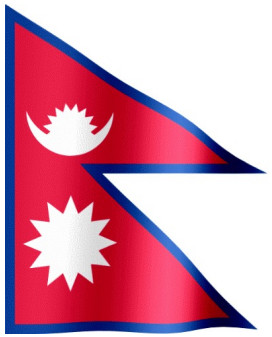
Economic, Energy and Environmental (3E's) Impact Assessment of Electrification of Transport Sector in Nepal



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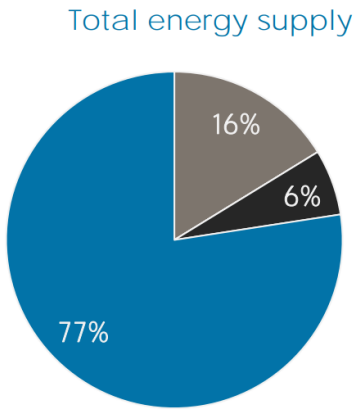
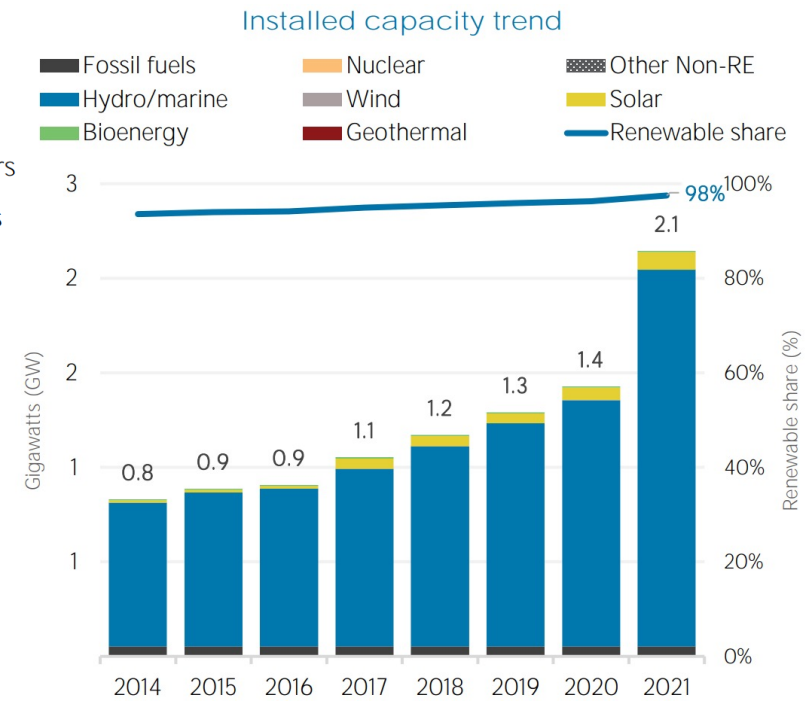
Input-Output-based Life-Cycle Assessment with MARIO

2023

Context, Challenges, and Main Findings

- Petroleum fuel accounts for 17% of the total imports
- 63% of fuel import used in transportation sector
- 50% of government revenues from tax levied on imports (such as petroleum fuel and vehicles)
- Sale of 90% EV private vehicles and 60% EV public vehicles targetted for 2030
- Impact of transport sector electrification on 3E's: economy, energy and environment





Nepal Reference Supply Use System

Total Production		Commodity 1	Commodity 2	Commodity 3	Activity 1	Activity 2	Activity 3	Final Demand
	Commodity 1				DEMAND			Household
	Commodity 2							Government
	Commodity 3							Exports
	Activity 1	SUPPLY						
	Activity 2							
	Activity 3							

