CLIMATE CHANGE MITIGATION FROM BRICK INDUSTRY IN INDIA

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System Dynamics Society

INTRODUCTION

- Paris Agreement to curb climate change
- India's commitment – 30-35% reduction in GDP intensity by 2030 compared to 2005 levels
- Opportunities for India:
  - Energy, renewables
  - Forestation
  - Industrial Energy Efficiency Improvements
- Industrial efforts require specific attention for emission reductions

BRICK INDUSTRY

- Emissions from burning of coal for cooking brick cake at 1100 degree centigrade temperature
- Second highest coal use in the country at 24 MT [1]
- Emissions of greenhouse gases (CO_2, CH_4) and local air pollutants (SO_2, NO_X, NMVOC, CO, and $PM_{2.5}$)
- Total emissions of 1.1 MT CO2 in 2010 [2]
- Cement Blocks – environmentally friendly alternative

OBJECTIVES

- To assess emission profile of brick manufacturing in India at present
- To study future emission profile from brick manufacturing based on technological improvements for 2050

METHODOLOGY

- Integration of top-down and bottom-up approach to overcome limitations of both the approaches individually such as
  - Complex data requirements
  - Integration of levels of information from economic equilibrium to technological details
- System Dynamics as a tool to develop a single model with hybrid approach

SUBLOOPS

- Brick Demand: Population, GDP and construction demand
- Brick Supply: Production growth rate, demand and exports
- Air Pollution: Local Pollution Control Board Standards, End of Pipe (EoP) measure
- Climate Change: Policy implementation, mitigation strategies adoption

CAUSAL LOOP DIAGRAM

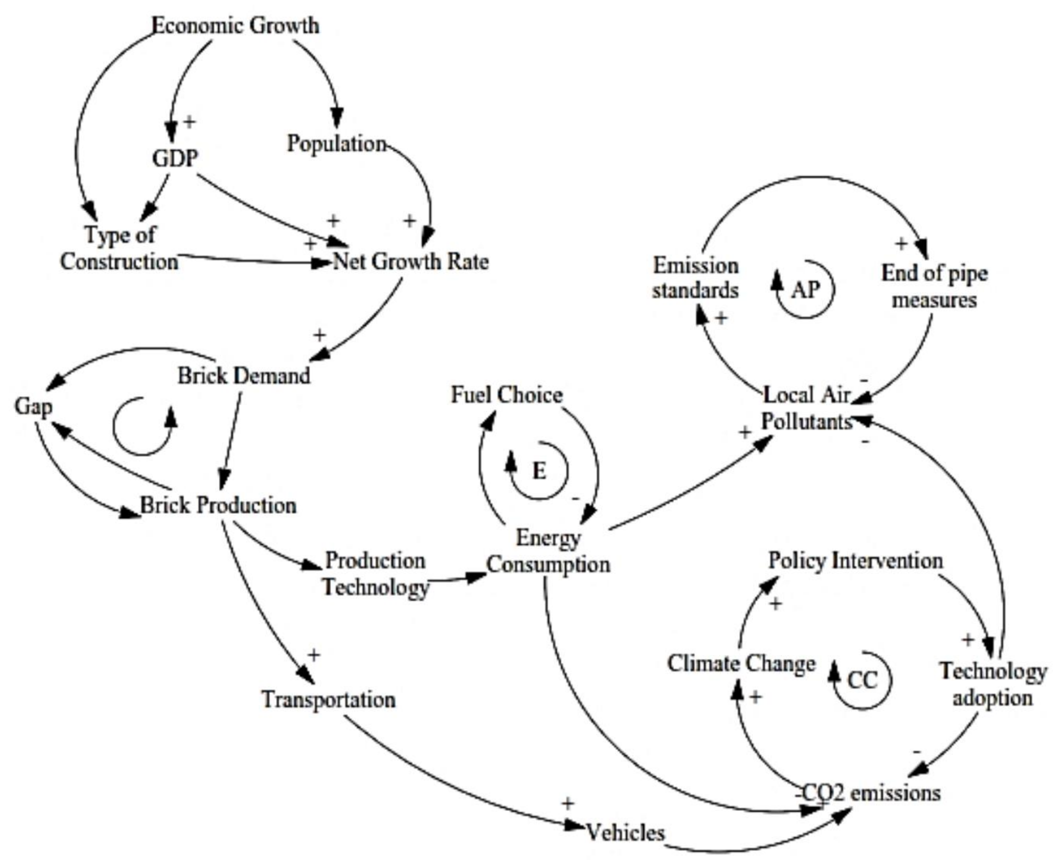

Figure 1: Causal Loop Diagram for Brick Industry with Brick Demand, Brick Supply, Air pollution loop and Climate Change loop subsections

