Energy modeling: Case of Kosovo
What are the alternatives?

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Coal in Kosovo

5th largest proven reserves of lignite in the world

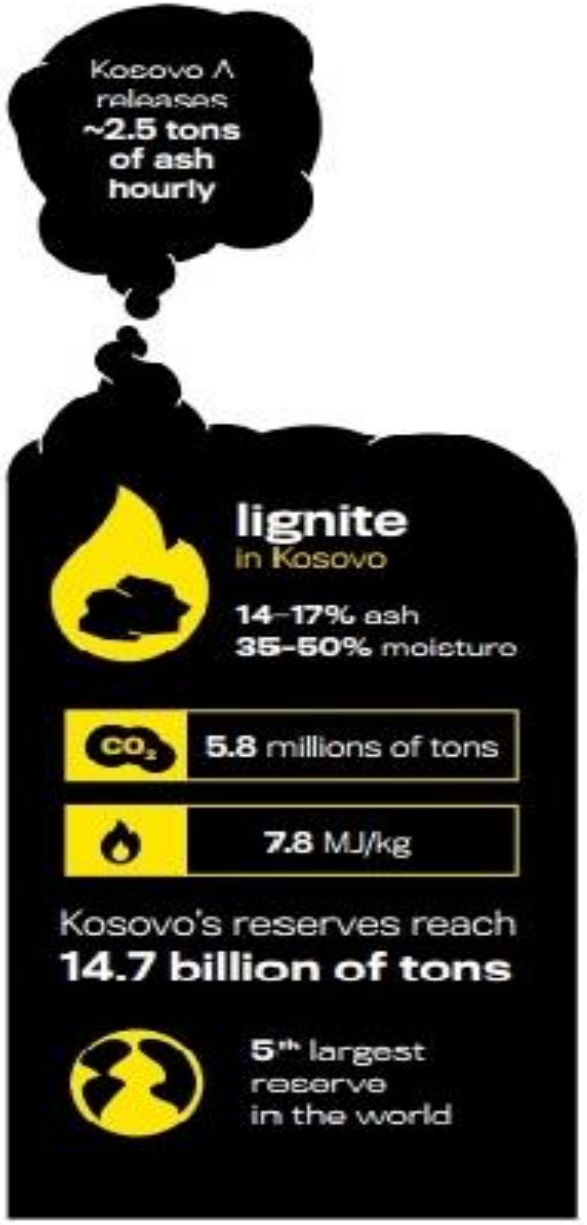
3rd largest proven reserves of lignite in Europe (Germany, Poland)

This mineral has been of outstanding importance for the country

Yet, the question remains, what about the future of coal?

‘Poor quality’ coal

- Kosovo lignite has very low energy containment, averaging 7.8 MJ per kilogram of lignite.
- Kosovo releases approximately 5.8 million tons of CO2 into the atmosphere annually.



Coal and pollution

Source:HEAL

Particulate matter emissions are three to six times higher from Kosovo A compared to Kosovo B

Emissions from the power plants are much higher than the European Commission (EC) Directive for Large Combustion Plants

