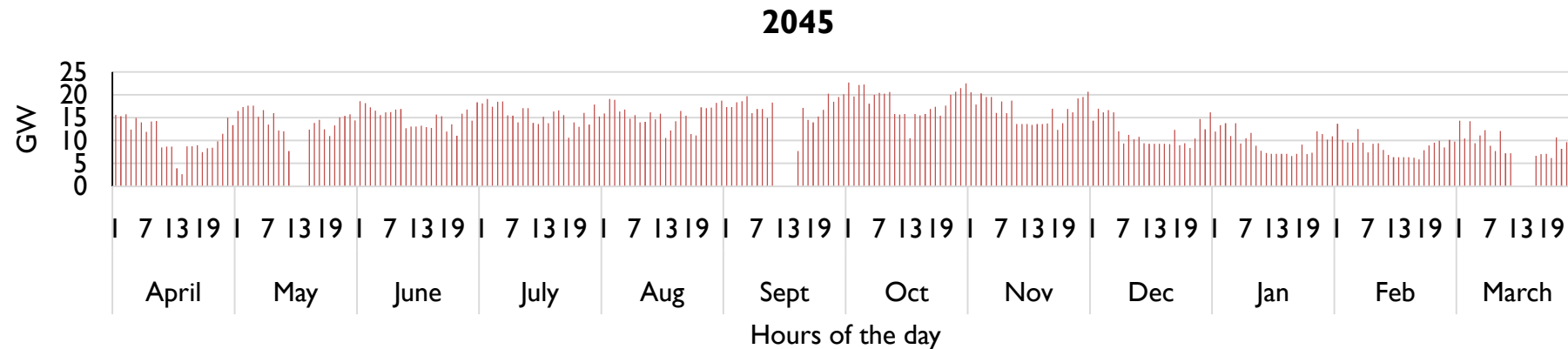
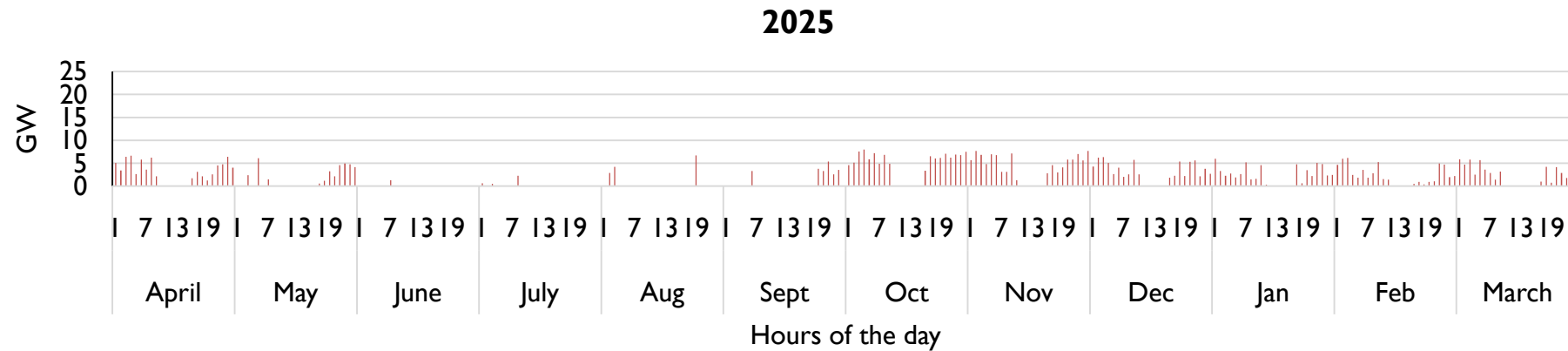
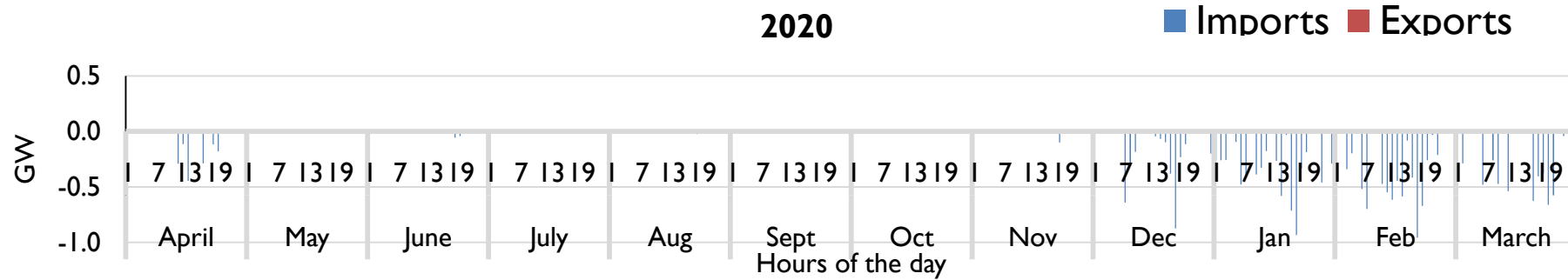
Nepal's Imports/ India's Exports (in MkWh)



