



Decarbonization Policy Pathways for India

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Outline

- Research question
- Methodology
- Results
- Policy implications
- Model limitations
- Future work

Research question

- Can India achieve 'deep decarbonization' by 2050?
 - We define 'deep decarbonization' as > 50 percent below 2050 business as usual (BAU) emissions level.
- What is the climate policy gap for India to achieve deep decarbonization by 2050?
- Which policies would be necessary for India to sustain or increase economic growth and job creation in a deep decarbonization pathway, compared to business-as-usual (BAU)?

Methodology

- **Policy inventory**
 - More than 100 direct and indirect climate policies compiled.
 - Policies identified by sectors targeted, policy type, and timeline of implementation.
- **Expert elicitation survey**
 - Policies ranked by experts for their past and future emissions impact.
 - Policies ranked for their importance to jobs and GDP.
- **Systems dynamics modeling**
 - <https://india.energypolicy.solutions/>
 - Allows us to estimate emissions, jobs, and economic growth impact of implementing multiple climate policies simultaneously.

Expert elicitation

- Peaking timeline – 2030 with aggressive policies. 2035 to 2040 with existing policies.
- With existing policies, India will achieve its INDCs except for its forest sector commitments.
- Difficult or impossible to achieve net-zero emissions by mid century even with an aggressive policy scenario.
- Missing data points
 - Policies to stimulate green finance.
 - Mitigation impact lost in policy implementation.
 - Policies to enhance the synergies between mitigation and adaptation.

Expert elicitation

Policies to achieve INDCs

National Solar Mission (NSM) and the renewable energy auctions policy

PAT – energy efficiency trading policy pilot

Renewable energy portfolio obligations (RPOs)

Accelerated depreciation (AD) policy

National Mission for Energy Efficiency

Coal tax

Policies for deep decarbonization

Comprehensive EV policy

Offshore wind policy and renewables for agriculture

Electrification of freight and railway

India cooling action plan

Comprehensive energy storage policy

Electricity capacity addition policy

Energy efficiency for MSMEs

Full scale energy efficiency trading policy (PAT)

Additional policies to stimulate job growth

EV charging infrastructure and component manufacturing

Rooftop and rural solar adoption

Energy conservation for buildings and affordable housing

National Green India Mission

Policy pathways

- **BAU scenario**
 - BAU scenario in the India EPS model – this includes existing climate policies to achieve India’s INDC targets.
- **Expert elicitation scenario**
 - BAU plus policies recommended by experts for deep decarbonization and job growth.
- **Raising ambition scenario**
 - Climate Policy Lab generated policy scenario to maximize job creation through further deep decarbonization policies.

Policy settings

Policies (Timeline)	BAU	Expert elicitation	Raising ambition
RE target (by 2050)	70%	90%	90%
Energy storage (From 2020 to 2050)	220 GW	450 GW	450 GW
Early coal retirement (From 2030 onwards)	-	7000 MW/year	7000 MW/year
EV sales mandate (From 2020 to 2050)	Up to 15% (Freight) 35% (Passenger)	Up to 20% (Freight); 80% (Passenger)	Up to 20% (Freight); Up to 80% (Passenger)
Hydrogen mandate (From 2030 to 2050)	--	40% (Freight HDVs)	40% (Freight HDVs)
Mode shifting (From 2020 to 2050)	--	30% passenger LDV and freight HDV segments;	30% for passenger LDV and freight HDV segments
Fuel economy standard (From 2020 to 2050)	--	60% (Passenger); 20% (Freight)	60% (Passenger); 20% (Freight)
Electrification + hydrogen for energy-related emissions (2030 to 2050)	0%	0%	50-70% emissions substitution across cement, steel, chemicals
Hydrogen electrolysis (2030 to 2050)	0%	0%	100%
CCS for process emissions (2035 to 2050)	0%	0%	20% of process emissions
Industrial efficiency standards (From 2020 to 2050)	--	Up to 30% increase across different industries	Up to 30% increase along with up to 30% reduction in demand through material efficiency efforts
Land Use Policies (2020 to 2050)	0	100% forestry and land use mitigation commitments achieved	100% forestry and land use mitigation commitments achieved
Carbon Tax	0	0	0 to 6000 INR from 2020 to 2050 for the industry sector