A combined **74 times higher** than what is allowed under EU standards

Energy situation in Kosovo

The case of Kosova A and B

Major (inefficient) investments in the sector

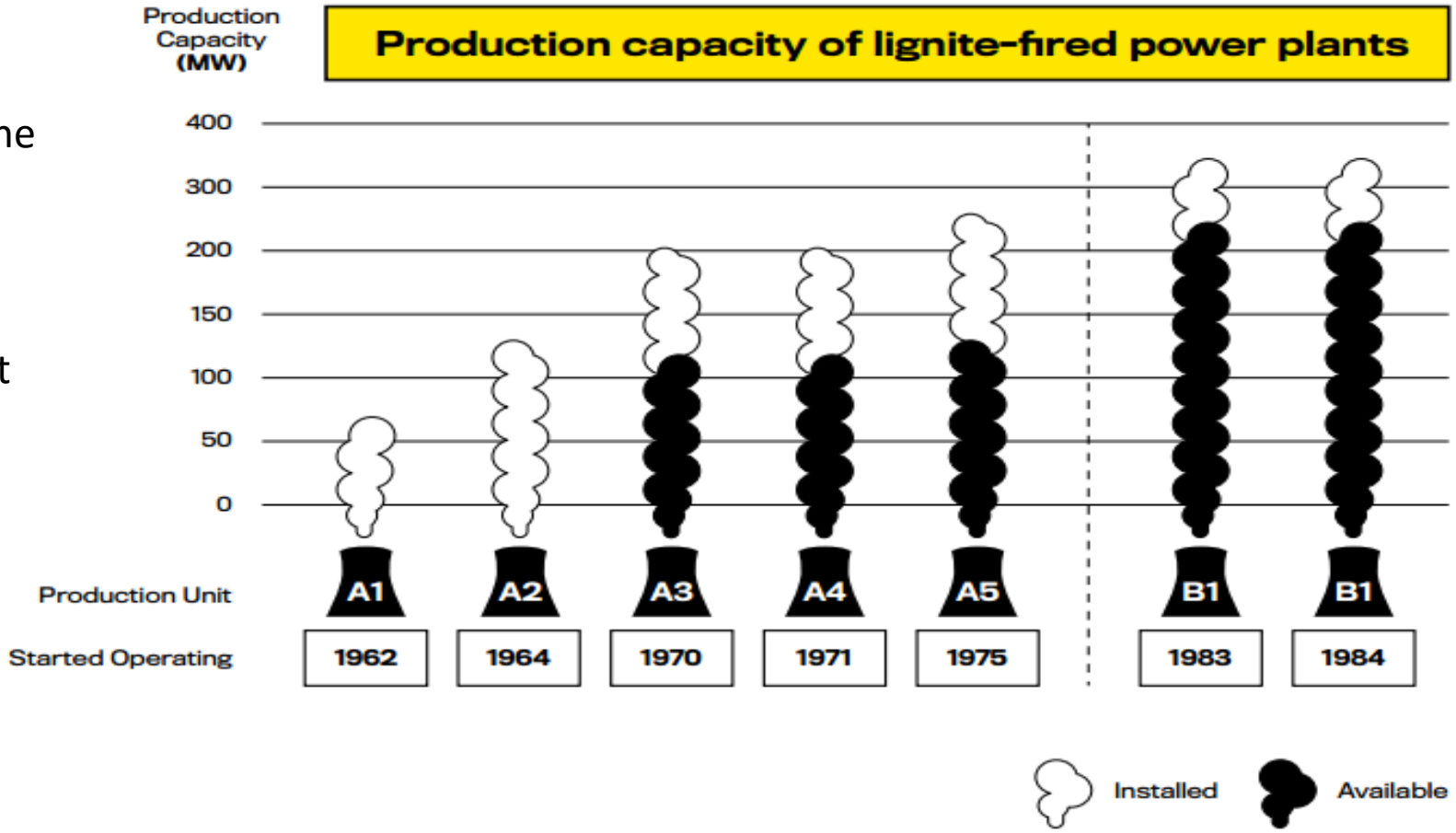
Net importer

Major impediment for development

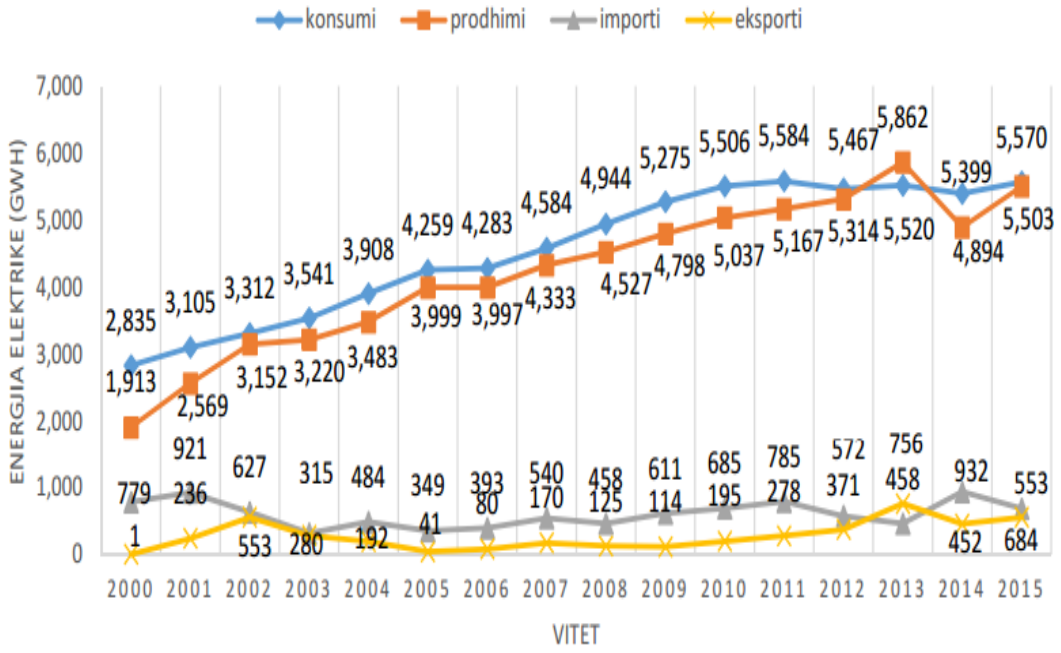
Poor energy mix

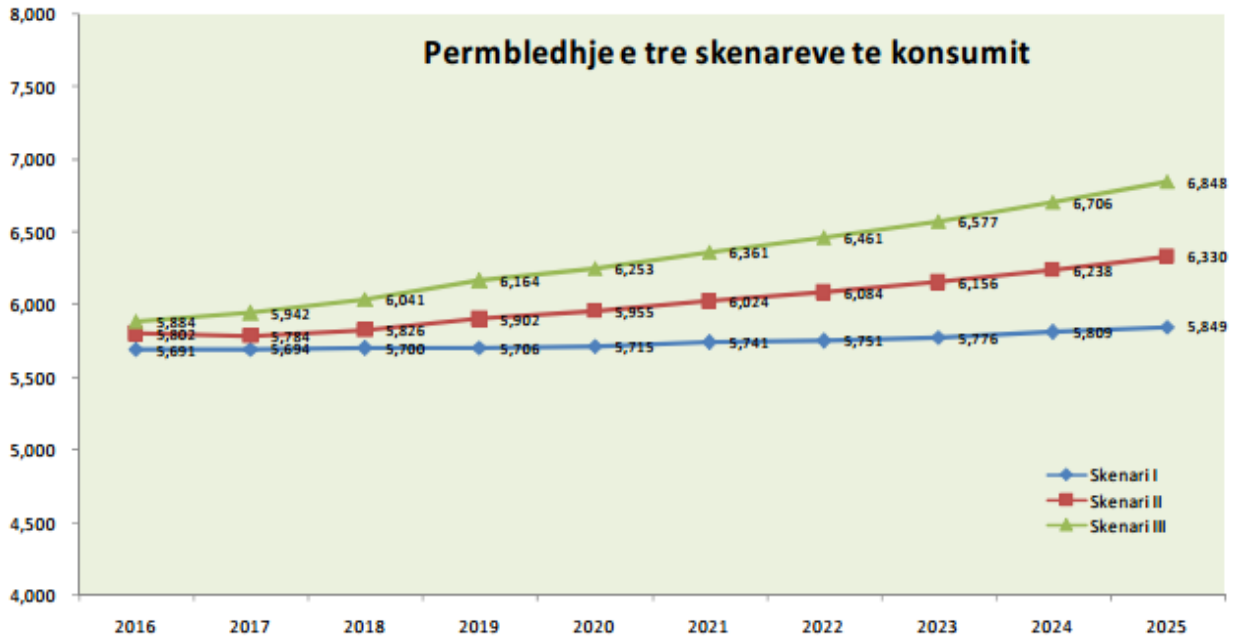
No strategic planning

Future reliance on coal



Energy demand vs. demand forecasting in Kosovo





Until now…

Future forecasted demand

Sustainable Electricity Options for Kosovo (2014)

- This study models the cost of building new generation capacity within the power sector in Kosovo.
- The scenarios emphasize a variety of renewable electricity resources – notably solar, wind, and hydropower
- Each scenario emphasizing renewable energy provides more energy than the forecast demand, opening the door for regional power trading and exports, which have significant capacity to build security, regional prosperity, and peace, as well as bringing Kosovo's carbon emissions closer to the EU standard.

Resource availability

Resource		Comments	
Coal Reserves		10.9-12.5 billion tonnes	Lignite coal has the lowest carbon content, highest amount of moisture, and lowest energy density compared to other types of coal