Nepal's Exports / India's Imports (in BkWh)

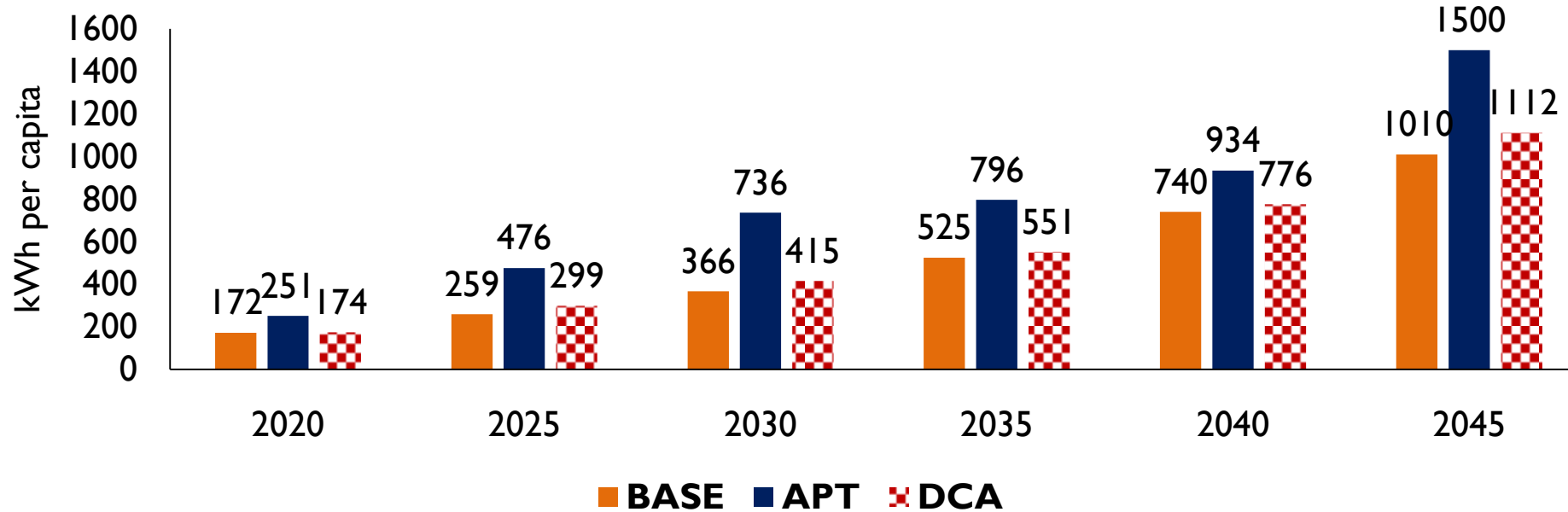


Selected Years Nepal's Imports/ Exports in APT



Change in Nepal's Per Capita Electricity Demand

Nepal's Per Capita Electricity Demand

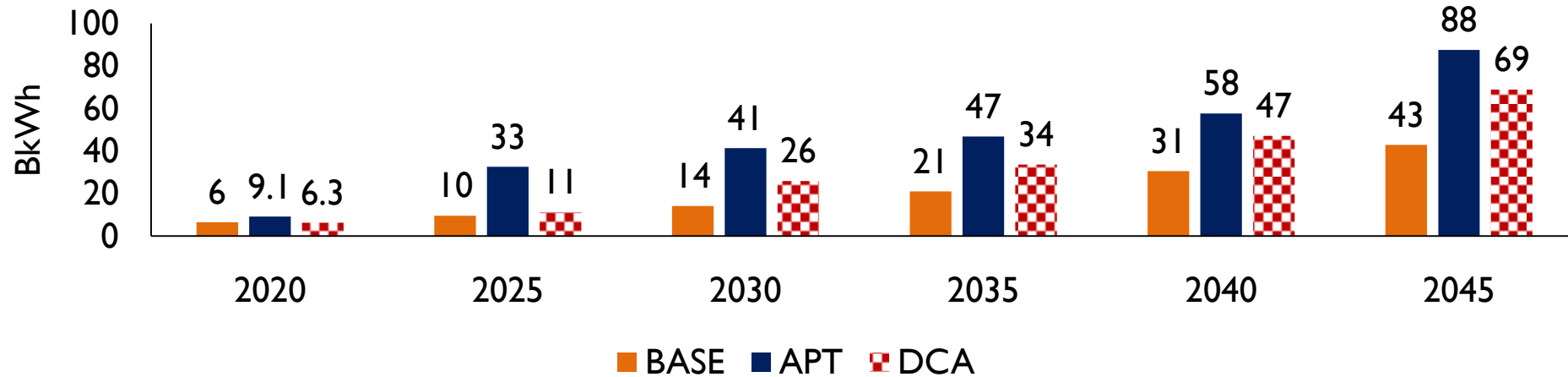