Total Value Added

Wages, Taxes, Operating Surplus

Satellite Accounts

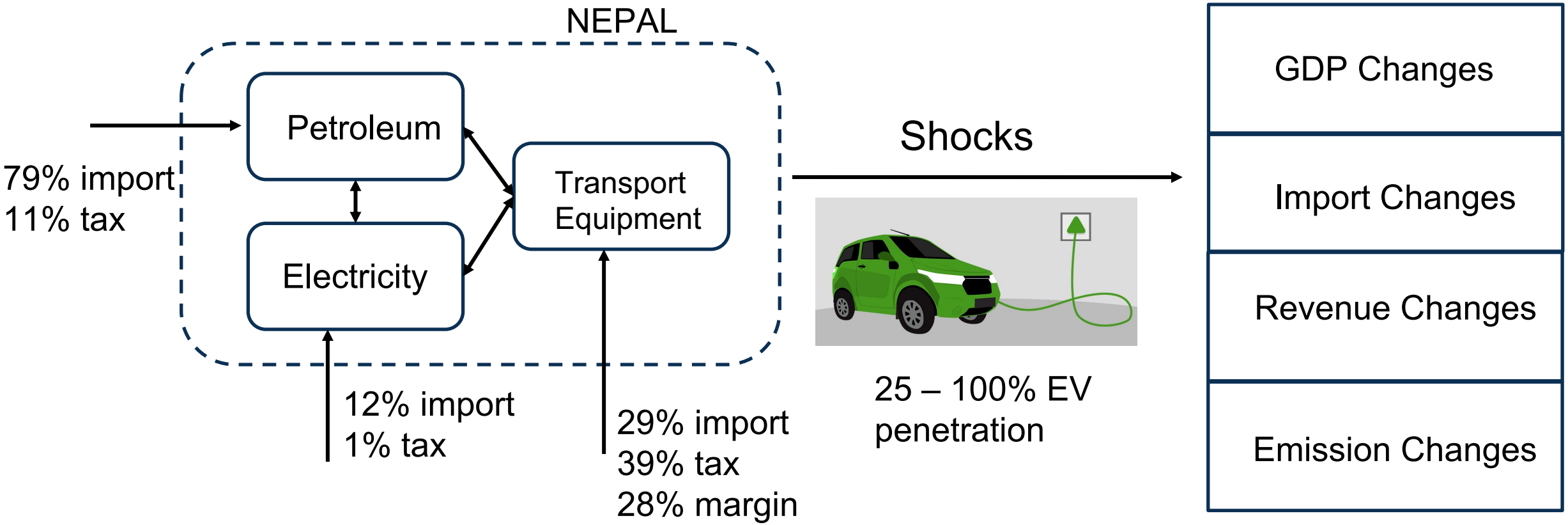
Emissions, Energy Usage

Nepal Reference Supply Use System

			Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal	Nepal
			Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Commodi	Commodi	Commodi	Commodi	Commodi	Commodi	Commodi	Commodi	Commodi	Consumption category
			Agricultu	Construct	Services	Manufact	Electricity	Others	Public Ad	Transport	Transport	Wholesal	Services	Manufact	Agricultu	Petroleur	Construct	Electricity	Transport	Public Ad	Transport	Final Demand
Nepal	Activity	Agriculture	-	-	-	-	-	-	-	-	-	-	57194.6	122817.0	##########	0.5	12.7	15.1	-	-	-	-
Nepal	Activity	Construction	-	-	-	-	-	-	-	-	-	-	63494.0	-	-	-	301734.8	-	-	-	-	-
Nepal	Activity	Services	-	-	-	-	-	-	-	-	-	-	599924.2	-	-	-	-	-	86.4	-	-	-
Nepal	Activity	Manufacturing	-	-	-	-	-	-	-	-	-	-	36158.3	376542.1	75.9	3043.3	4.9	20.5	-	-	1901.9	-
Nepal	Activity	Electricity,Gas and Water	-	-	-	-	-	-	-	-	-	-	3482.0	1752.8	-	4786.7	-	52963.1	-	-	-	-
Nepal	Activity	Others	-	-	-	-	-	-	-	-	-	-	298497.8	-	-	-	-	-	-	61593.0	-	-
Nepal	Activity	Public Administration	-	-	-	-	-	-	-	-	-	-	7859.0	-	-	-	-	-	-	60140.0	-	-
Nepal	Activity	Transport	-	-	-	-	-	-	-	-	-	-	199432.4	-	-	-	-	-	117768.3	-	-	-
Nepal	Activity	Transport Equipment	-	-	-	-	-	-	-	-	-	-	140.3	211.1	-	-	-	-	-	-	356.4	-
Nepal	Activity	Wholesale, Retail, Repair a	-	-	-	-	-	-	-	-	-	-	429813.4	-	-	-	-	-	-	-	-	-
Nepal	Commodi	Services	82470.6	7723.5	95440.9	21147.6	12033.7	84538.2	3915.8	16175.7	19.4	40530.1	-	-	-	-	-	-	-	-	-	864196.1