Solar		1600 kWh/m2 /year	The annual incoming solar radiation ranges from 1550 kWh/m2 /year to 1650 kWh/m2 /year at 35° inclination
Hydropower	Large scale (reservoir-based)	45 MW in capacity if it is built (Zhur)	This resource could provide nearly 300 GWh of electric generation per year. Even more supportive of hydropower development, the Energy Regulatory Office (ERO) in Kosovo expects 140.3 MW of run-of-river capacity by 2020.
	Small scale (run-of-river)	Aggregated potential to develop approximately 63 MW of small-scale, run-of-river, mini-hydropower projects	

Resource	Comments	
Wind	Wind projects in the pipeline include the development of 140 MW of wind by NEK Umwelttechnik, a Swiss firm, beginning with the Zatric farm project with a capacity of up to 45 MW. The other projects include the Budakove wind farm and Cicavices, which could come online by 2016 (NEK, 2013)	The estimated average annual wind-speed from Budakova at 38 meters is approximately 6.9 m/s. Figure 4 exhibits the monthly average wind resource at Budakova. We use the log law to extrapolate wind speed at commercial hub of 90 meters to 7.4 m/s using a roughness class of 1 based on the European Wind Atlas classification
Bimoass	Wood, livestock waste, and agricultural straw	Approximately 6600 GWh/yr of theoretical annual energy from biomass resources available in Kosovo