Gains over BASE in Per Capita Electricity Demand

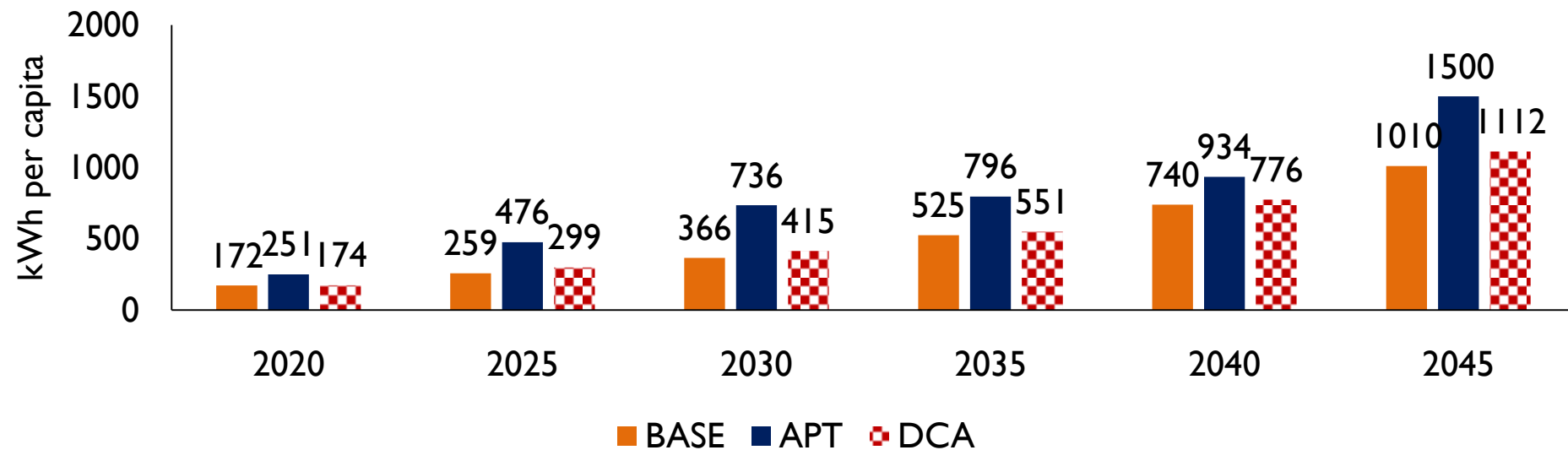
Year	Base kWh per capita	APT		DPT	
		Change over Base	% Change	Change over Base	% Change
2030	366	369	101%	49	13%
2045	1010	490	49%	102	10%