Note: Only key decarbonizing policy targets mentioned in the table

Emissions reductions

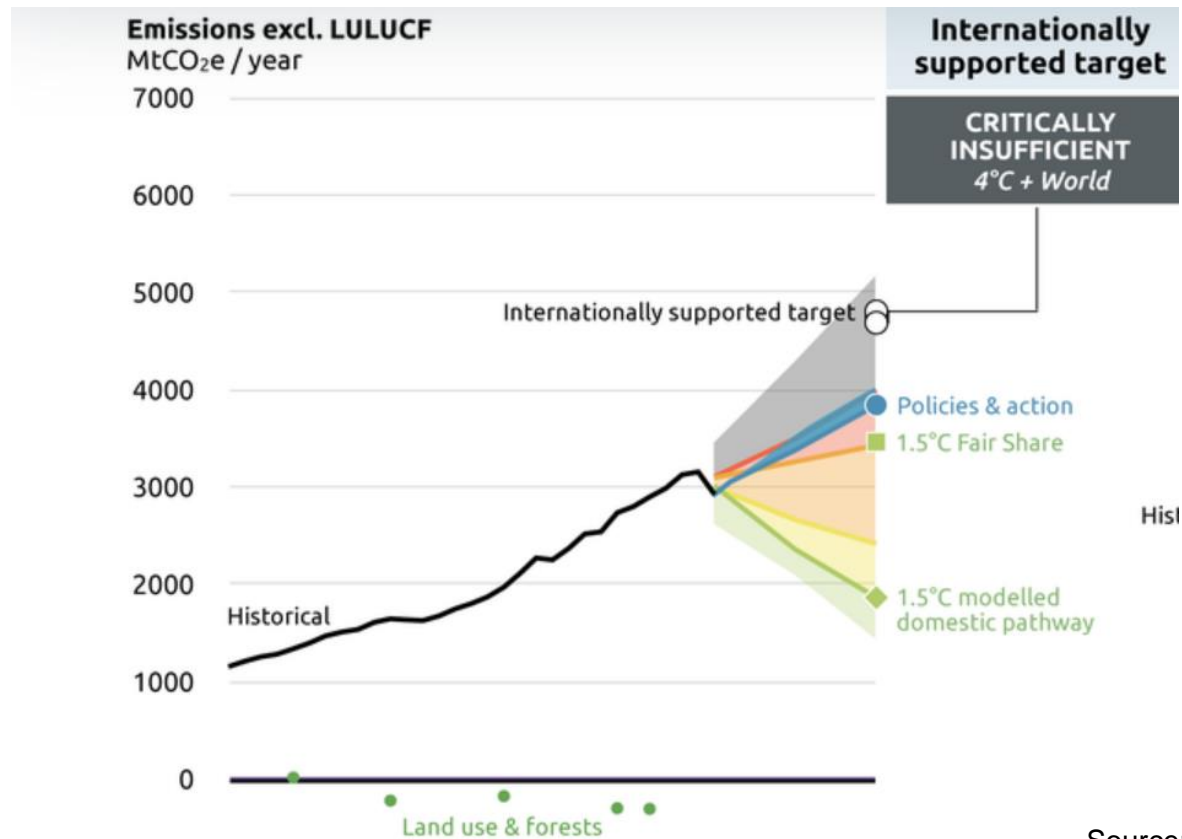
Raising ambition scenario

70% below BAU by 2050; Emissions peak at 3.5 Giga tons CO₂e in 2031



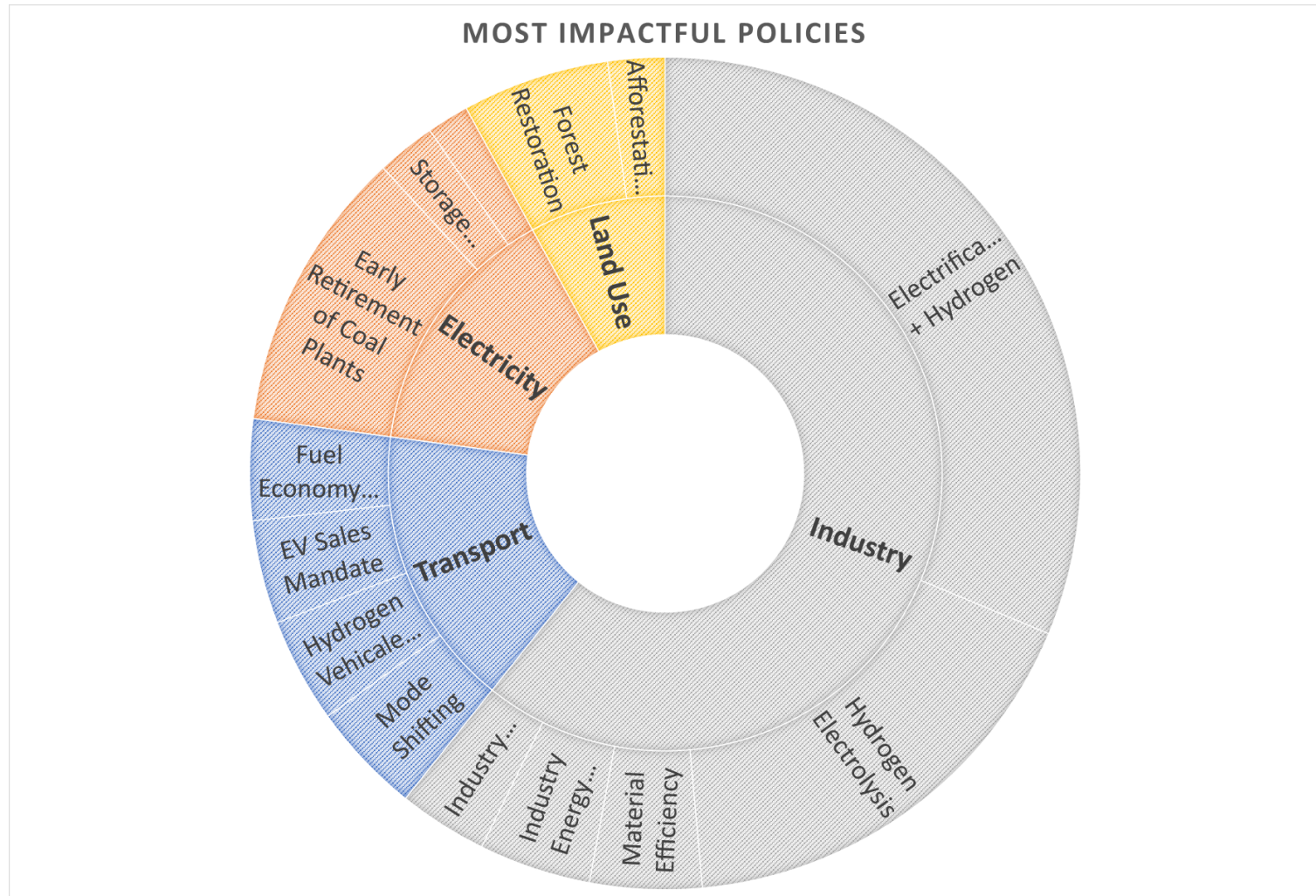
India's emissions trajectory