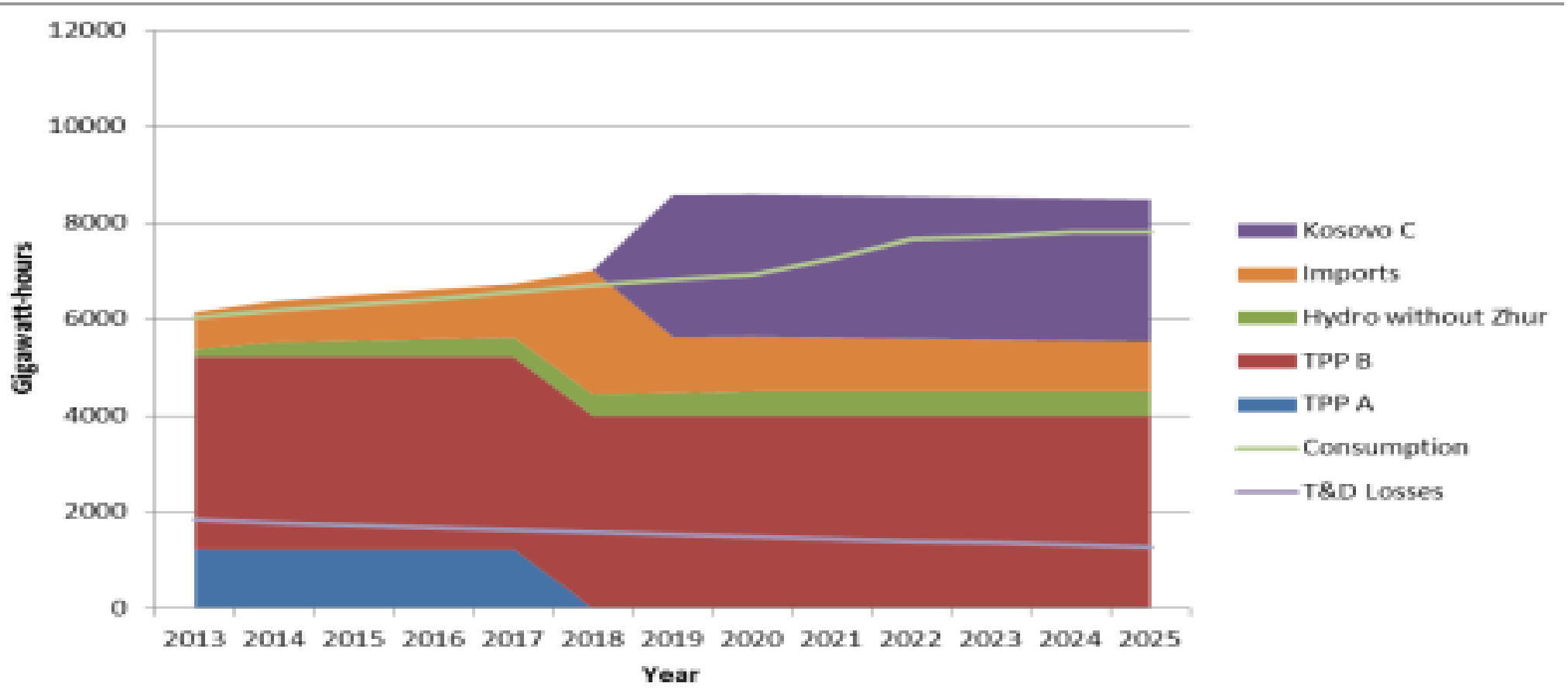
Resource	Comments	
Waste to energy	Annual urban waste of 192 kg per capita, which represents approximately 384,000 tons/year	Assumes that 1 ton of waste is equivalent to 670 kWh of electricity generation, and 10% of the electricity generated is lost to waste recycling.
EE	Assumes that 1 ton of waste is equivalent to 670 kWh of electricity generation, and 10% of the electricity generated is lost to waste recycling.	World Bank projects; Upgrading transmission and distribution infrastructure would greatly address electricity generation concerns 31%
Natural gas development	No domestic natural gas resources for ; The Trans Adriatic Pipeline (TAP) electricity generation	If combined with Kosovo's existing, but not yet implemented feed-In tariff policy, this use of gas, including biogas, can provide a scalable backstop resource that supports an overall path to expand the role of renewable energy deployment

Clarifications

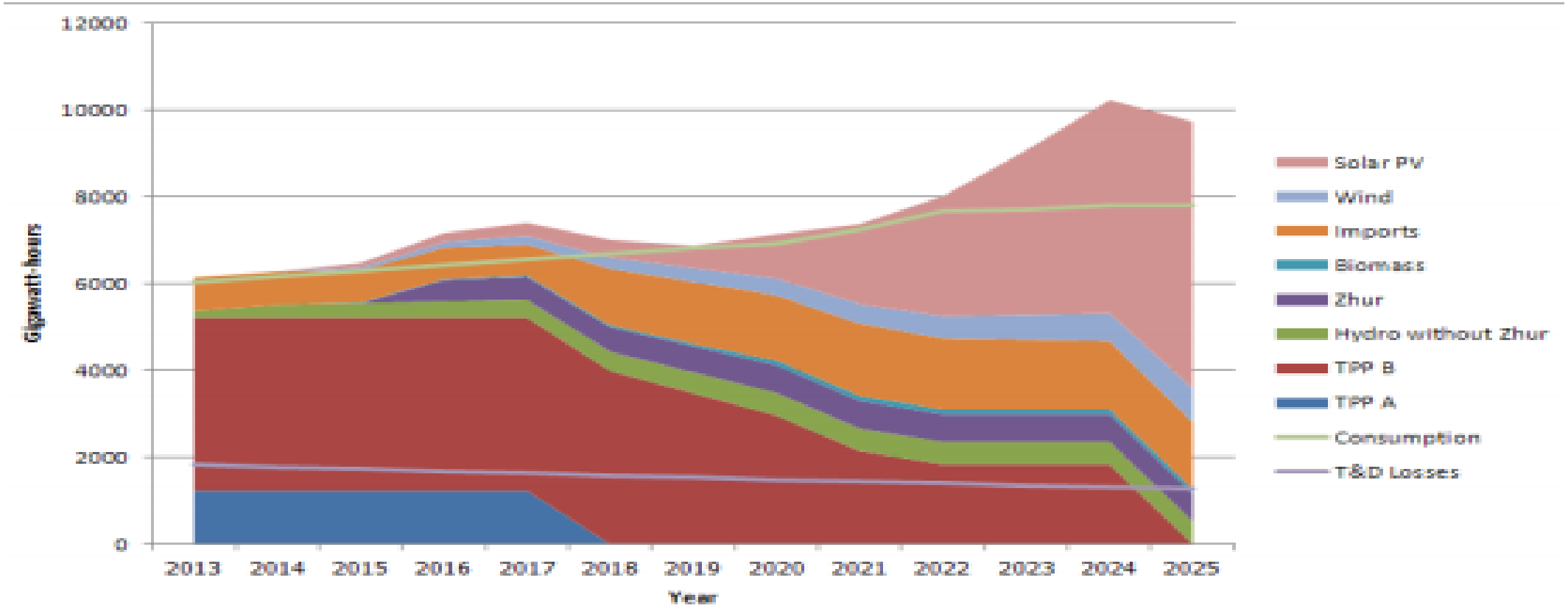
- We created a spreadsheet model to estimate the cost of annual generation and supply over 8760 hours.
- We incorporated previous analyses and parameters of Kosovo's power sector. These scenarios provide a framework to investigate the cost and generation of Kosovo's power sector.
- The data were from the latest levelized cost of energy projections determined by Fraunhofer and represent prices within Southeast Europe.
- Investment and capital costs are included in this calculation, as the LCOE comprises total capital cost, fixed and variable O&M, fuel price, and construction time.

