Stable Electricity Supply and Development: An Economy-Wide Model

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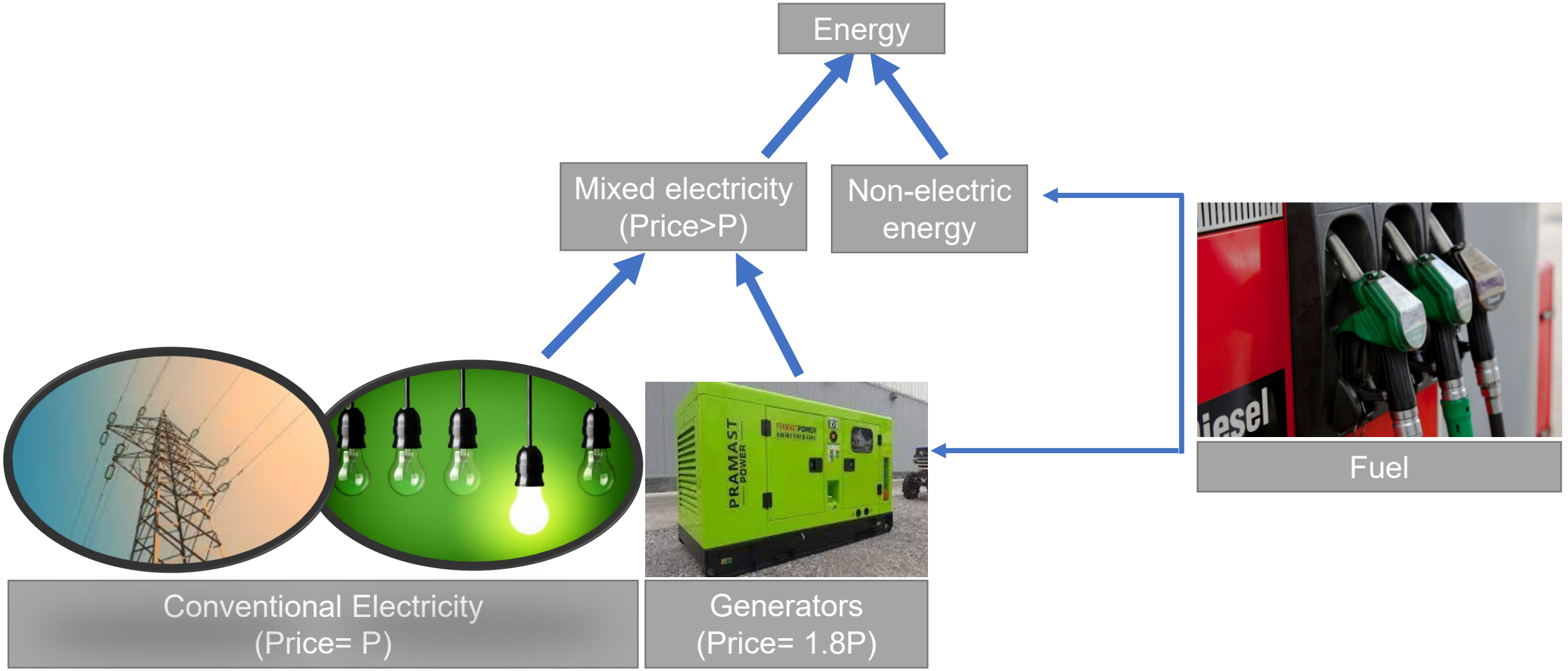
Background (1/4)

- In the last decade, most African countries follow the African Union's (AU) and regional unions' policy orientations to set up agricultural development plans
- Agricultural development without suitable value chain development ➔ possibly negative effect on farmers (Gupta et al., 2018; Grethe et al., 2020)
- Benin: policy to enhance productivity and develop value chain (MAEP, 2017)
- Agriculture = input for industry: 40%, 65%, and 7% production cost of food, non-food agricultural, and non-agricultural industries respectively (Kinkpe et al., 2022)
- Energy = key factor of industrial development.

Background (2/4)

- A SWOT analysis of the industrial sector shows that
  - Lack of stable electricity supply is one of the most important bottlenecks (Kinkpe et al., 2021)
  - Benin is not yet fully covered by electricity networks, especially in rural areas (Somalon, 2020).

Background (3/4)



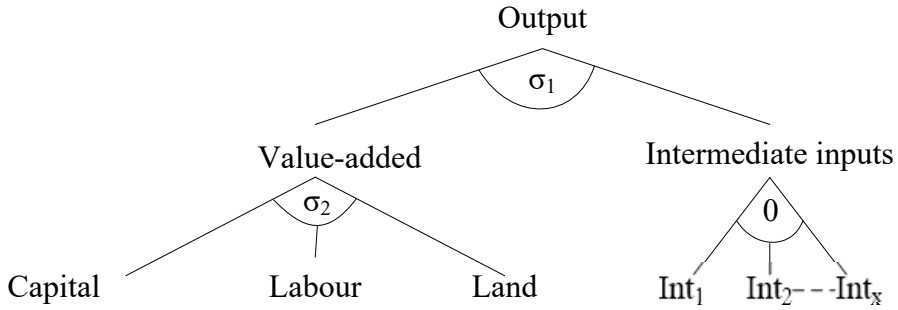
Background (4/4)

- Benin is striving for stability of electricity supply (Akinocho, 2019; Somalon, 2020)