The raising ambition scenario falls within India's 1.5 C emissions band



Source: Climate action tracker

Key policies for deep decarbonization

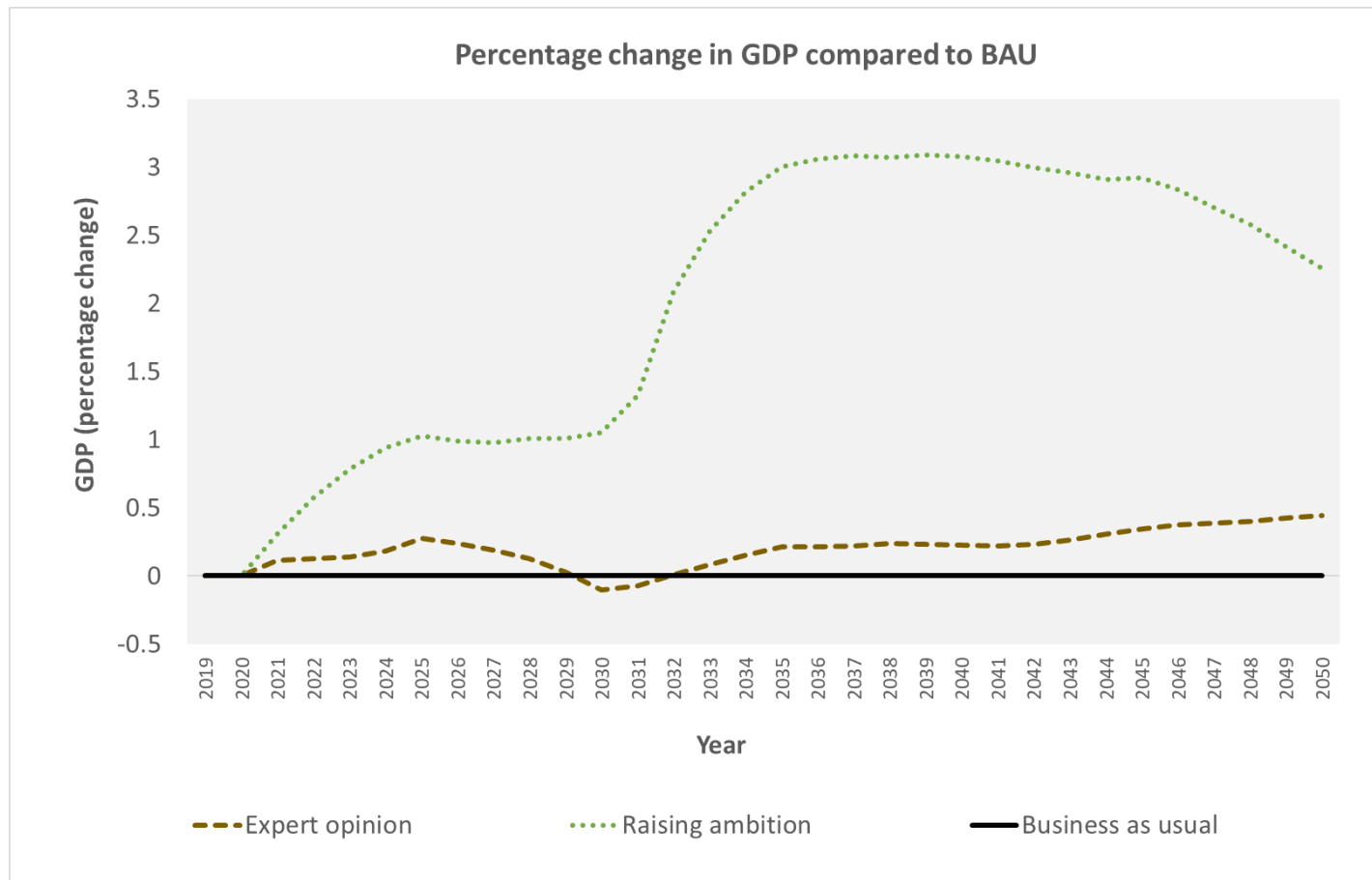


Economic impact of decarbonization

(GDP)

GDP

Raising ambition could create a modest 2.5 to 3% more GDP than BAU levels from 2035