$$LCOE = \frac{\{capital\ investment\ cost * capital\ recovery\ factor + fixed\ O\&M)}{8760 * capacity\ factor} + (fuel\ cost * heatrate) + variable\ O\&M$$

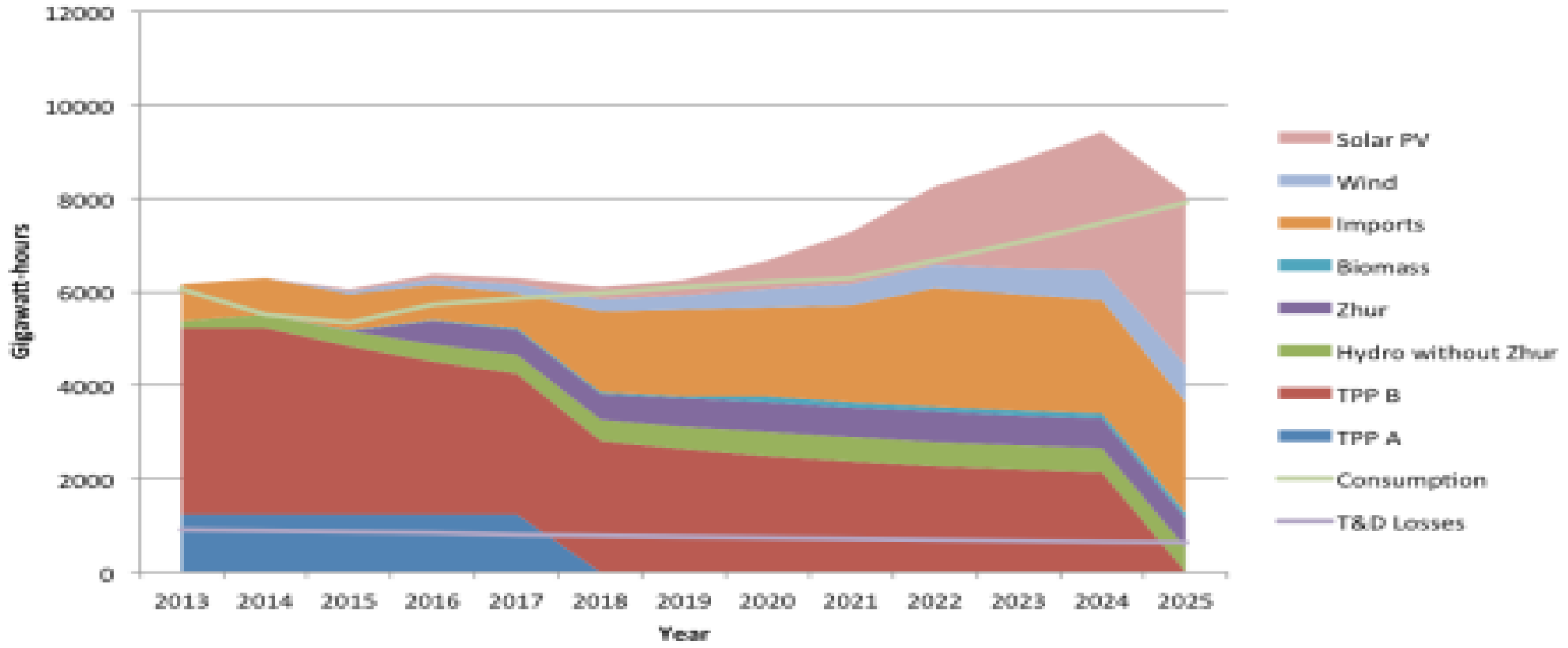
The Base case