- Glo-Djigbe Industrial Zone (GDIZ) is established, providing stable electricity to attract industrial investments (GDIZ, 2021)

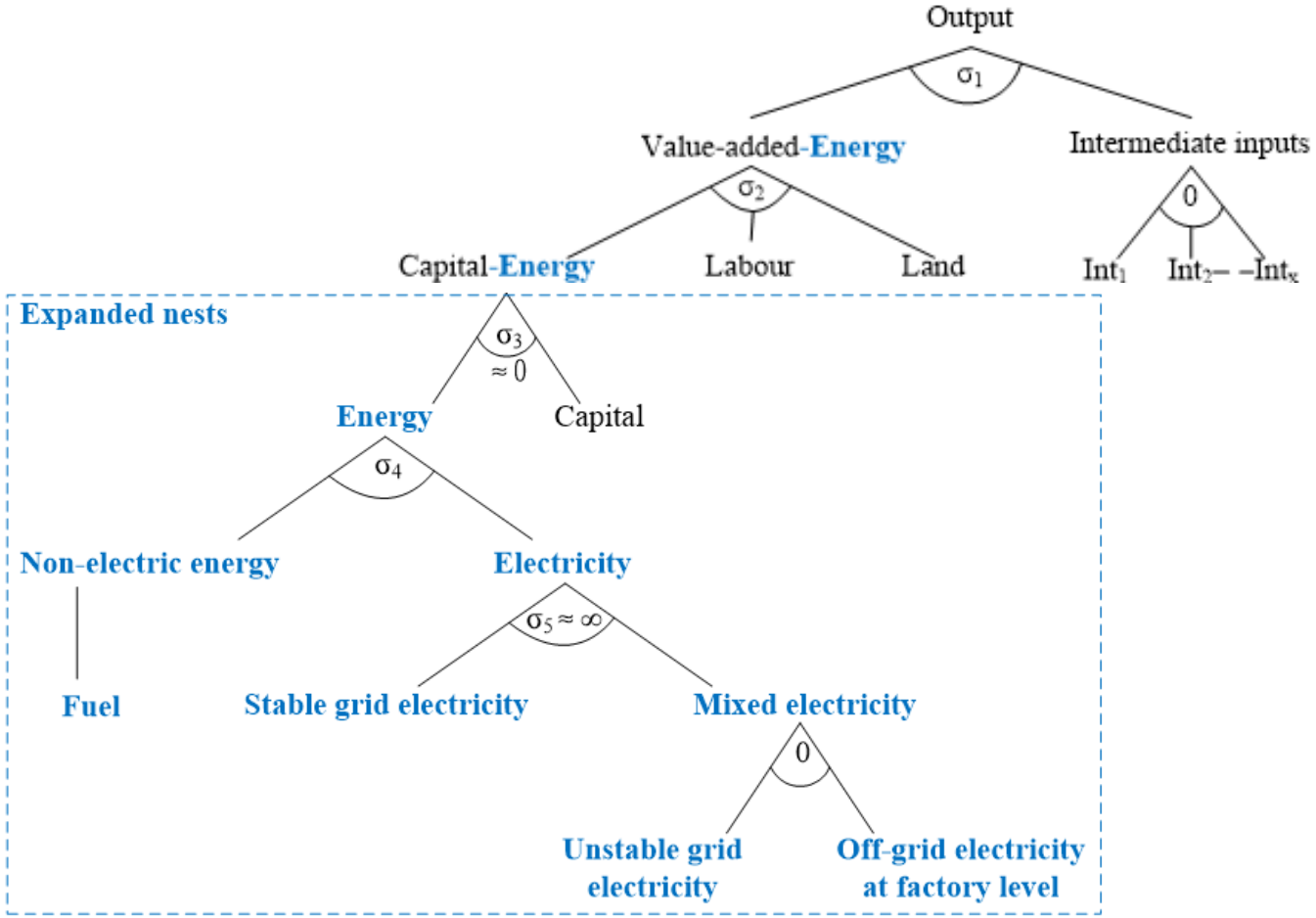
- **To what extent can a stable and sufficient electricity supply stimulate industrial development and enhance overall economic growth in Benin?**

Production structure in STAGE



Source: McDonald and Thierfelder (2015)

Production structure in STAGE_E



Source: Own compilation based on Burniaux & Truong (2002); McDonald & Thierfelder (2015); Peters (2016)

Closure rules

- Fixed exchange rate (ER) regime, flexible current account balance;
- Fixed CPI (numeraire);
- Investment-driven;
- Fixed government savings, flexible household income tax rate;
- Factors fully employed and mobile.

Database

- **2019 Social Accounting Matrix (SAM) for Benin** (Kinkpe et al., 2022)
  - Agriculture: 29% GDP; Food Industry: 7% GDP; Non-Food Industry: 6% GDP; Construction: 6%; Services: 53%
  - Energy cost for industry: 1.2% (food and non-food agricultural), 8.1% (other)
  - **Stable electricity** (activity and commodity)
  - Production factors
    - Labor, Land;
    - Capital: **agricultural, non-agricultural capital, electricity plants and network**.