Developmental Impact

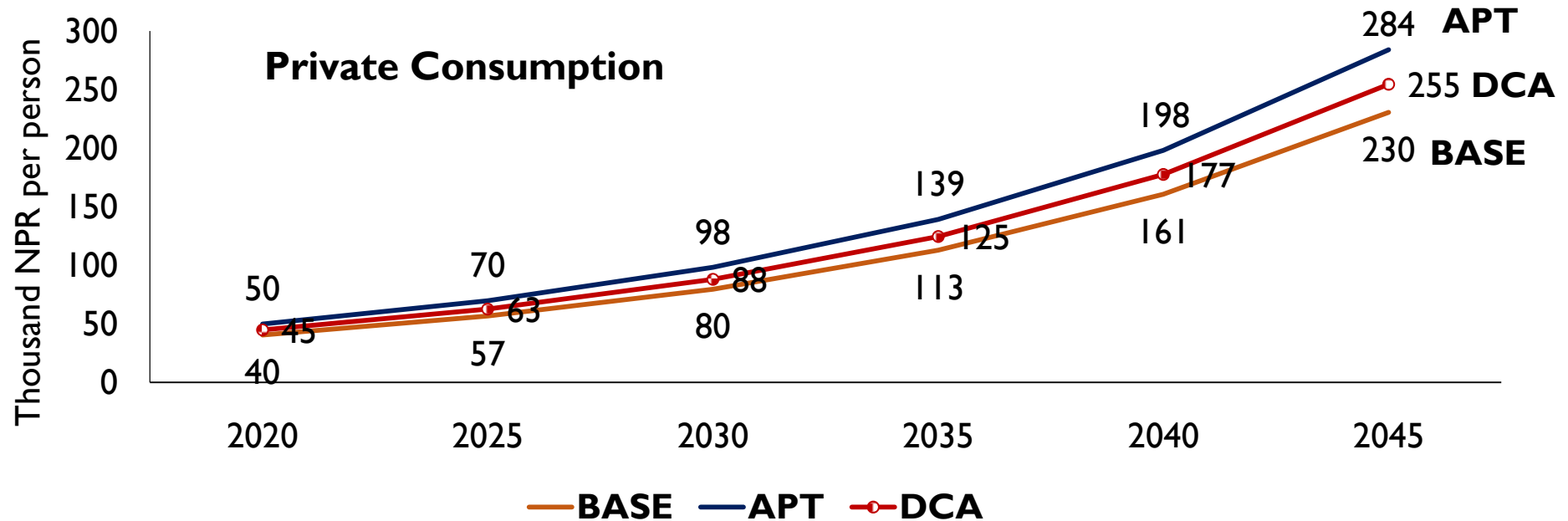
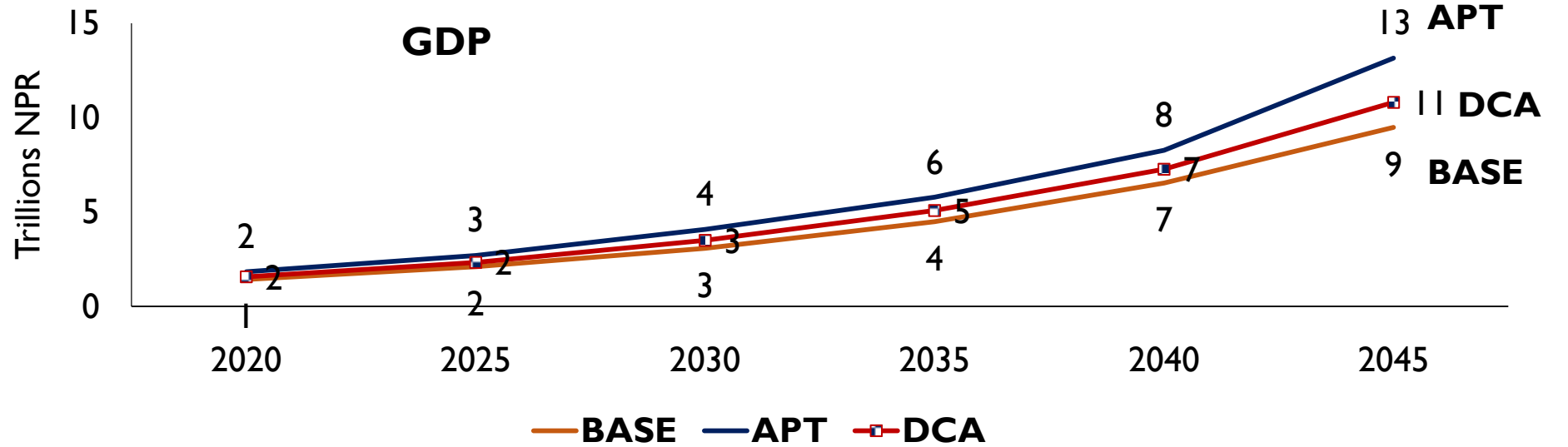
Total Electricity Use