Nepal	Commodi	Manufacturing	142549.6	168200.2	20715.5	201327.9	10407.5	4941.8	1452.0	8111.0	397.1	70.3	-	-	-	-	-	-	-	-	-	680786.4
Nepal	Commodi	Agriculture	255700.5	-	57816.1	10544.8	2782.0	-	9314.0	582.0	-	-	-	-	-	-	-	-	-	-	-	1374195.1
Nepal	Commodi	Petroleum	1049.6	9266.4	6815.9	20667.3	2835.4	1561.3	704.0	105154.2	4.8	3040.9	-	-	-	-	-	-	-	-	-	60089.1
Nepal	Commodi	Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	320986.3
Nepal	Commodi	Electricity,Gas and Water	9662.5	1326.5	13999.3	5700.2	2186.6	3426.3	406.0	739.9	11.3	4918.5	-	-	-	-	-	-	-	-	-	18793.9
Nepal	Commodi	Transport	2627.7	-	22075.6	1086.1	736.1	9523.6	1046.2	10779.7	3.2	22640.8	-	-	-	-	-	-	-	-	-	125454.7
Nepal	Commodi	Public Adminsistration	-	-	-	-	-	1190.0	-	-	-	-	-	-	-	-	-	-	-	-	-	122852.2
Nepal	Commodi	Transport Equipment	-	-	-	-	-	-	-	-	76.0	-	-	-	-	-	-	-	-	-	-	147832.4
-	Factor of	GDP	988610.9	178712.1	383147.9	157272.8	32003.3	254909.6	51161.0	175658.3	195.9	358612.8	-	-	-	-	-	-	-	-	-	-
-	Factor of	Imports	-	-	-	-	-	-	-	-	-	-	56452.7	470643.7	98444.4	161044.5	-	7415.4	71000.2	2309.2	43325.7	-
-	Factor of	CIF	-	-	-	-	-	-	-	-	-	-	-1369.2	-13107.2	-5786.0	-58.0	-	-	-	-	-827.3	-
-	Factor of	Margins	-	-	-	-	-	-	-	-	-	-	-560202.2	200840.5	292833.5	20632.2	-	-	-	-	45896.0	-
-	Factor of	Taxes on Products	-	-	-	-	-	-	-	-	-	-	37713.6	80280.8	23334.8	21739.7	19234.0	756.8	7118.8	-	57255.8	-
-	Factor of	Subsidies	-	-	-	-	-	-	-	-	-	-	399.4	1021.4	599.2	-	-	-	-	-	-	-
-	Satellite	Energy Usage (TJ) - Hydroel	-	-	-	-	23864.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	Satellite	CO2 emissions (kton)	462.7	216.5	1424.1	1494.0	69.4	20.6	93.6	2247.2	168.2	174.4	-	-	-	-	-	-	-	-	-	884.3