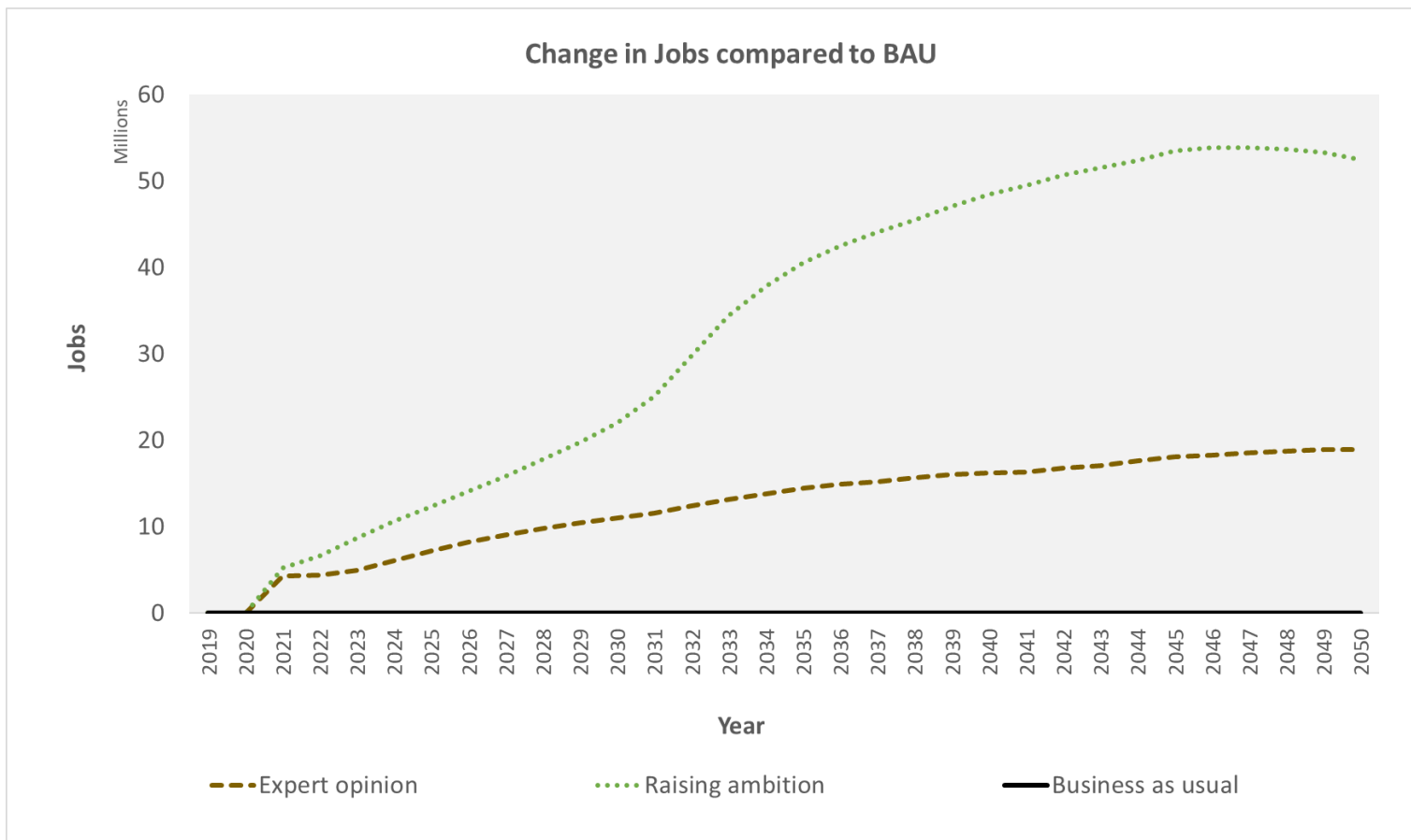


Economic impact of decarbonization

(Jobs)

Jobs

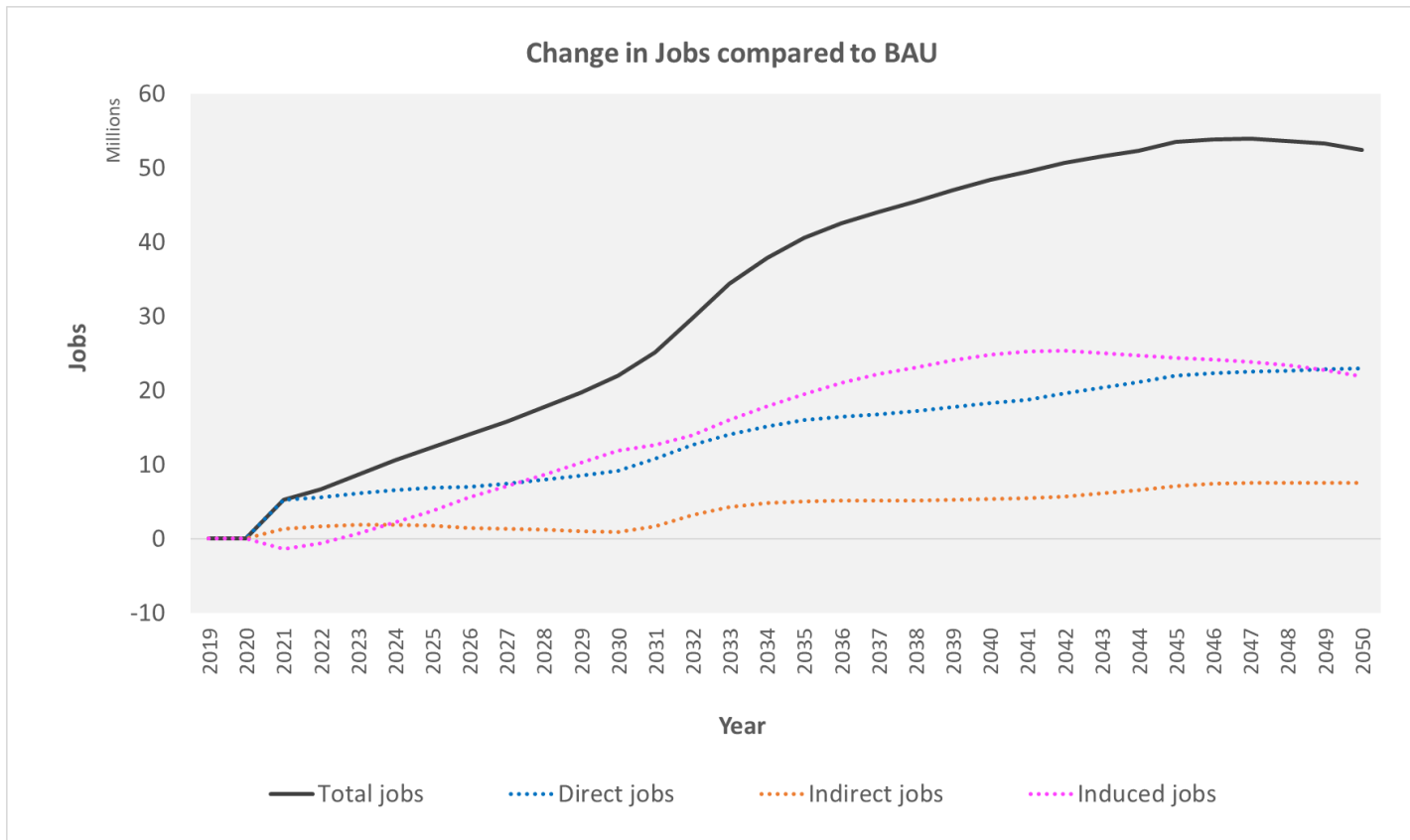
Raising ambition could create 53 million more jobs than BAU by 2050



Type of jobs

Revenue distribution from carbon taxes to

- 1) General spending → induced jobs
- 2) Deficit spending → lost fuel tax revenues
- 3) Corporate tax reductions → direct jobs
- 4) household tax reductions → carbon dividend payments