Per Capita Electricity Demand



Economy wide Impact



Gains over BASE in GDP at Constant Prices

Year	Base		APT		DCA	
	billion NPR	Change over Base	% Change	Change over Base	% Change	
2020	1432	406	28%	136	10%	
2025	2109	593	28%	222	11%	
2030	3082	995	32%	414	13%	
2035	4490	1297	29%	590	13%	
2040	6537	1741	27%	733	11%	
2045	9484	3666	39%	1328	14%	
Cumulative 2012-2045	121589	35347	29%	14098	12%	

Key Findings for Nepal

- Nepal's hydro potential could be a source of large economically feasible electricity export to India.
- Earlier development of trade infrastructure necessary for Nepal to satisfy its internal demand in the short or medium term during the construction of hydro projects and use the same infrastructure for export when hydro plants are ready.
- APT leads to significant step up of growth of household per capita consumption, an indicator of improvement in well-being, which increases by 23% over the BASE scenario.
- Per capita electricity consumption, traditionally strongly correlated with human development, increases by 50% in 2045 in APT scenario;
- In APT scenario, net annual export revenue from the electricity trade is NPR 310 billion in 2030, which jumps by two and half time to NPR 840 billion in 2040, rises further to NPR 1069 billion in 2045. Delayed capacity addition reduces earnings.
- GDP in 2045 with trade in APT is 39% higher than in the BASE scenario.
- Investments in 2045 with APT becomes 33% of GDP, suggesting even more robust economic growth in the future.
- Trade promotes industrialisation in the country as the share of industry in GDP becomes 30% compared to 21% in BASE and since GDP is 39% larger, the level of industrial GDP doubles in APT. Industrialisation can create better paying employment.