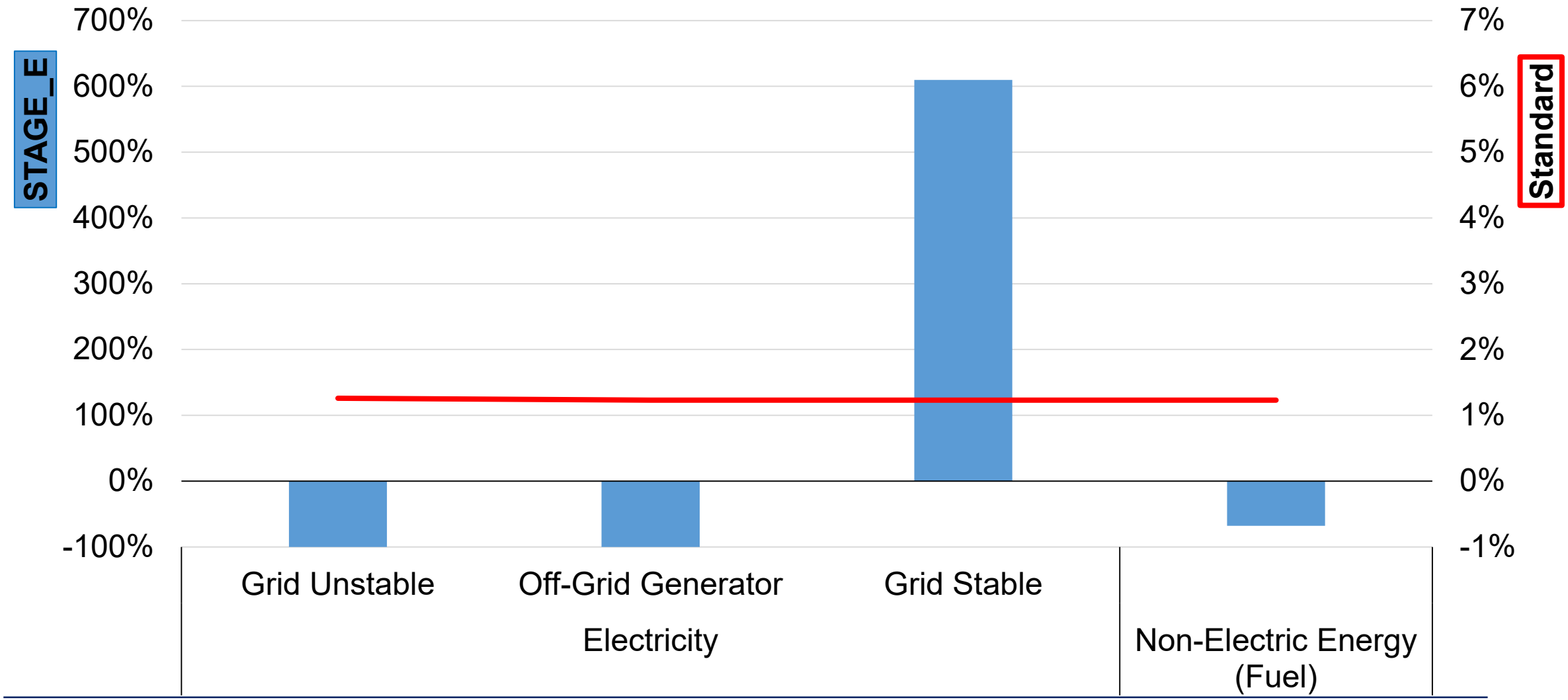
Scenarios

- Electricity plants and network to supply additional 140 MW to industry (GDIZ, 2021)
  - **INVEST**
    - USD 221.9 million over 5 year: USD 44.4 million per year (2% public expenditure in the base)
    - 70% equipment, 25% construction, 5% services
  - **StabEl**
    - Additional supply of 140 MW of stable electricity to industries
    - ➔80% increase in electricity supply to industries.

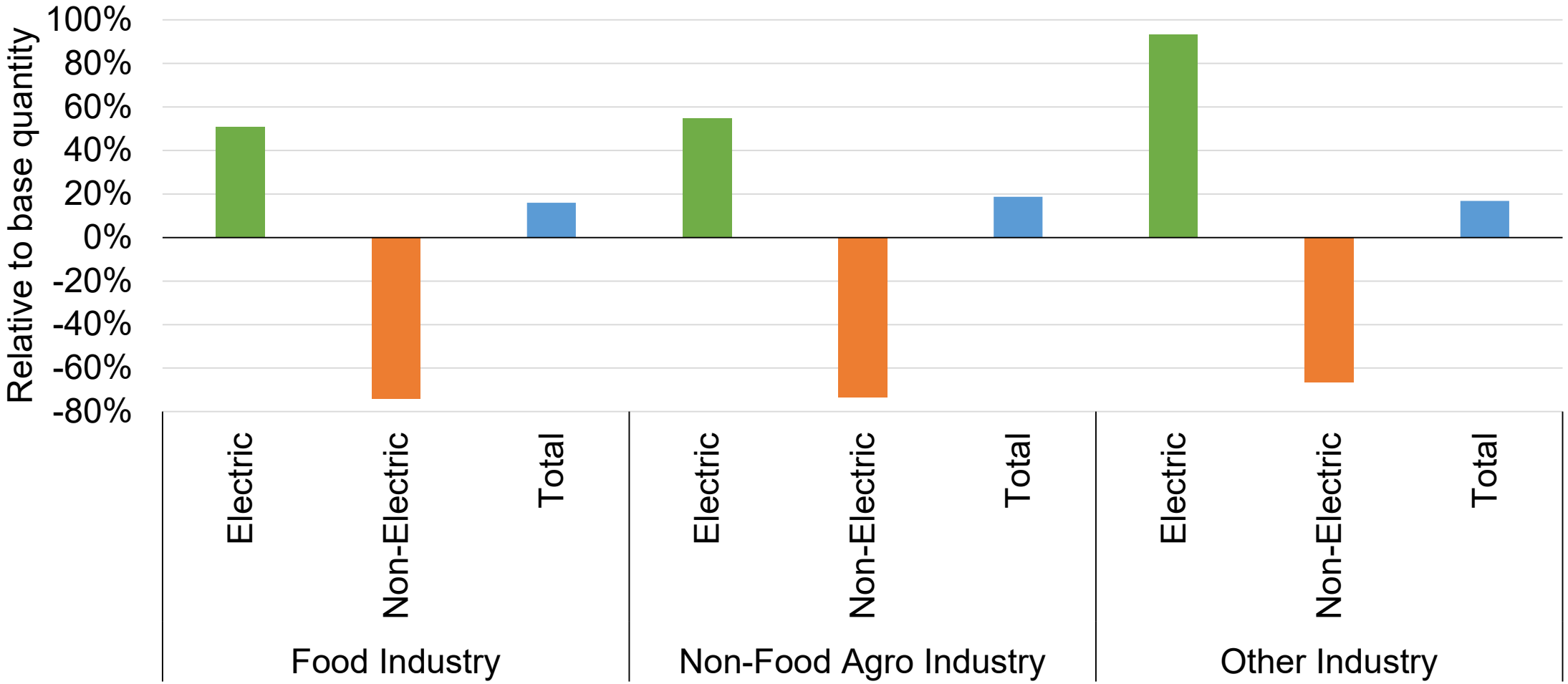
INVEST (short-run effects)

