Kaya Identity – A System Dynamics Interpretation

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Overview

- Kaya Identity
- Calculation Musings
- Systems Thinking
- System Dynamics - First Perspectives
- System Dynamics - Full Expansion
- Summary

Kaya Identity

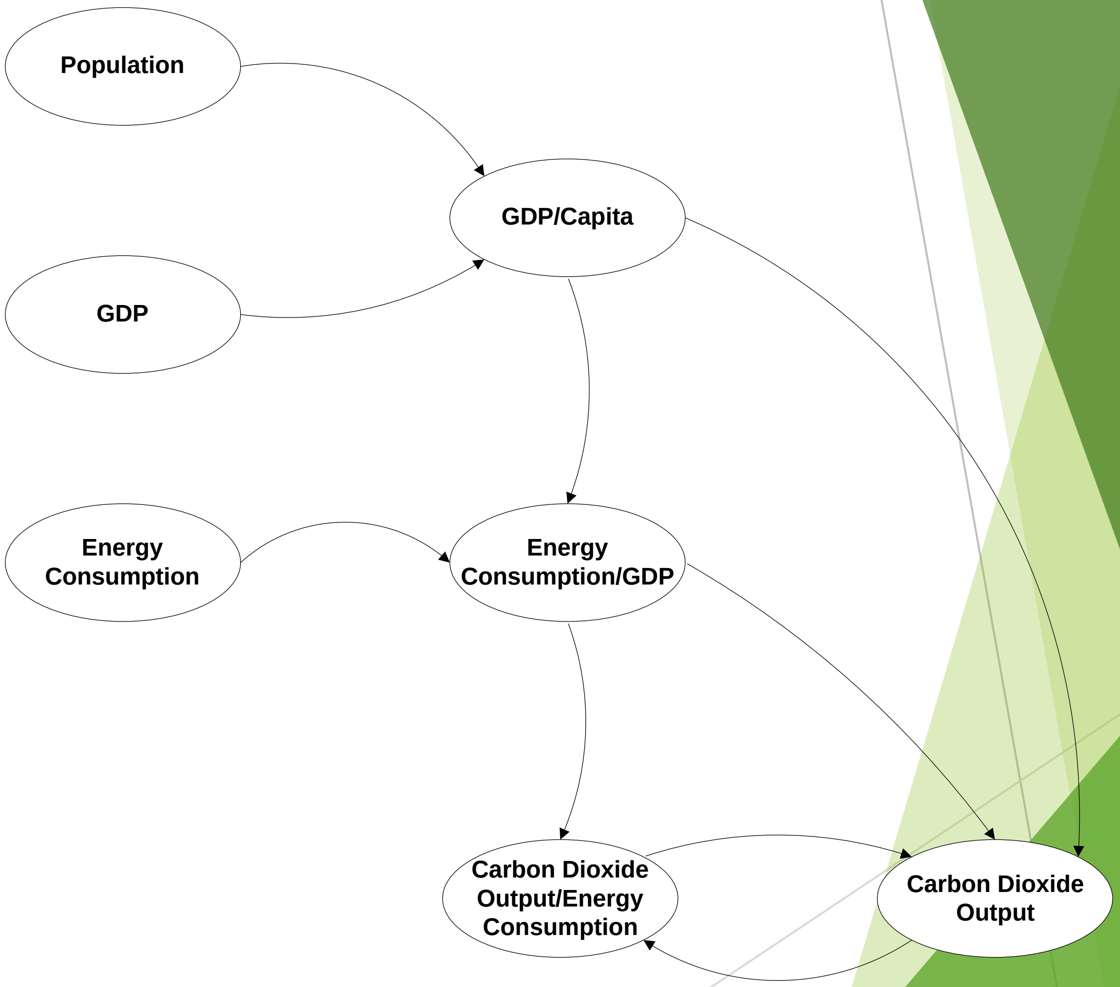
- Defined as a Method to Calculate a Country's Carbon Dioxide Emissions
- Carbon Dioxide Emissions (F) is a Function of:
  - Population (P)
  - Gross Domestic Product per Capita (G/P)
  - Energy Consumption per Gross Domestic Product (E/G)
  - Carbon Dioxide Emissions per Energy Consumption (F/E)

Calculation Musings

- Kaya Identity Formula:
  - $F = P \times (G \div P) \times (E \div G) \times (F \div E)$
- Circular Connection!
- Alternatively - Sequential Calculation
  - $F_{i+1} = P_i \times (G \div P)_i \times (E \div G)_i \times (F \div E)_i$