Data from Asian Development Bank and EORA Global Supply Chain Database

Nepal Reference Supply Use System

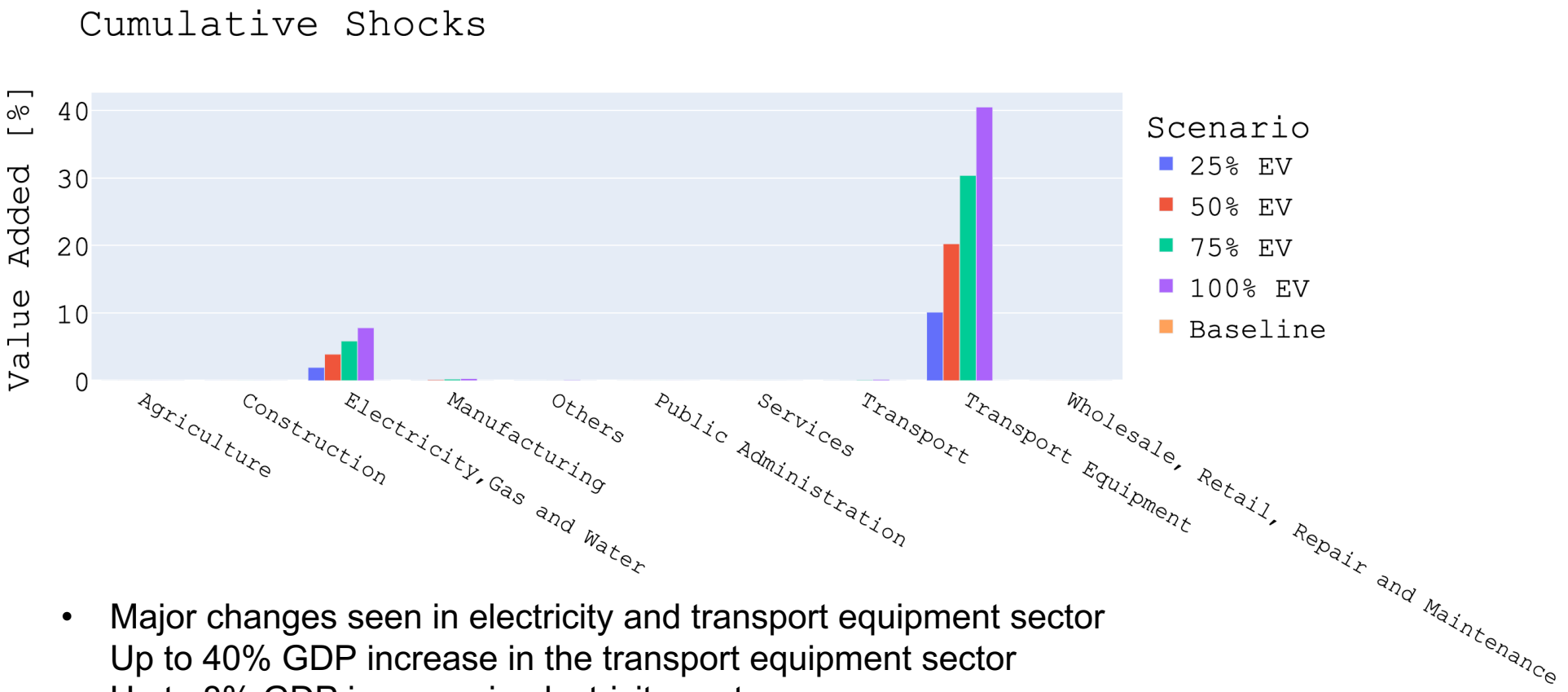


Scenarios

Using the Input-Output Life Cycle Assessment with MARIO Tool the following scenarios were investigated:

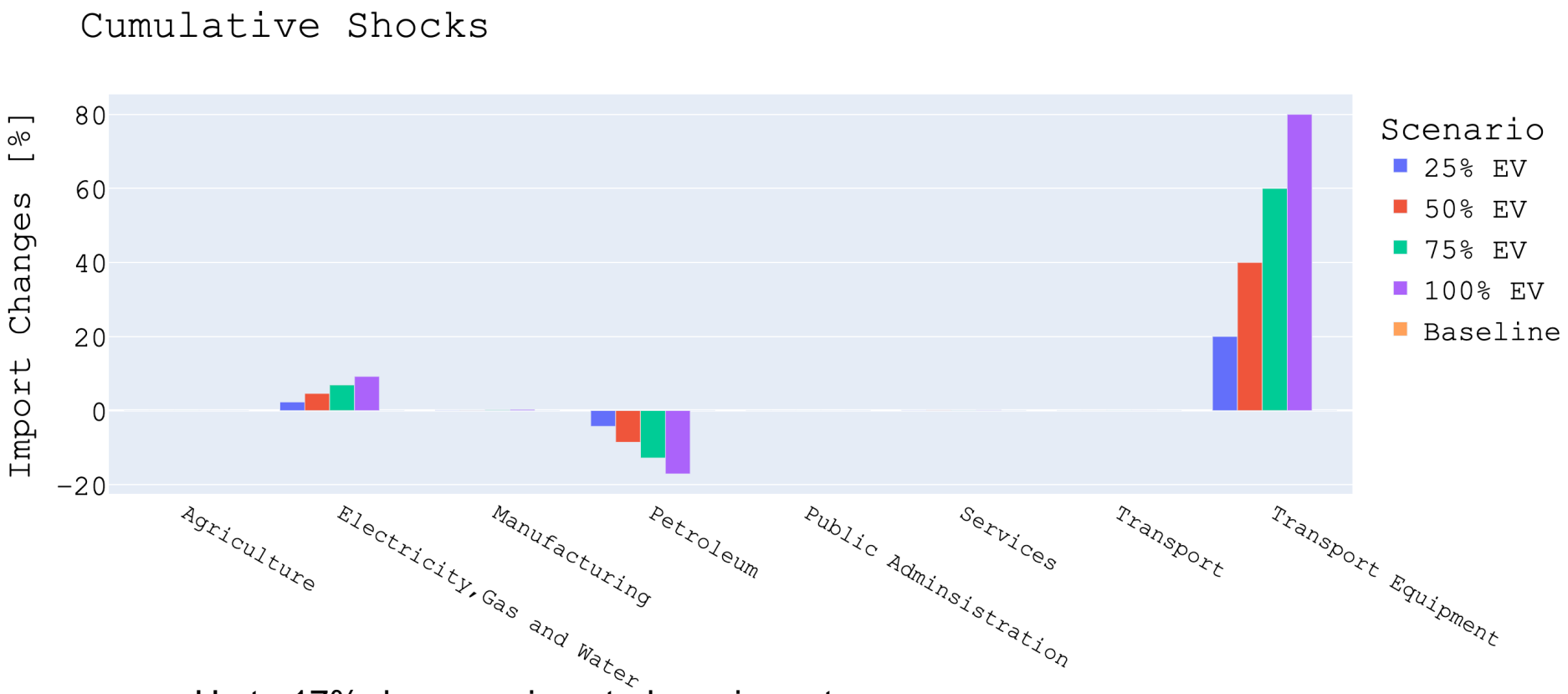
Scenario Label	Scenario Description	Key Assumptions
25% EV	25% penetration of EV in transport sector	- EV vehicles roughly twice as expensive as ICE vehicles - Increase in EV vehicles will have synergistic effects of petroleum import decrease and electricity consumption increase - Different taxation rates for EV and ICE will have revenue losses from import - Revenue losses from reduced fuel demand
50% EV	50% penetration of EV in transport sector	
75% EV	75% penetration of EV in transport sector	
100% EV	100% penetration of EV in transport sector	

Results



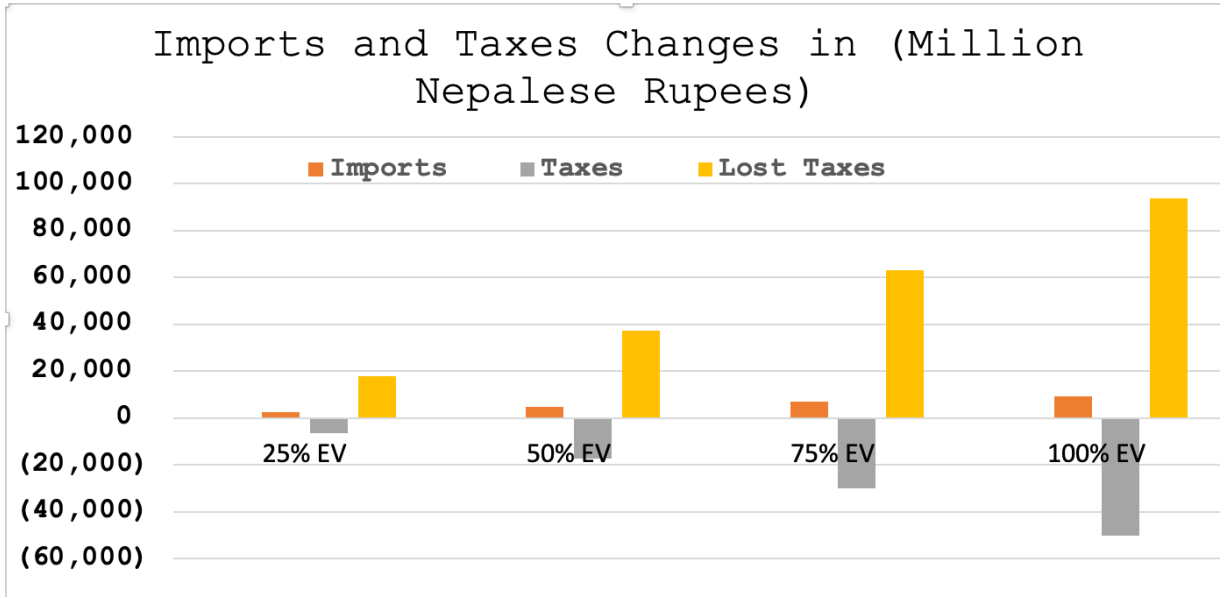
- Major changes seen in electricity and transport equipment sector
  Up to 40% GDP increase in the transport equipment sector
- Up to 8% GDP increase in electricity sector
- Value added = taxes, wages and operating surplus