- **Increased government demand for equipments, construction & services**
  - Increased production: Industry +0.2%, construction +0.9%
  - Decreased production for services: -0.2%
  - Decreased factor prices: -0.6 to -0.02%; except non-agricultural capital: +0.16%
- Slight income lose by households :-0.01%
  - More in urban area: -0.06 to -0.03 % (because of skilled labor wage)
- Higher income tax: rural= +0.1 to +0.2 % points; urban= +0.3 to +0.9 % points
- Increased imports: +0.4% ; decreased exports: -0.1%
- GDP almost not affected: +0.01%

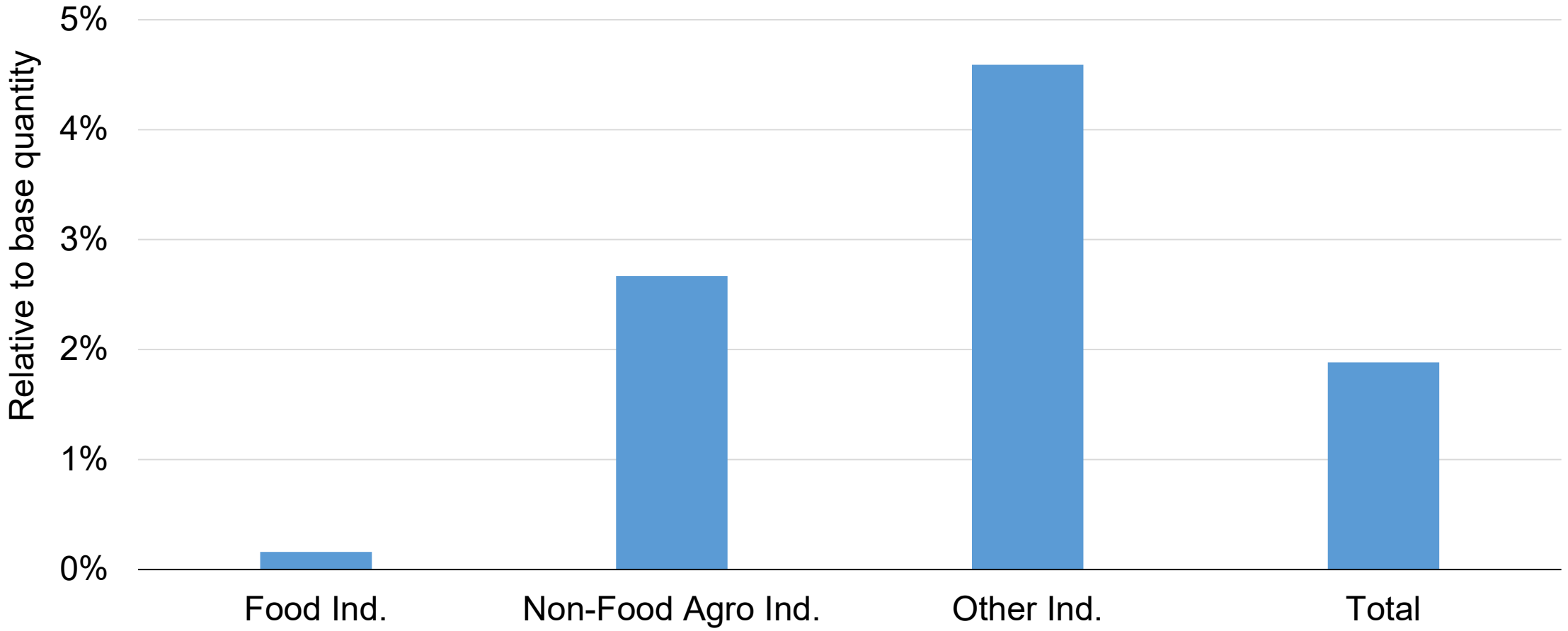
StabEl (long-run effect) (1/6): Model comparison