ASSUMPTIONS

- Production rate: 6.6% (from 2015 to 2030), a sharp decrease after 2030 dependent on the exports
- Fuel used throughout the scenario: Coal along with biofuels
- Pollutants: CO_2, $PM_{2.5}$, CO, SO_2, N_2O, NO_X, NMVOC
- Energy requirements and emission factors from [3]

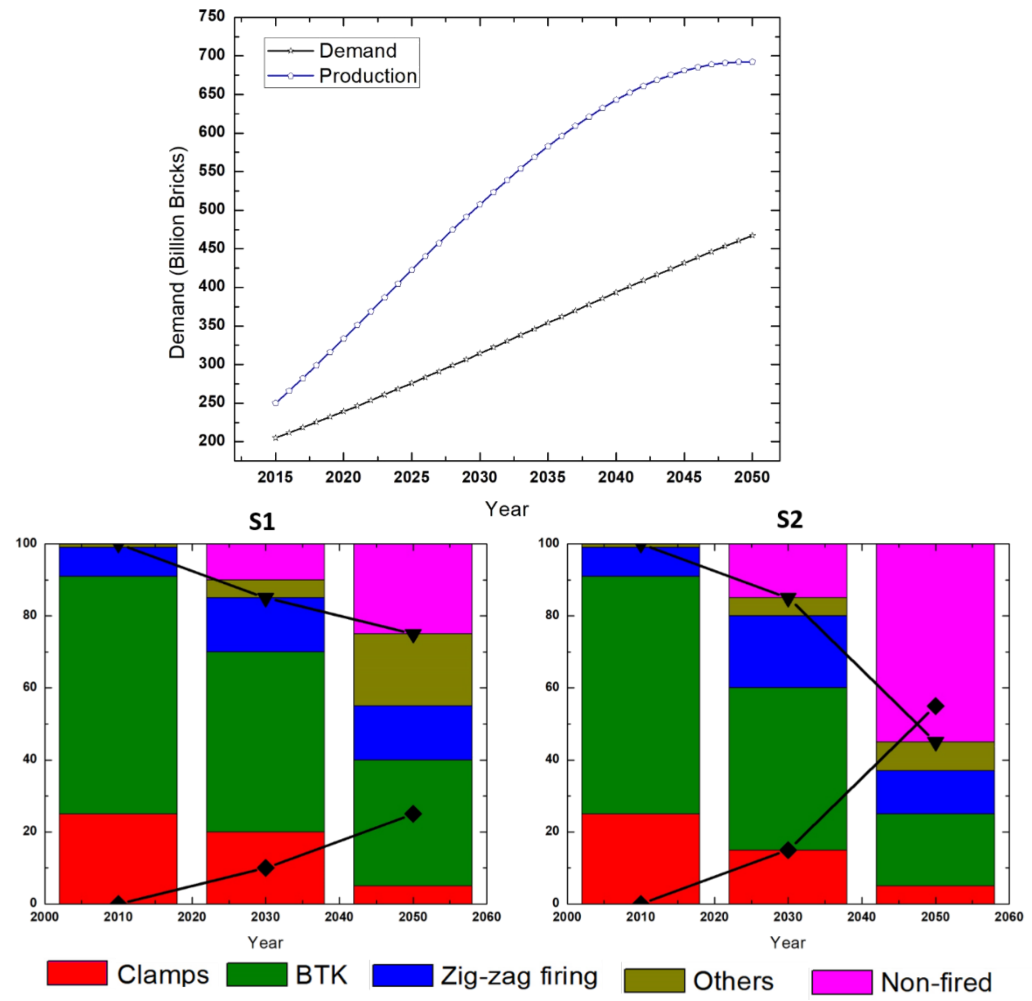

Figure 2: (a) Demand and Production interaction of brick industry (b) & (c) Technology fraction assumptions for S1 and S2 respectively