53 million

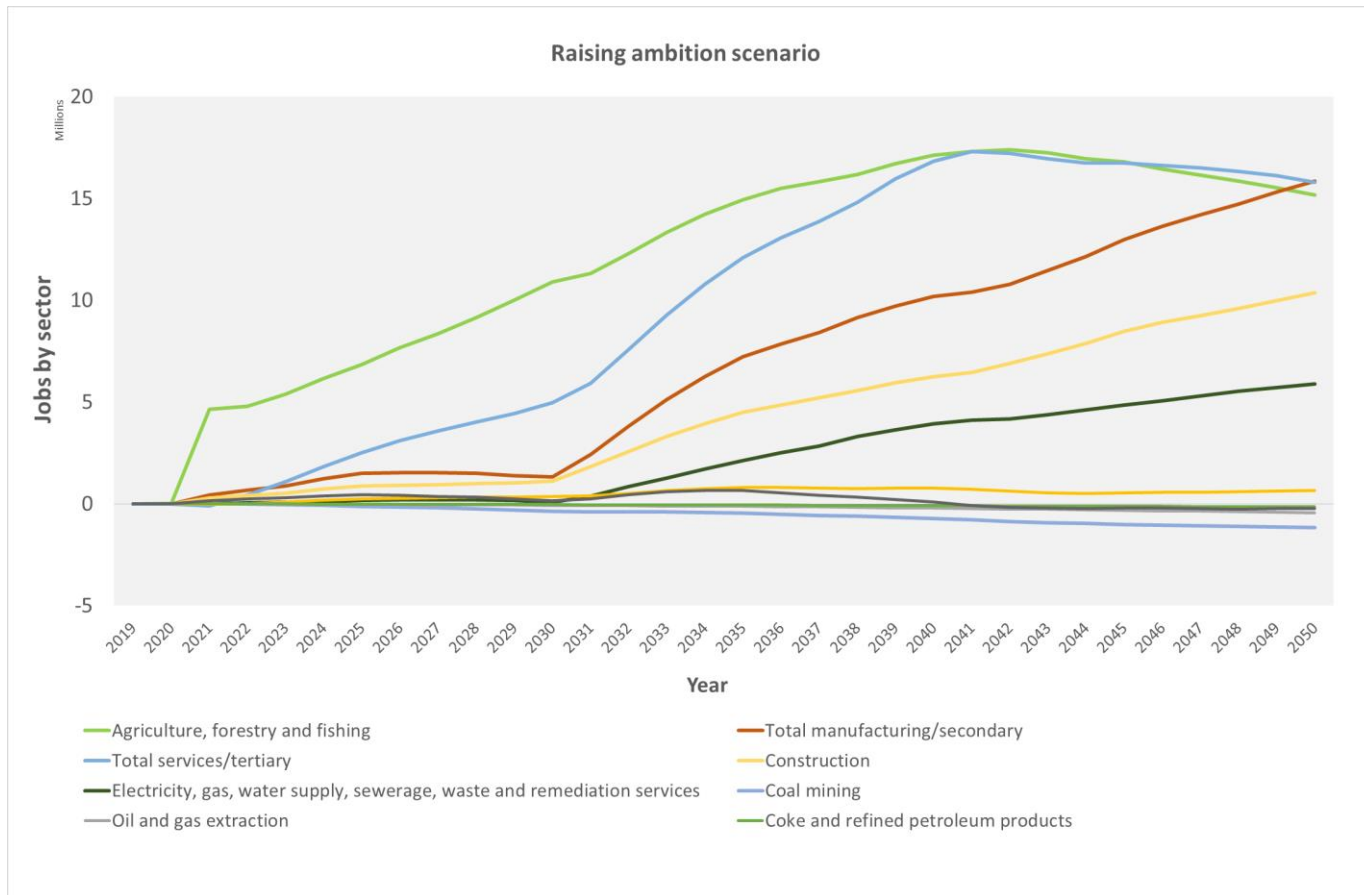
23 million
direct jobs

22 million
induced jobs

7.5 million
indirect jobs

Job categories

Redistributing carbon taxes across general and deficit spending, corporate & household tax reductions creates more agricultural and service sector jobs overall followed by manufacturing.