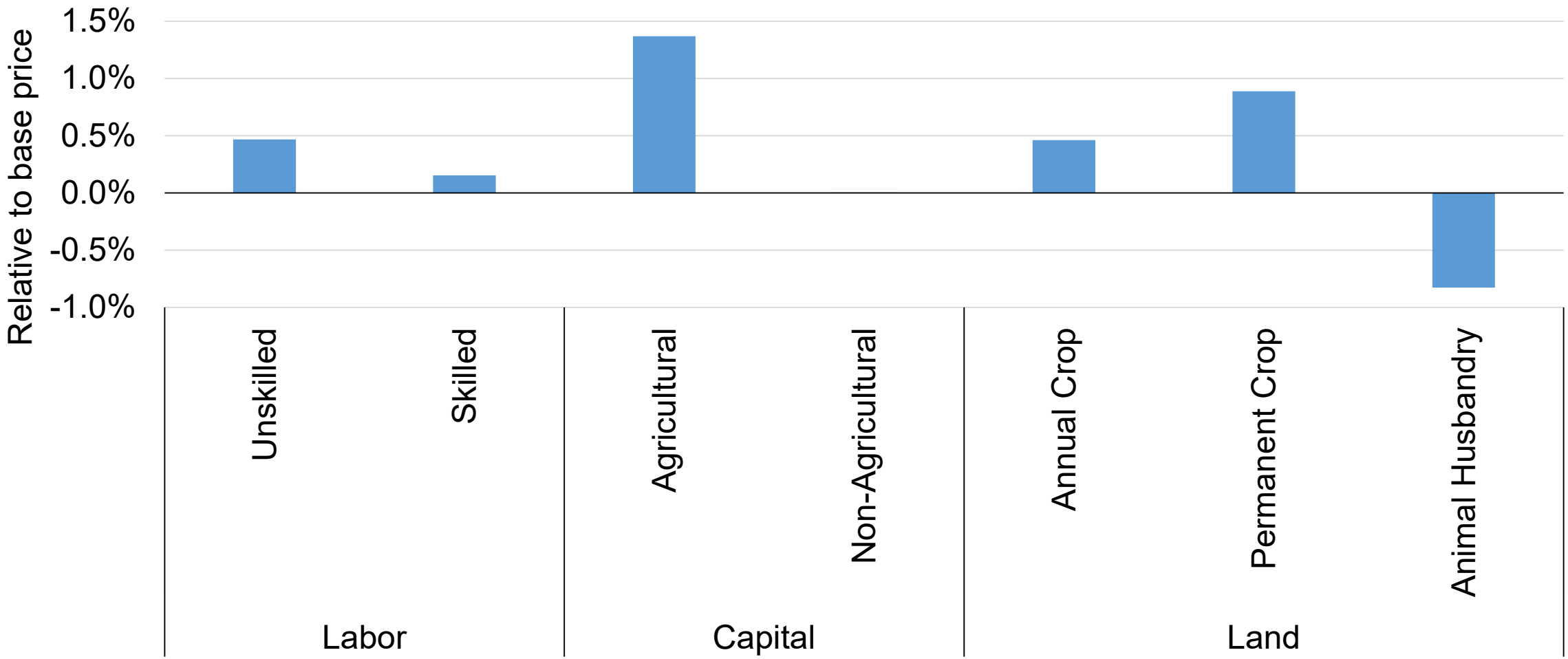
StabEI (2/6): Change in energy demand by industry



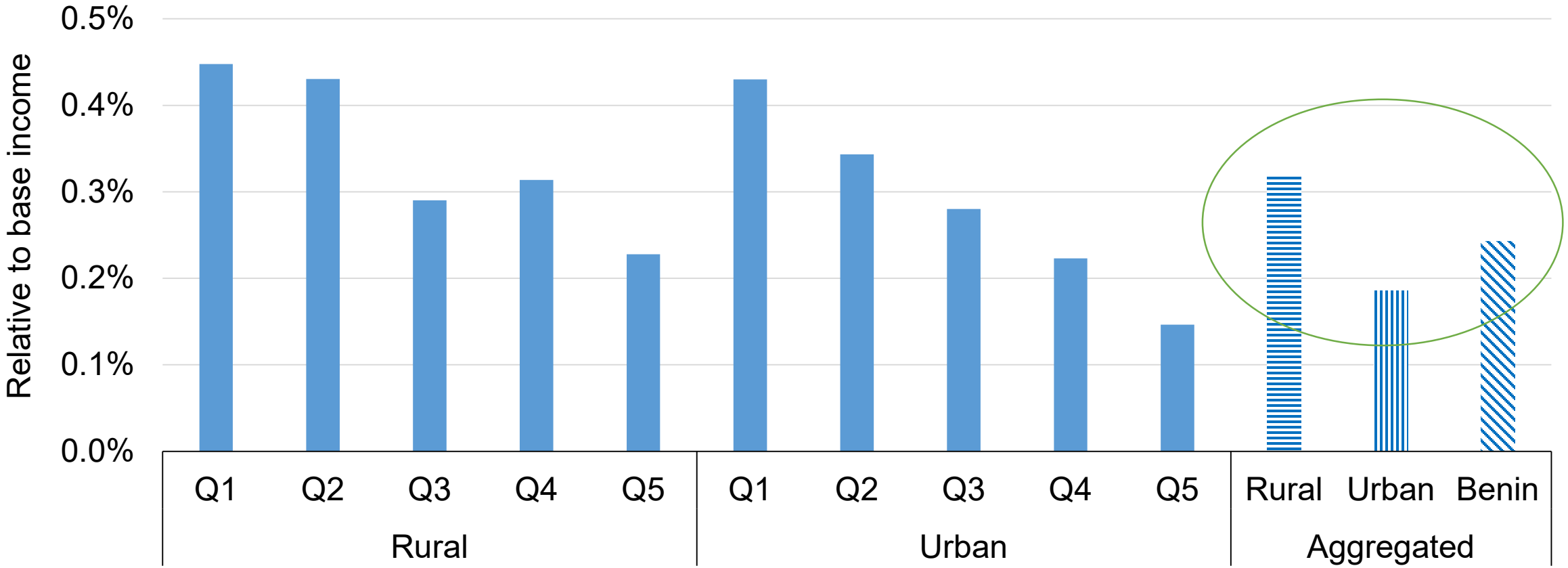
StabEI (3/6): Change in industrial production