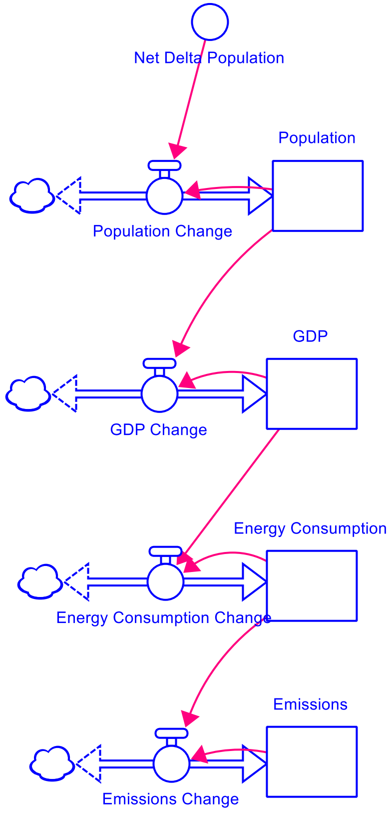
Systems Thinking

- Strange, But Explains Need for Drivers and Connections



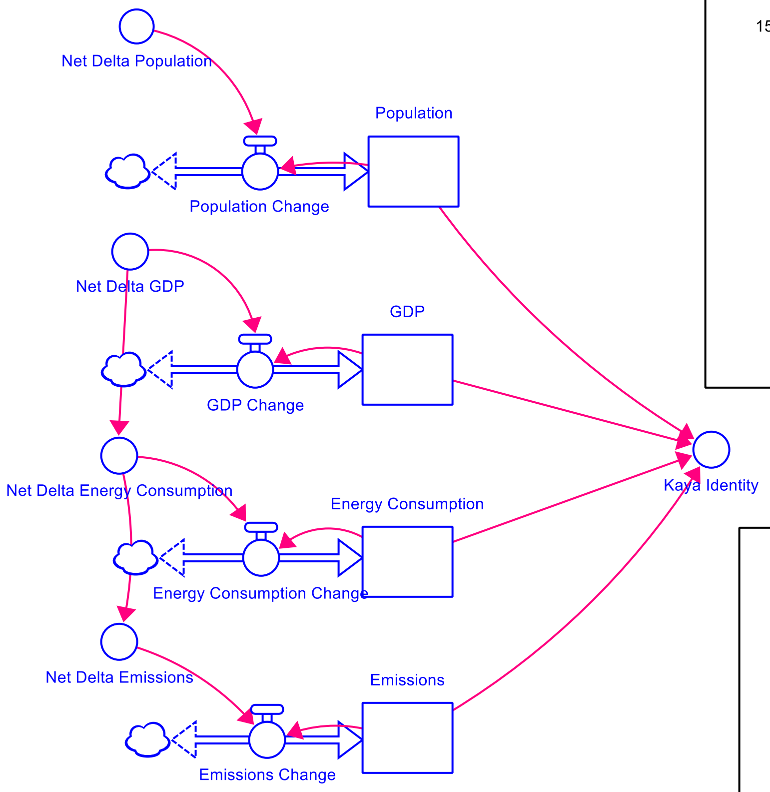
System Dynamics - First Perspectives

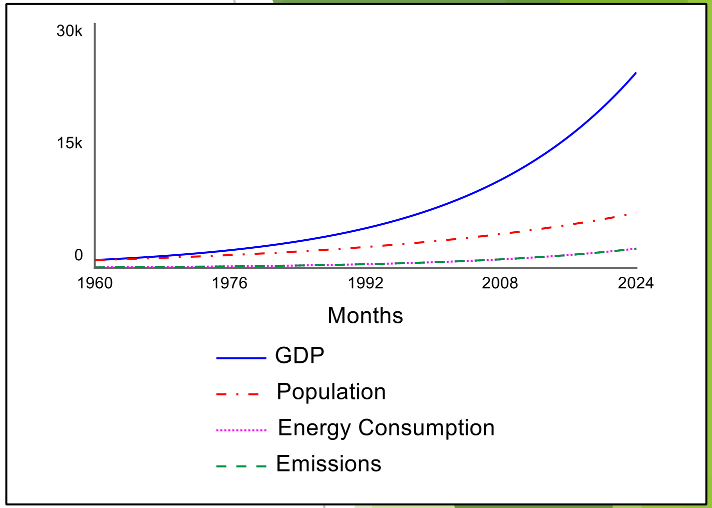
- Sequential Model

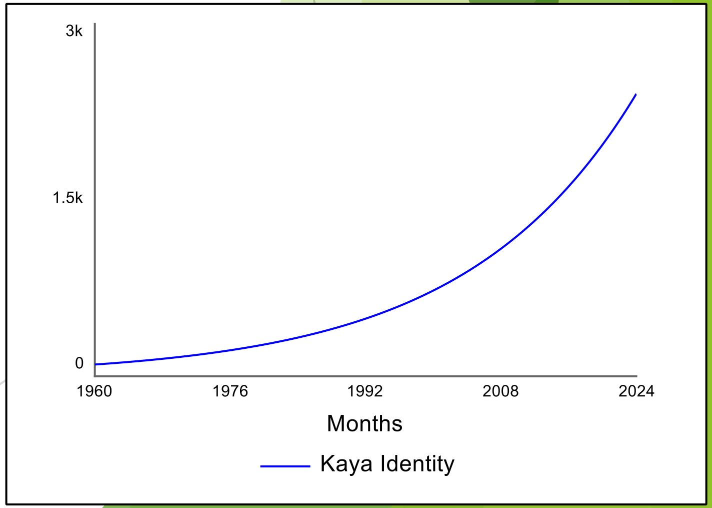


System Dynamics - First Perspectives