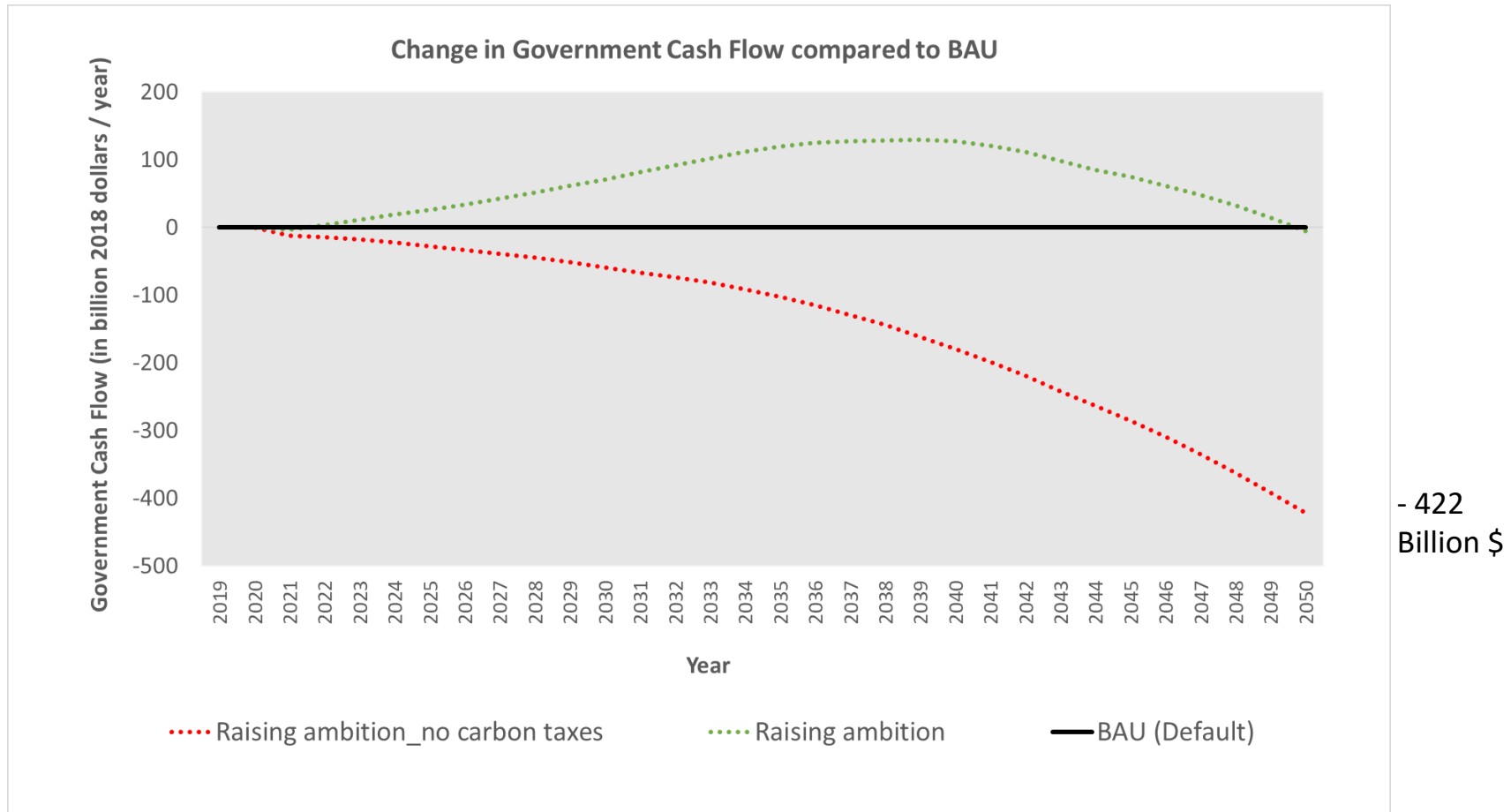
→ 1.17 million coal jobs lost

Financial impact of decarbonization

(Government Cash Flows)

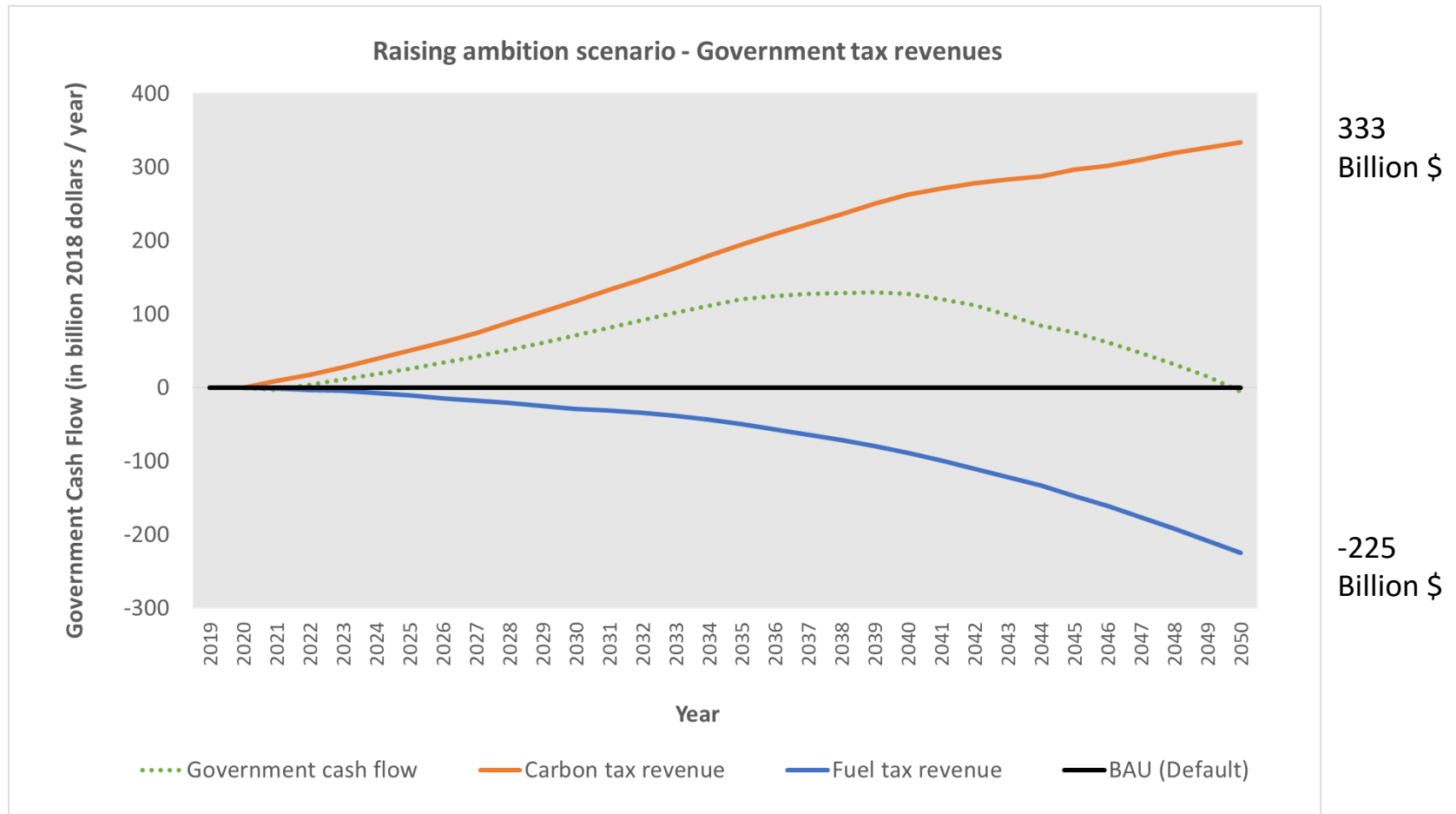
Change in government cash flows

Carbon taxes compensate for fuel tax revenue losses and national debt interest



Change in government cash flows

Need a post 2050 analysis to better understand carbon tax revenue implications



Findings

- No viable path to deep decarbonization without compensating for the loss in fuel tax revenues.
- India needs ambitious R&D investments into transport and industrial decarbonization technologies today.
- Short-term policies include target setting combined with R&D investments for emerging technologies and policy incentives to deploy mature technologies at scale.
- Most jobs created are induced jobs in agriculture and services. This is mitigated to some extent carbon taxes are distributed to reduce payroll and corporate tax rates. The equity implications of tax redistribution needs to be better understood.