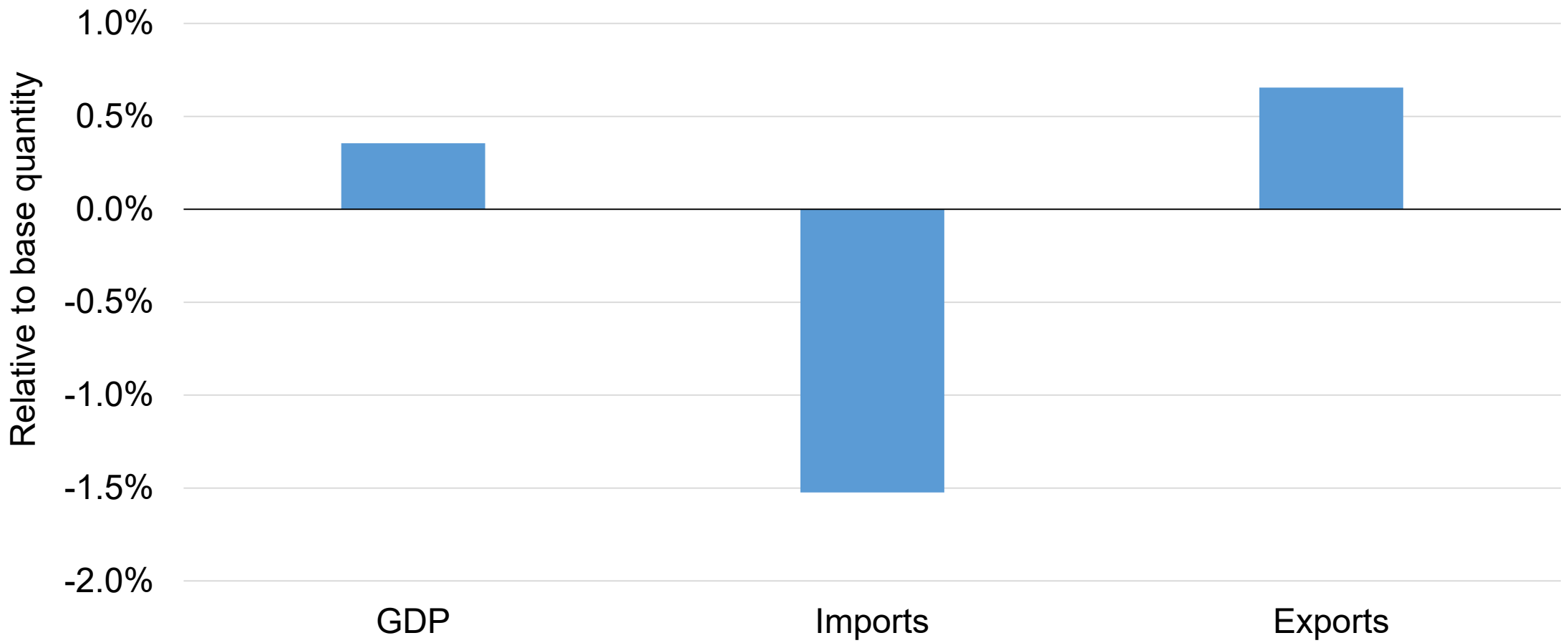
StabEl (4/6): Change in factor prices



StabEI (5/6): Change in household income



StabEl (6/6): Change in macroeconomic indicators



Conclusions

- STAGE_E model depicts more suitably the energy use in industry.
- Application to the case of Benin shows
  - Investing in stable electricity supply ➔ industrial production cost reduction
  - ➔ Industrial growth ➔ higher demand for agricultural commodities as inputs
  - ➔ Increased value-added
  - ➔ Economic growth
  - Pro-poor distribution effects.
- Industrial zone can be a model for other countries like Benin.

Outlook

- Model assumption: factors fully employed
  - ➔ Hinder development
  - Increased capital flow to industry (also agriculture, e.g. irrigation): larger positive effects
  - 56% of agricultural land unsed: larger positive effects (Kinkpe et al., 2024).
- Higher electricity supply ➔ increased household access to electricity
  - Air conditioning ➔ lower heat stress ➔ increased labor productivity
  - Increased use of electric cookers ➔ sustainability.