Results

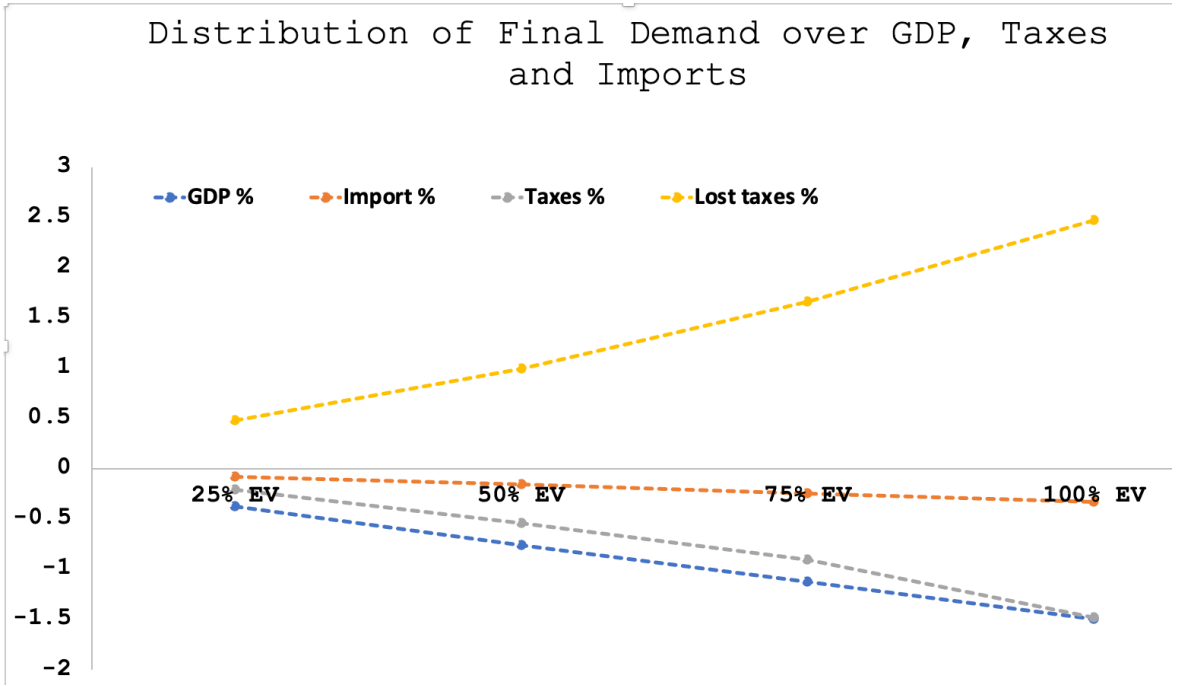


- Up to 17% decrease in petroleum import
- Up to 80% increase in Transport equipment
- Up to 9% increase in electricity import
- Up to 8% GDP increase in electricity sector