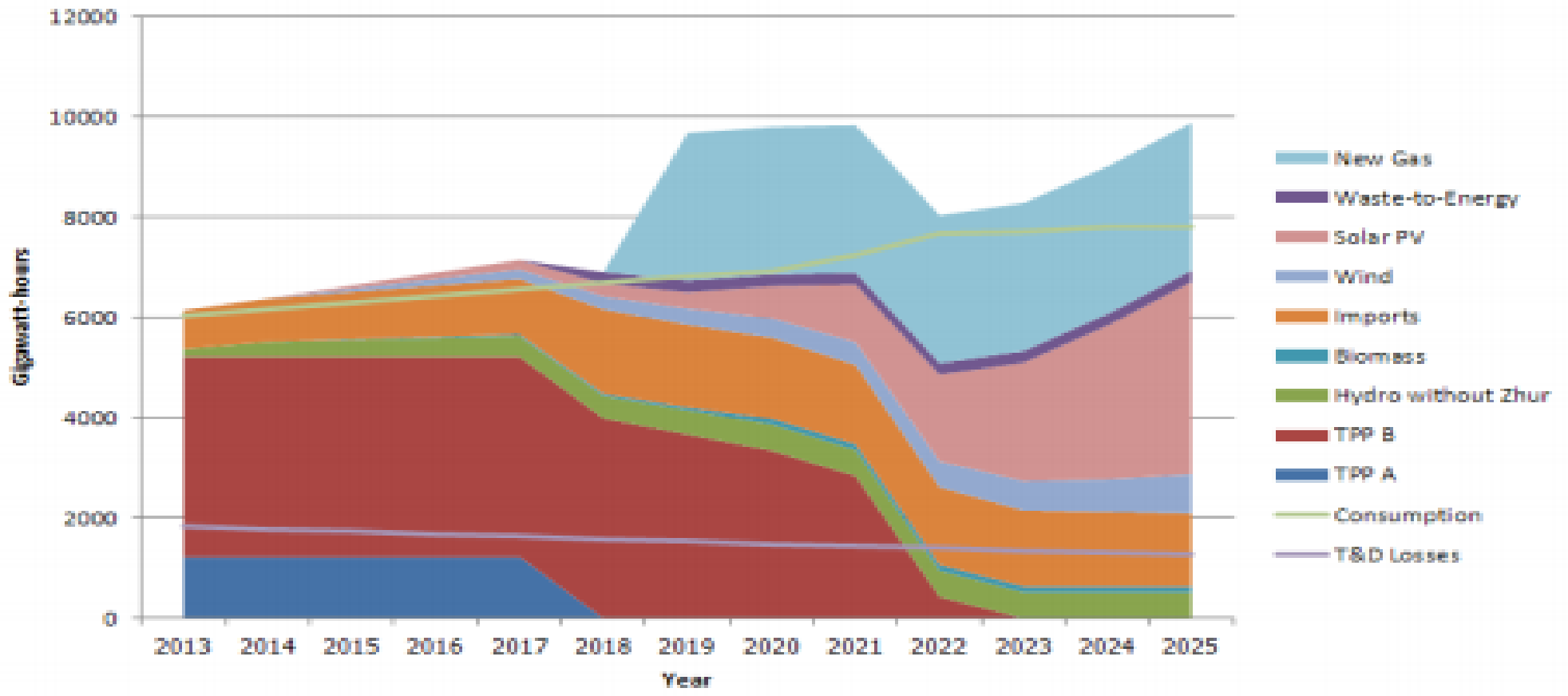
Solar prices reduce to SunShot levels ($1/watt)



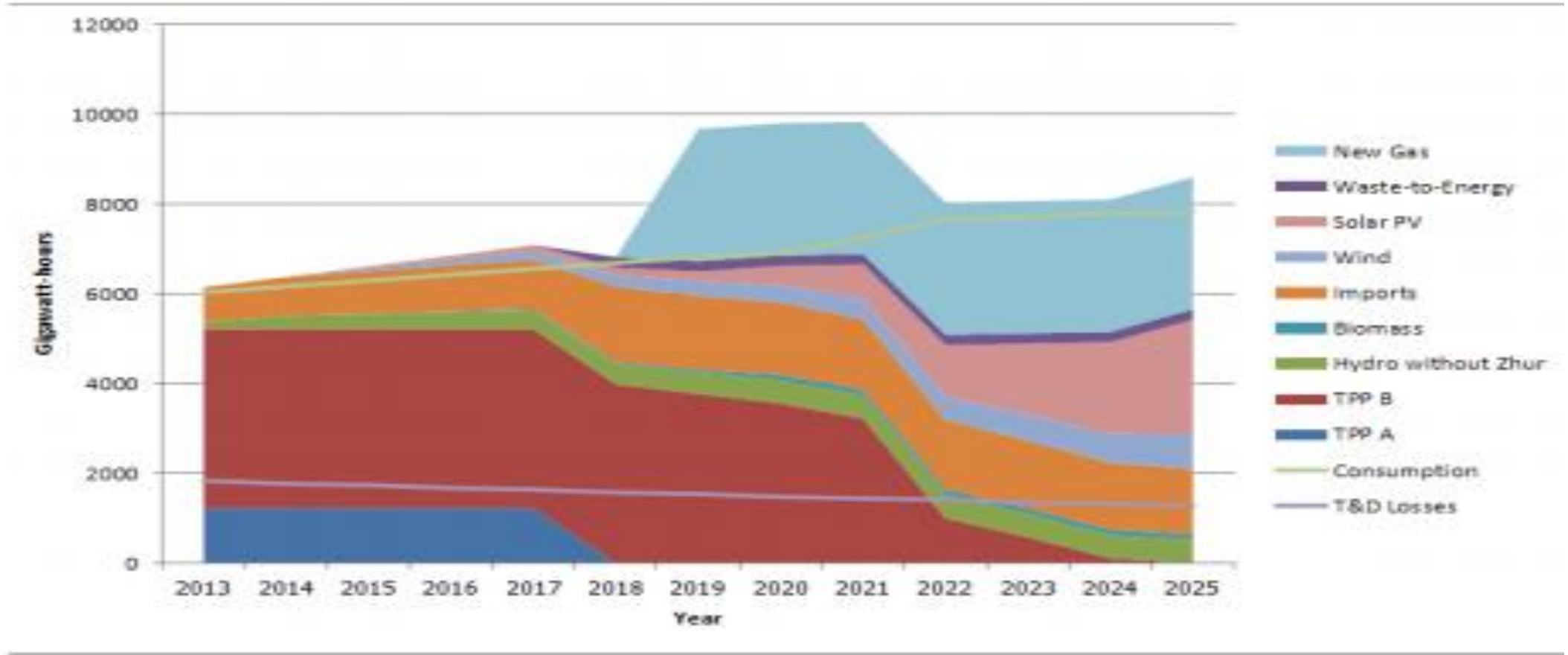
Aggressive energy efficiency measures to reduce end-use consumption