Key Findings for Nepal

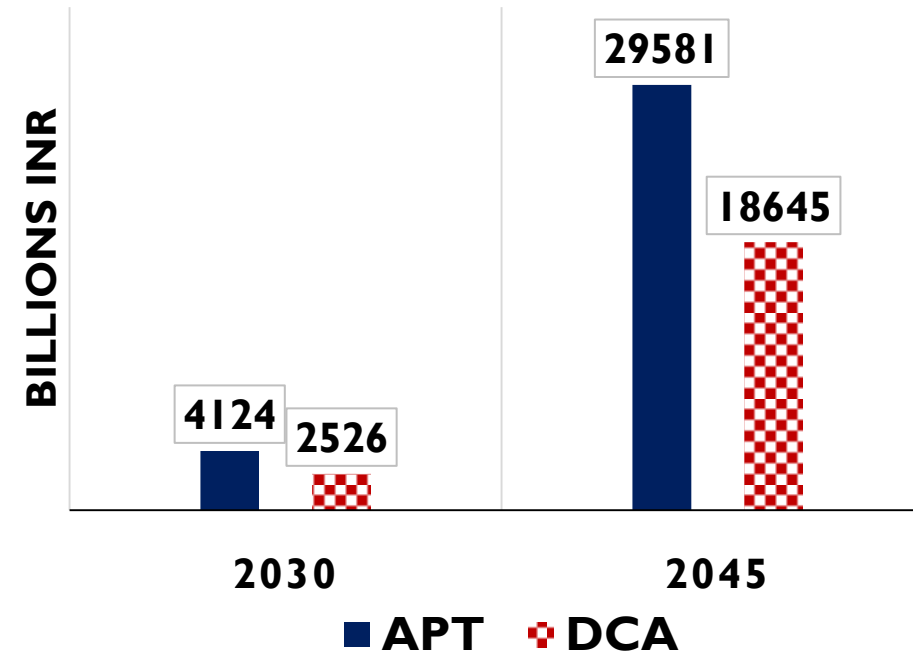
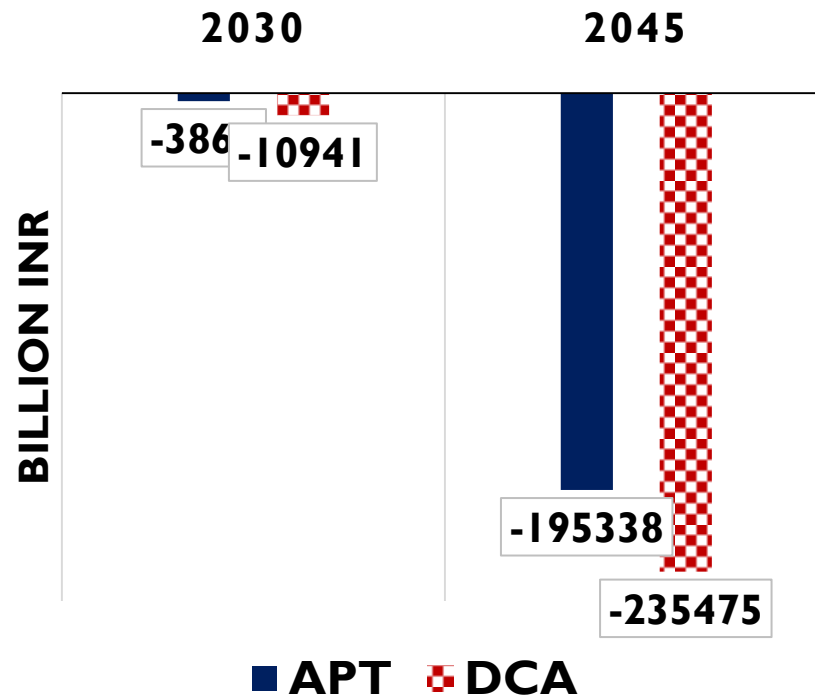
- The power capacity increases to 34.4 GW in 2045 with APT compared to only 8.9 GW without trade
- In the APT scenario, substantial power capacity is built through foreign direct investment. The value of foreign inflow over 2012 to 2045 is 28931 billion NPR. Of this 4649 billion NPR is used to fund investment in power capacity this amounts to 51% of the total investment in power sector through outside support.
- Even a five-year delay in capacity creation in DCA reduces these benefits substantially compared to APT. In 2045 GDP is higher compared to BASE by only 14% (39 % in APT) and per capita consumption by only 10% (23% in APT).
- Without electricity trade in the BASE scenario a number of storage type hydro projects are required to meet domestic demand.
- With trade in APT, exploitation of hydro potential is through run of the river (ROR) type plants, which are the cheapest and easiest to construct. In addition, ROR plants cause less environmental externality and human displacement compared to storage type plants.