Results

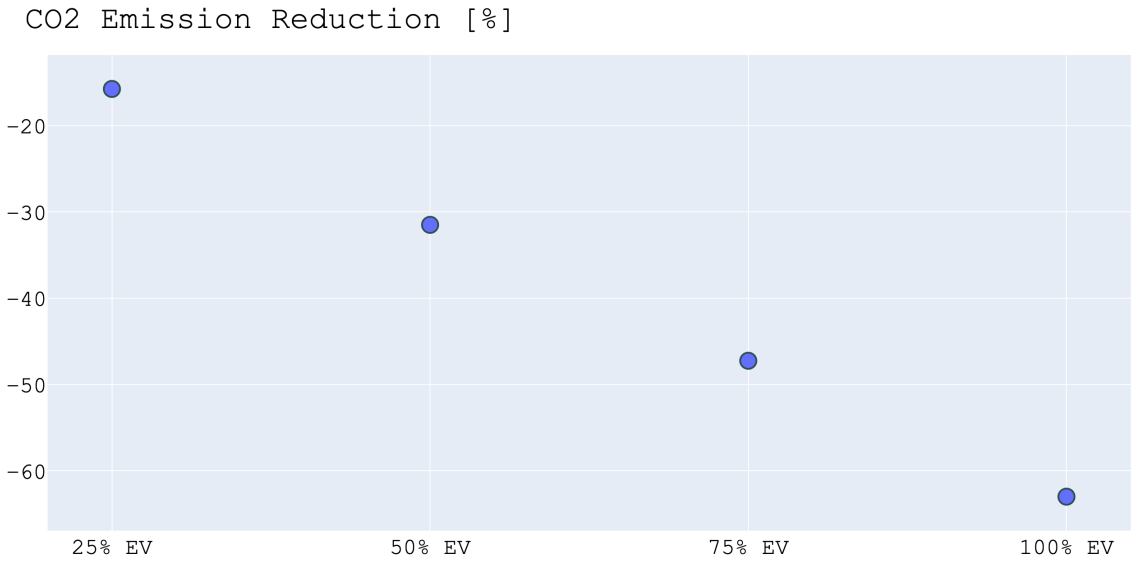


- Revenue losses from taxes are significant for electrification of vehicles

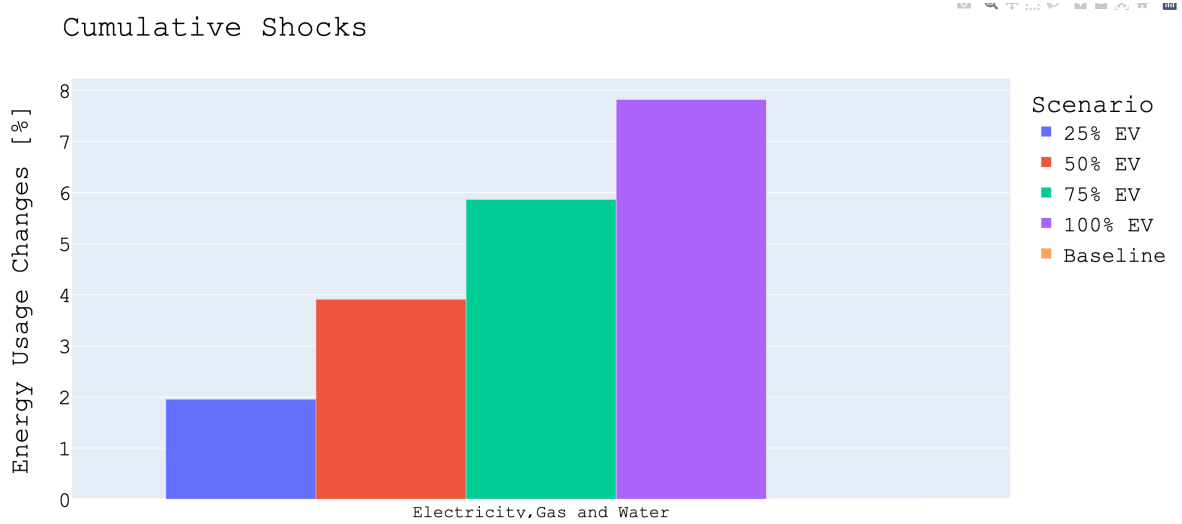


- Increased demand of electric vehicles contracted GDP by 1.5% due to lost taxes
- Up to 2.5% losses in revenue for 100% electrification

Results



- Up to 63% decrease in end use CO_2 emission



- Up to 8% increase in hydro energy usage

Conclusions and Policy Insights

Conclusions

- Electrification of transport sector increases electricity demand by up to 8%
- End use CO_2 emissions decreases by up to 63%
- Increased demand of EV contracted GDP by up to 1.5%
- Transport electrification could lead to up to 2.5% in lost taxes

Policy Insights

- Gradual electrification suggested
- Need to find other revenue sectors before moving for full electrification
- Need better transmission and distribution lines for increased energy consumption

Future Work

- Gather more data
- Analyze other more dominant sector in GDP such as agriculture or industry
- Include in teaching and research activities