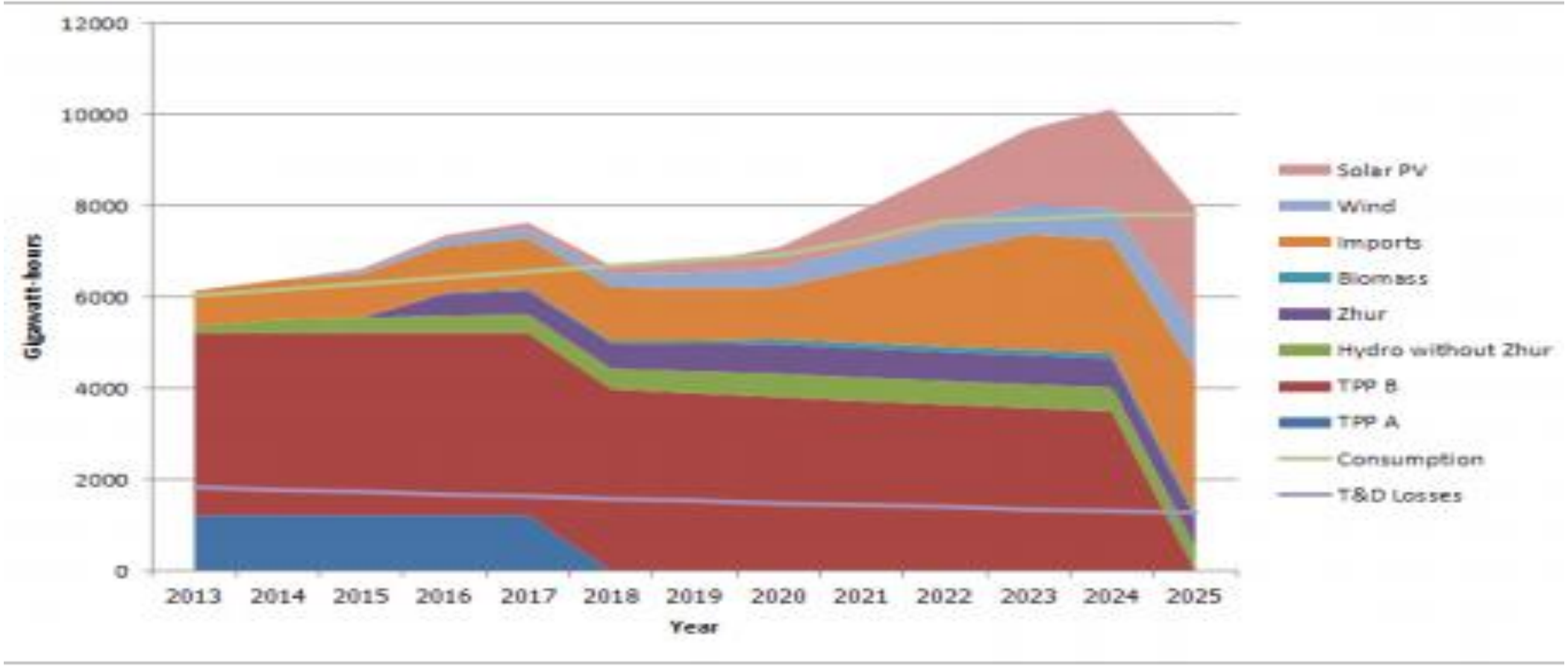
Introduction of natural gas with aggressive EE measures