Thanks for your attention

Contact

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DAAD
Deutscher Akademischer Austauschdienst
German Academic Exchange Service

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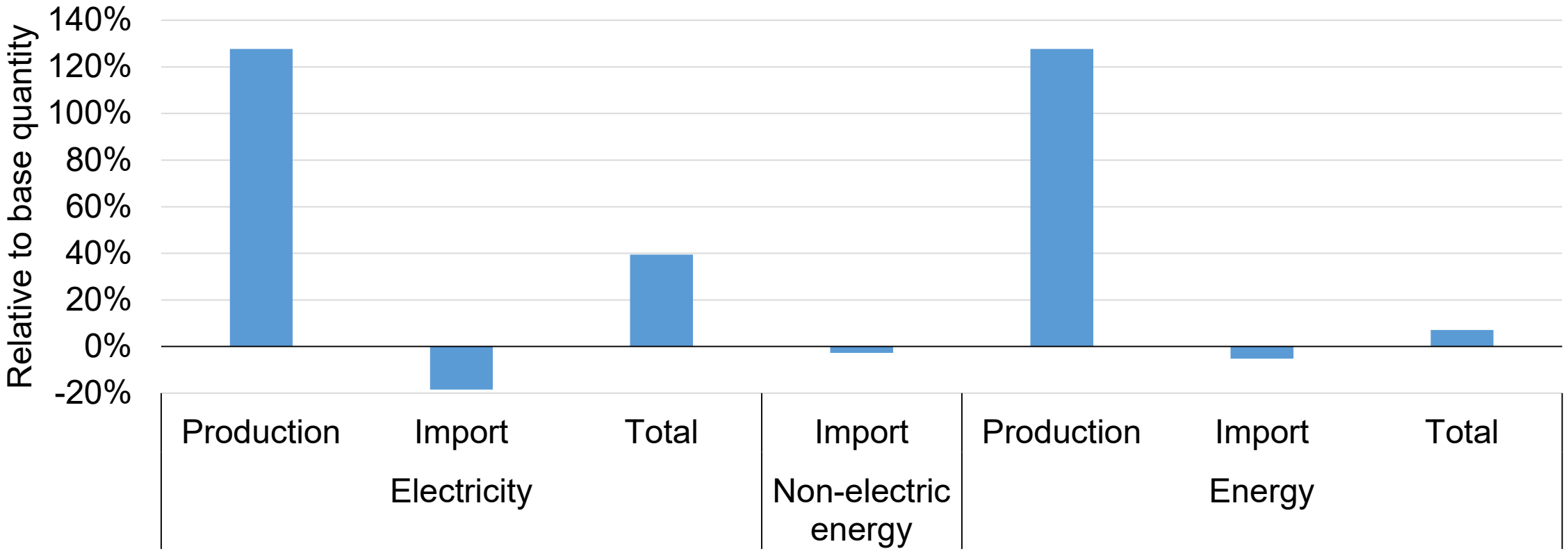
Appendix