Policy implications

Next decade (Infrastructure readiness and emissions peaking)

- Electricity sector
 - Deploy renewables and storage
 - Increase transmission capacity and reduce T&D losses
 - Improve demand response
- Transport sector
 - Mode shifting
 - EV charging infrastructure
 - Improve fuel economy standards
- Industry sector
 - Improve energy efficiency and material efficiency
- Land use
 - Forest restoration and afforestation policies

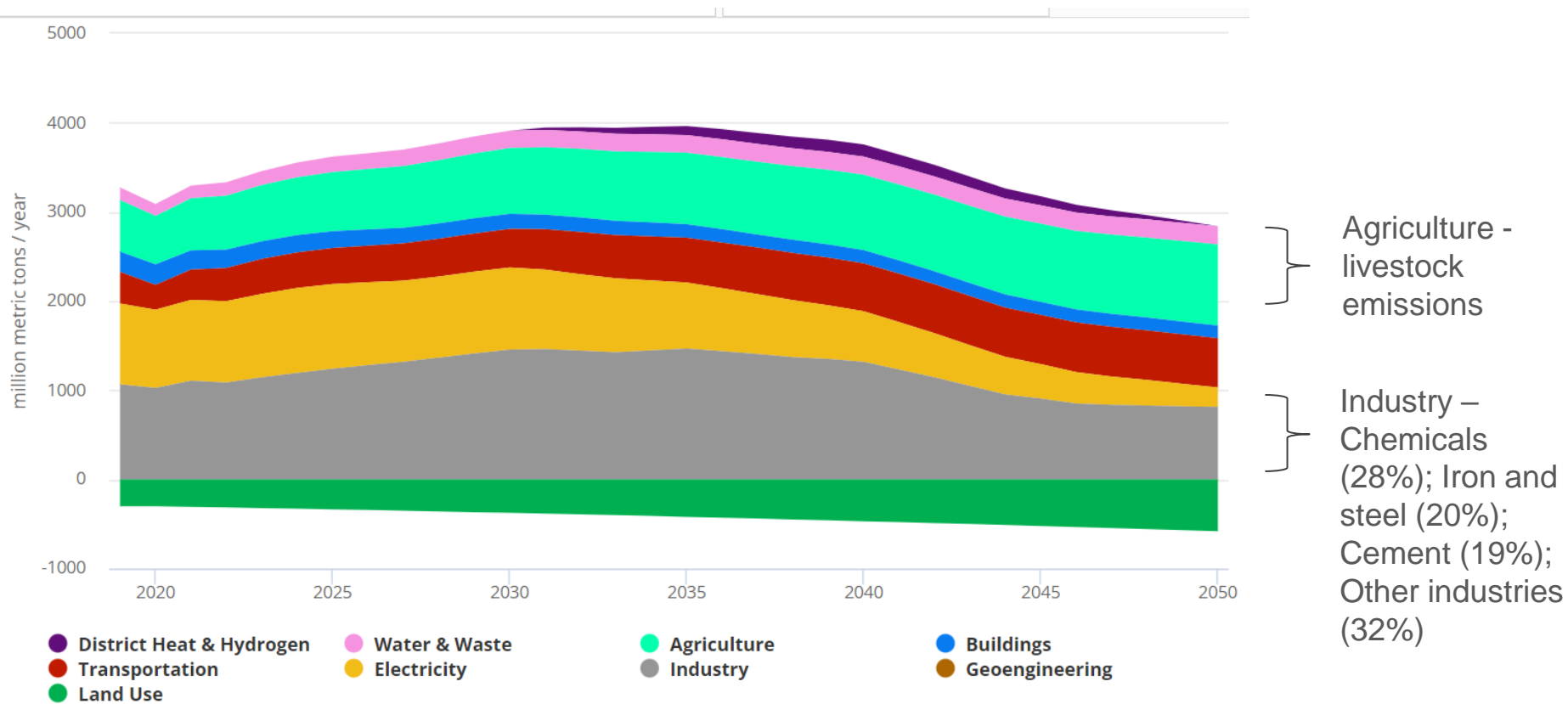
Policy implications

2030 to 2050 (Putting India on a deep decarbonization pathway)

- Electricity sector
 - Yearly coal phase down
 - Expansion of offshore wind and electricity storage
- Transport sector
 - EV transition for light duty vehicles
 - Hydrogen transition for the freight segment
- Industry sector
 - Electrification and hydrogen (with electrolysis) for energy-related emissions
 - Industry CCS for process emissions
- Land use
 - Forest restoration and afforestation policies

What remains to be decarbonized?

Is it possible to transition to Net Zero by 2070?



Model limitations

- Uncertainty when pushing policy levers closer to maximum potential
- Research and development policy costs are not factored into cash flows and hence the economic/jobs impact.
- Inability to capture the impact of tax policies and others on industrial competitiveness.
- Limitations to modeling nuanced policy recommendations such as solar feeders for agriculture and promotion of rural solar applications, that are jobs enhancing.