- Limited Link Model
  - GDP

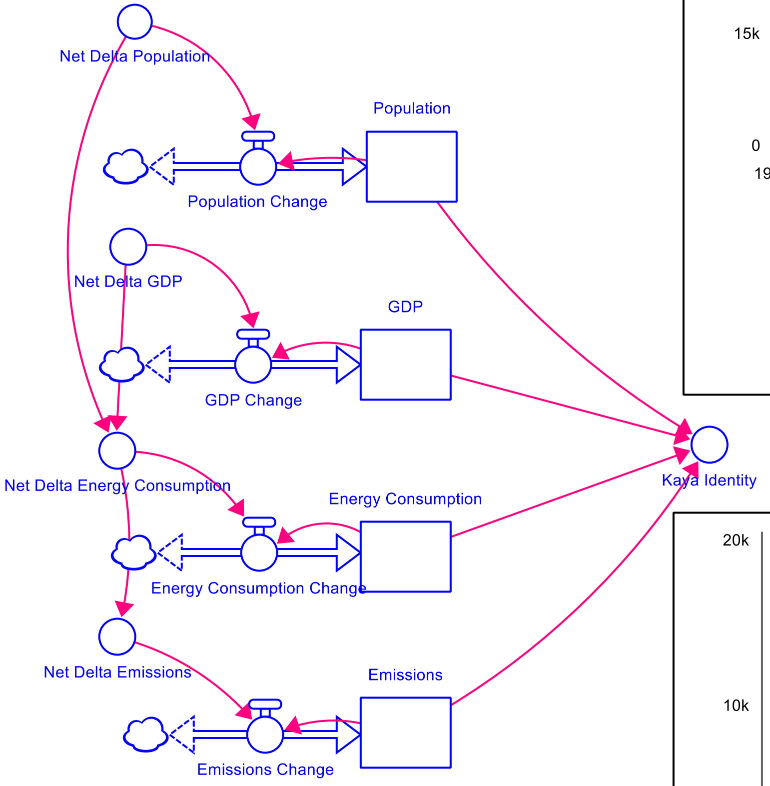


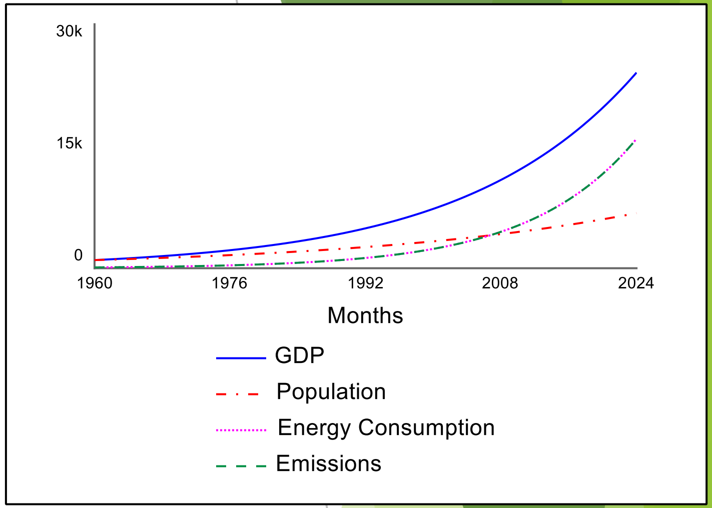


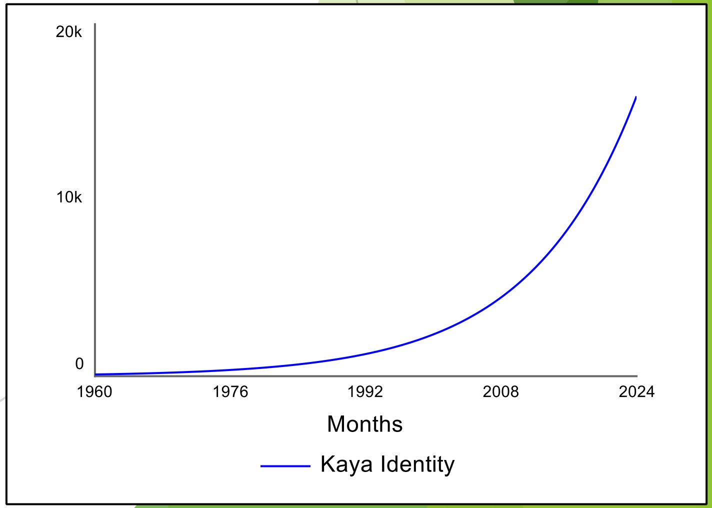


System Dynamics - First Perspectives

- Expanded Link
  - GDP, Population

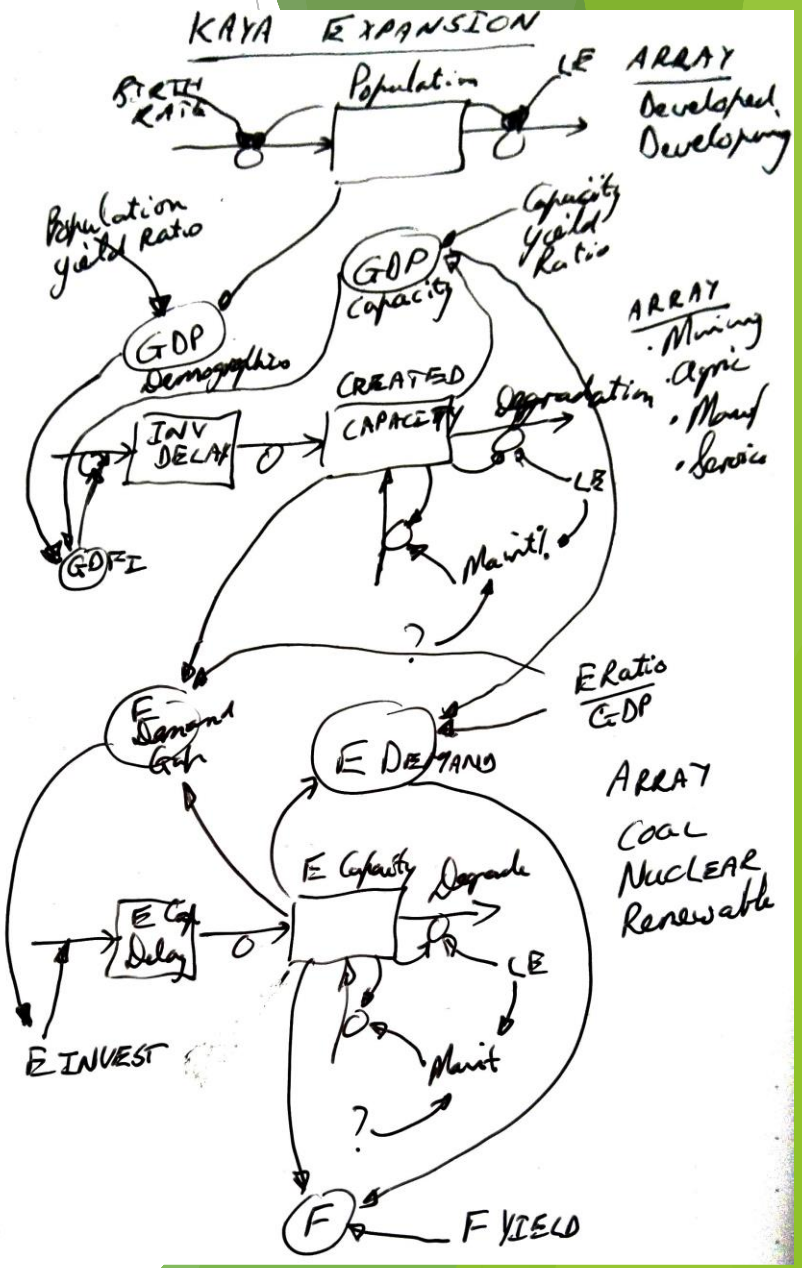






System Dynamics - Full Expansion

- Population Model
- Economic Capacity – Invest and Maintain
  - GDP Driven by Population and Economic Capcity
- Energy Capacity – Invest and Maintain
  - Energy Demand Driven by Economic and Energy Capacity
  - Kaya Identity – Carbon Dioxide Emissions Driven by Energy and Economic Capacity and Design



Summary

- To-Do
  - Obtain World Bank Data
  - Calibrate the Model Against Concept Data