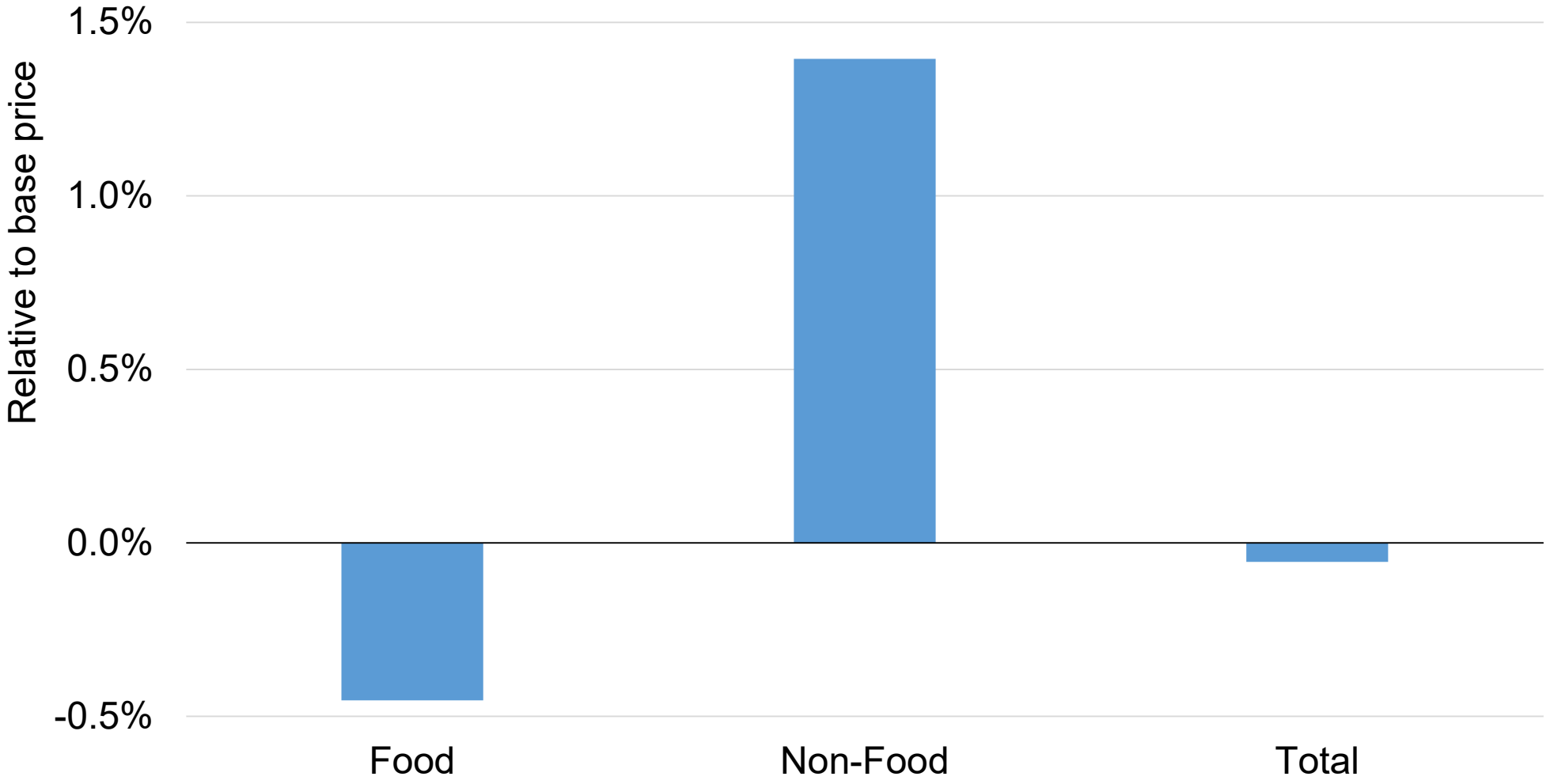
Database (2/2): Energy use by sector

Type of industry		Energy share (% of total energy cost)				
		Non-electric	Electric			Total
			Mixed		Grid Stable	
		Fuel	Grid unstable	Off-grid generator-based		
Agricultural Processing	Food	25.15	25.70	27.31	21.85	100
	Non-Food	25.29	38.02	15.48	21.21	100
	Total	25.18	28.81	24.32	21.68	100
Non-Agricultural Industry		43.98	20.39	19.84	15.79	100
All Industry		39.09	22.58	21.01	17.33	100

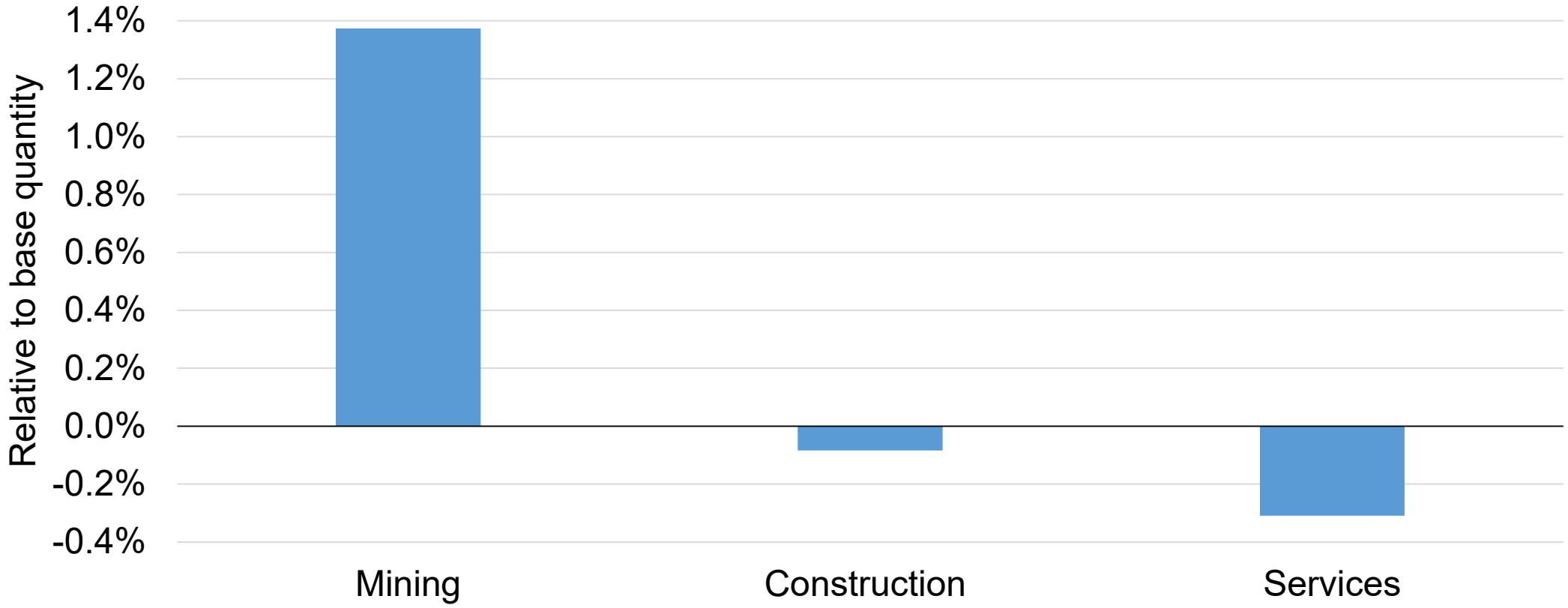
StabEl (7/10): Change in energy supply



StabEl (8/10): Change in agricultural production



StabEl (9/10): Change in other production



StabEI (10/10): Change in producer prices