Storage penalty for solar at $200/kWh along with introduction of natural gas via TAP and aggressive energy efficiency measures



Carbon Shadow Price of $30/ton CO2



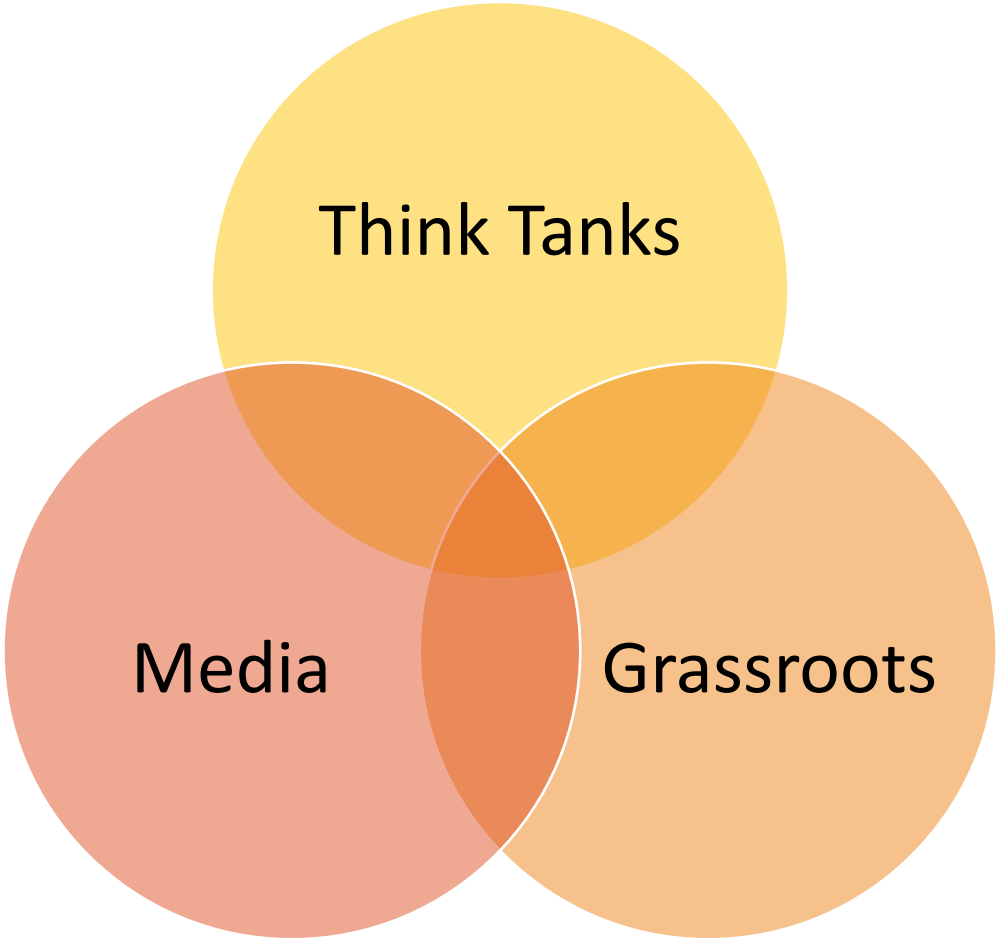
Total cost estimates of each scenario including business-as-usual case

Scenario	Name	Notes	Estimated Cost*	Figure
1	**Base Case (coal)**	"New Kosovo" built in 2017	**$2.17 billion USD**	Figure 5.1, Appendix Table A.1, A.1.1
2	Solar Prices Reduce to SunShot Levels	Solar at $1/W by 2020	$1.85 billion USD	Figure 5.2; Appendix Table A.2
3	Aggressive energy efficiency measures to reduce consumption and T&D losses along with open regional market via a power exchange	1 kWh energy avoided displaces 1 kWh coal-fired generation	$1.73 billion USD	Figure 5.3; Appendix Table A.3
4	Introduction of natural gas via TAP by 2018 with aggressive energy efficiency measures	Solar at $2/W by 2020	$1.71 billion USD	Figure 5.4; Appendix Table A.4
5	Including storage cost for solar at high deployment levels	Solar at $2/W by 2020 and storage penalty at $200/kWh, representing 10% of system generation costs	$1.74 billion USD	Figure 5.5; Appendix Table A.5
6	Including a carbon shadow price	$30/ton of CO_2 added to cost of coal generation	$1.97 billion USD	Figure 5.6; Appendix Table A.6
7	Excluding gas and Zhur, but including a power exchange, and waste-to-energy	Solar at $2/W by 2020 and excess generation from Albania is sold on Kosovar market	$1.94 billion USD	Not pictured; Appendix Table A.7

Food for thought

- There is no shortage of low-cost, low-carbon paths that Kosovo and international investment and development partners could follow;
- Based on results, a coal-dominated future is neither an economic nor political necessity. In ongoing work, the job creation and both human and environmental health benefits of these non-coal scenarios will be further detailed, which makes the case for a multi-billion dollar coal-based pathway unnecessary.
- A diversity of low-carbon pathways requires further discussion and action; the range of options presented, in fact, may make the pathway to a decision challenging in a contentious environment

KOSID – who are we?



THANK YOU!