EMISSION PROFILE FROM 2015 TILL 2050

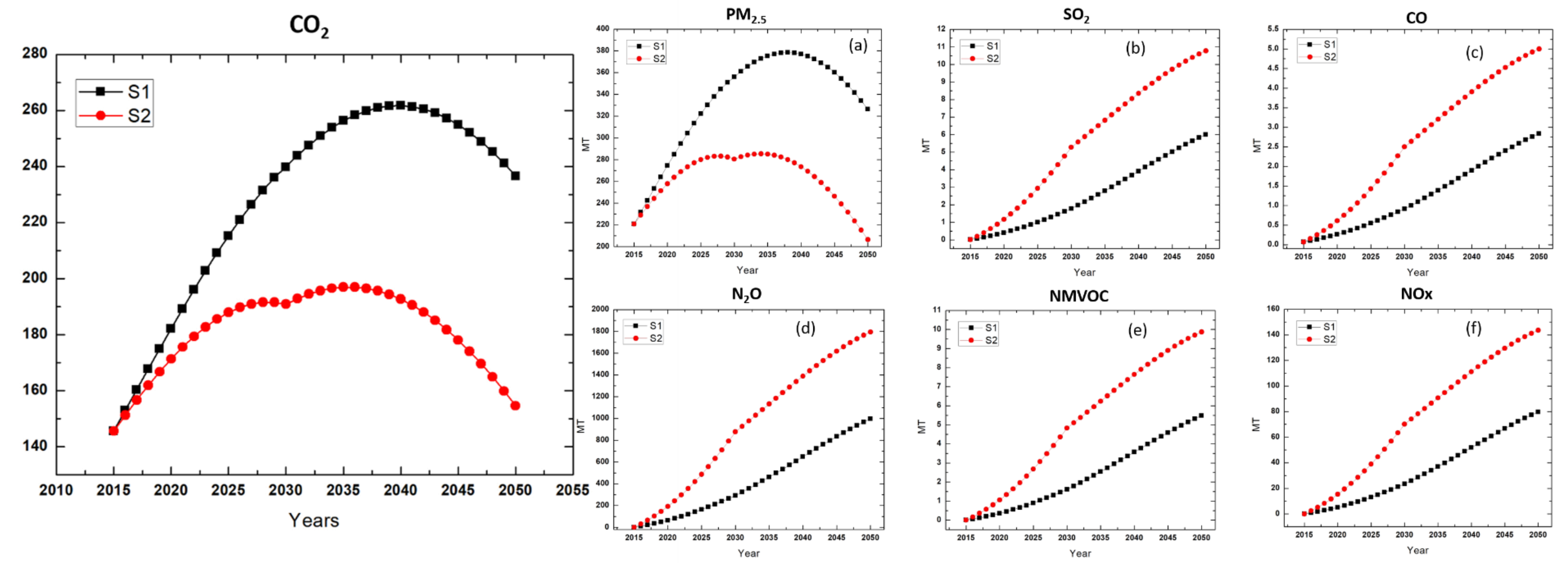

Figure 3: (a) Emission estimate of CO_2 from 2015 till 2050 for S1 and S2 (b) Emission estimates for $PM_{2.5}$, SO_2, CO, N_2O, NMVOC and NOX for S1 and S2 from 2015 to 2050

- CO_2 and $PM_{2.5}$ emissions show similar trend of emissions with reductions achievements throughout the study period
- Increase in emissions of SO_2, CO, N_2O, NMVOC and NO_X is observed under S2

CONCLUSION

- Non-fired bricks lead to emission reduction of CO_2 and $PM_{2.5}$ with an increase in emissions of SO_2, CO, N_2O, NMVOC and NO_X
- Future reductions of greenhouse gases can be achieved by increasing use of advanced brick production technologies
- Prioritization of emissions is required for to determine future of brick manufacturing
- Potential GHG mitigation options can be tapped easily with one sector
- Technology shifts should be considered as a part of mitigation strategy development

FUTURE RESEARCH

- Further research is required to determine the balance of GHG and air pollution mitigation from the brick manufacturing industry
- A further cost analysis and sophistication in the model may lead to precise prediction of the future course of mitigation

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