Impact of Electricity Trade on India

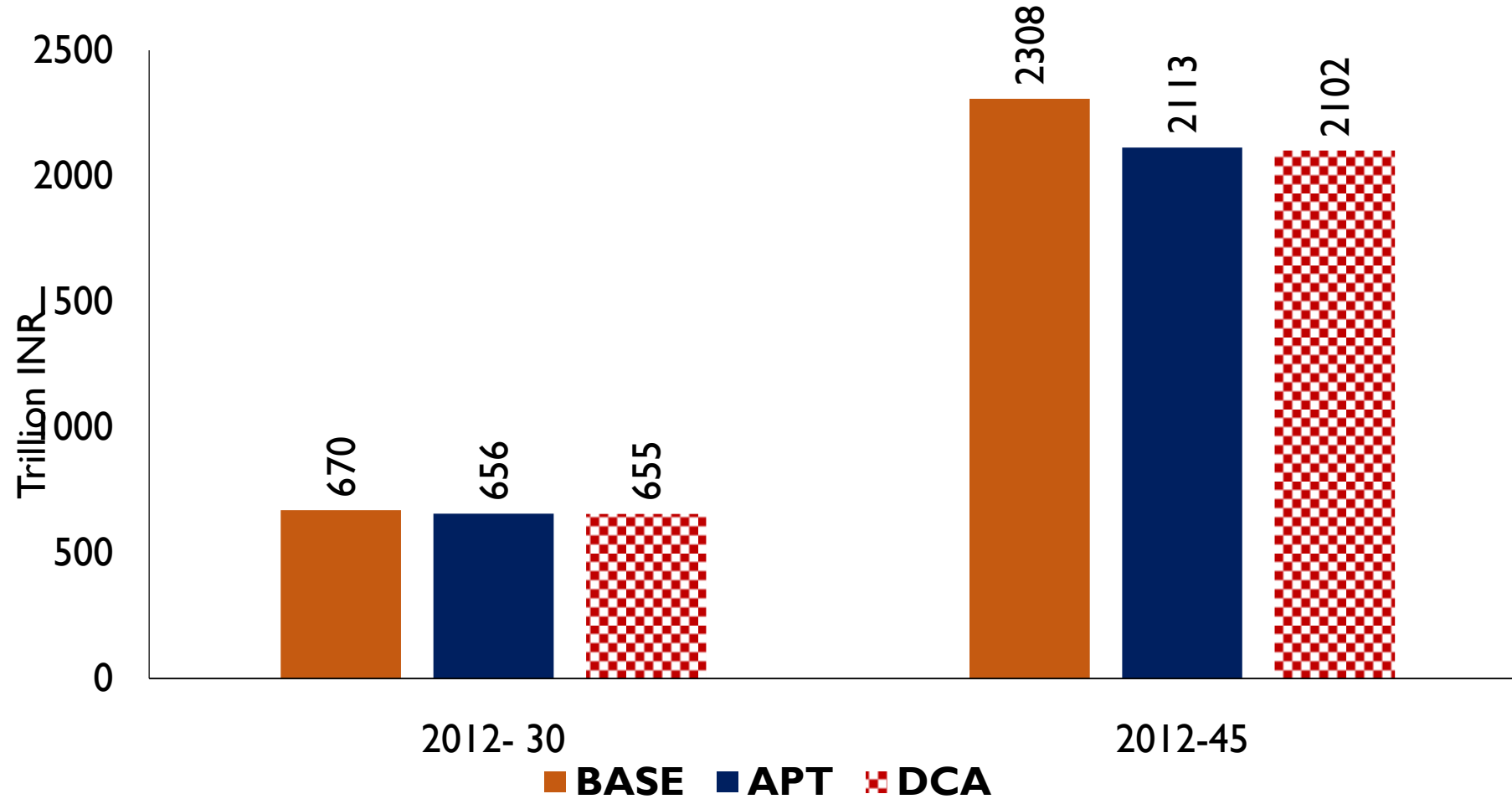
Economy wide Impact Compared to Base

Cumulated Consumption Gains

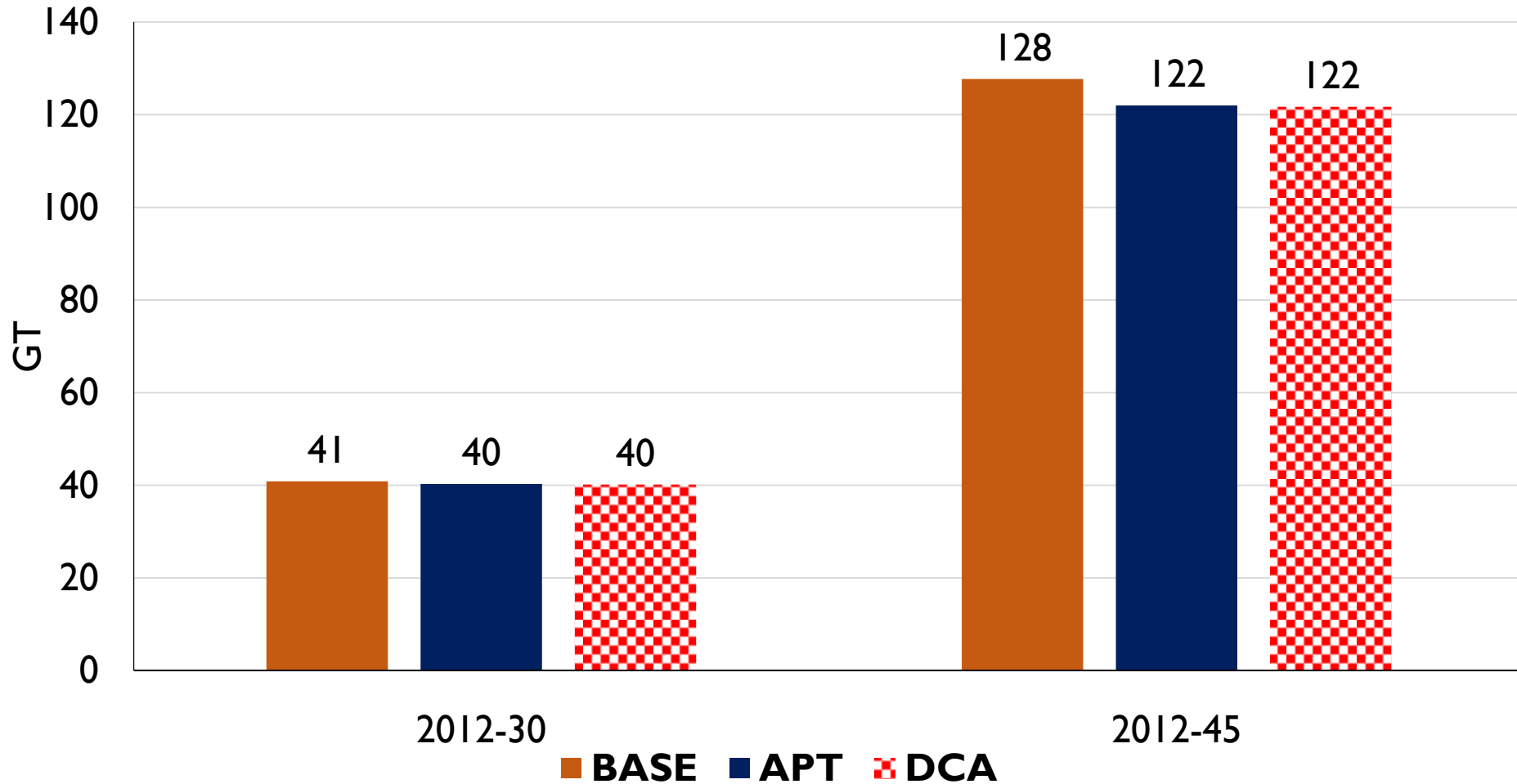
Cumulated GDP Gains



India's Cumulated Total Investment



India's Cumulated CO2 Emissions- Economy Wide



Key Findings for India

- Electricity supply cost is lower as imported electricity is cheaper than domestically produced one.
- The domestic generation, capacity creation, and investment in the power sector are reduced.
- More importantly, as India plans to have large solar capacity as part of its ambitious renewable target, and peak in the system occurs in the evening, available imported capacity in the evening helps to encounter solar intermittency and meeting peak.
- It may be noted that India imports electricity from Nepal even when its own hydro potential of 145 GW is fully utilized.
- In APT per capita consumption in 2045 increases by 1.7% though GDP reduces by 6.33% compared to BASE.
- In absolute terms however, the gain in cumulated consumption over 2012 to 2045 is larger for India than in Nepal.

Key Findings for India

- Use of energy commodities (coal and gas) for power generation is lower, therefore their production and import needs are lower.
- Reduced use of fossil fuels reduces pollution and brings environmental benefits.
- As import is sourced from hydro plants with their flexibility in generation, it helps India to meet its renewable target by providing balancing power.
- The cumulated CO₂ emission from 2012 to 2045 reduces by 5.6% and 5.4% respectively compared to BASE scenario. This is important for India, which is increasingly playing a leadership role on climate change issues.
- With reduced CO₂ emissions by India, the world also gains.

The Way Forward

- Both Nepal and India gain significantly in economic and environmental terms
- To make CBET a reality – Many steps are needed
- Task Force reports have worked out the nitty-gritty of some 20 points in the SAARC agreement
- The Mock Trading will show how trading can be done easily
- This study has shown its desirability
- We need to build a larger consensus for which this study should help
- We are carrying out a similar study for India-Bangladesh trade
- Hopefully we can extend it to multilateral trade – Nepal-Bhutan-Bangladesh-India
- And hopefully to BIMSTEC countries

Thank you