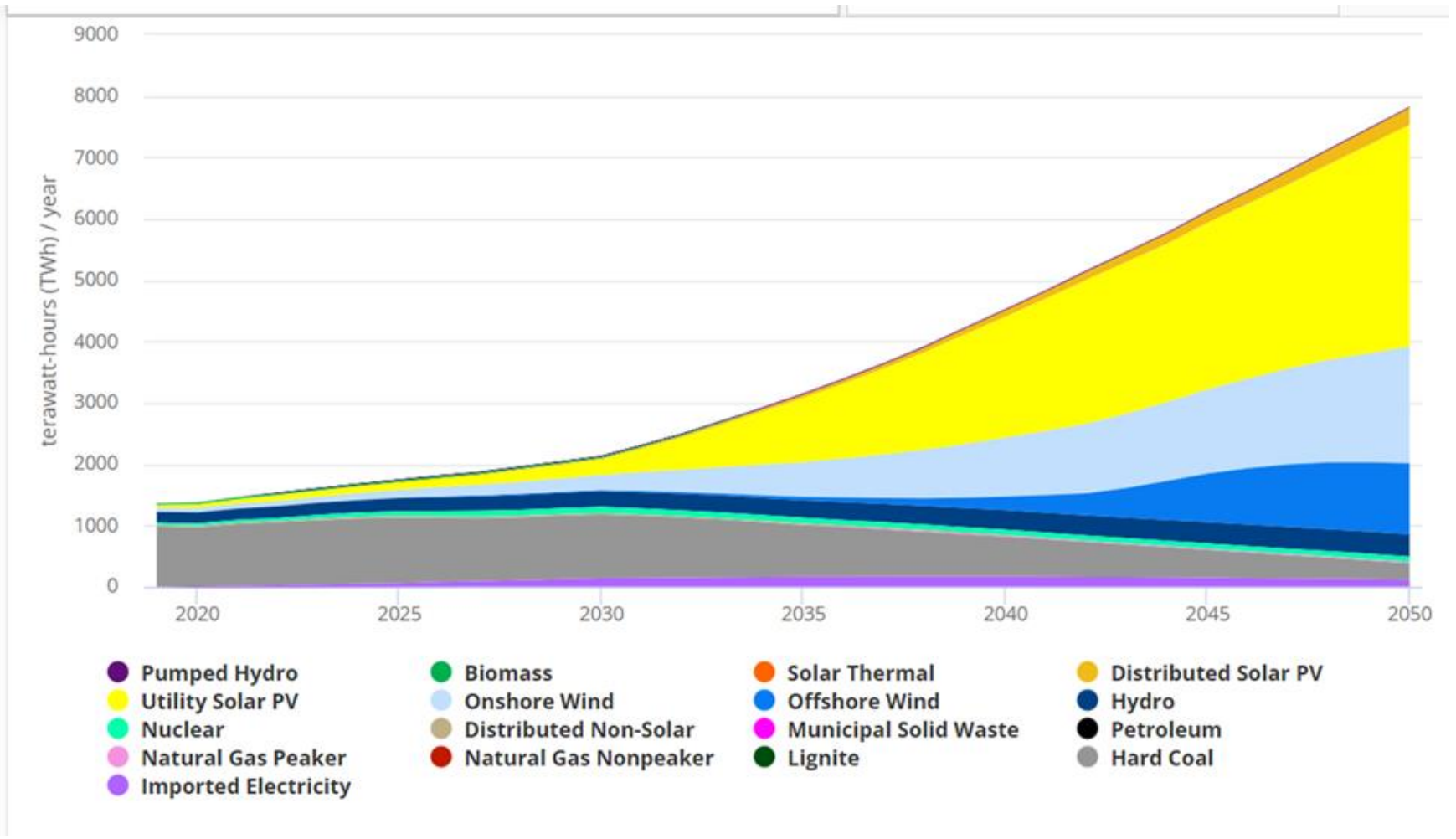
Future work

- Implementing a tax shift policy from fuel to carbon in the model.
- Model a potential low interest climate finance option to assess its impact on deficit spending and government cash flows.
- Assess the industrial competitiveness, equity, and financial impact of a tax shift from fuel to carbon.

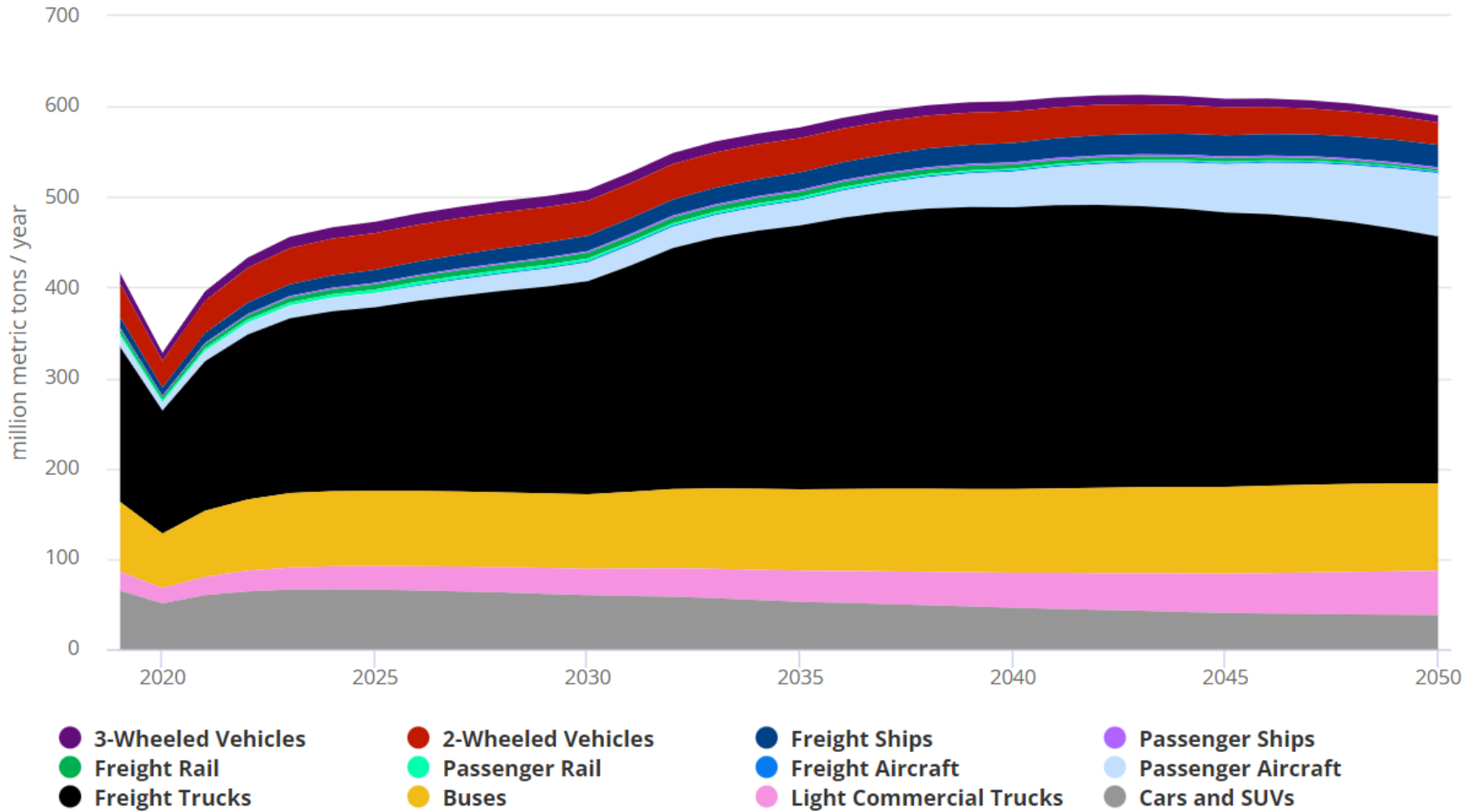


Thank You!

Electricity generation



Transport emissions by vehicle type



Industry emissions by industry type

