

Meeting on Copenhagen University
@ DEA - Modelling Approaches and
Synergies – 18 September 2026

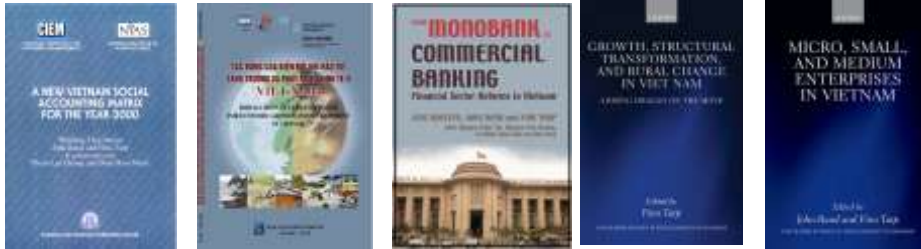
An introduction to the current
UCPH-DEERG project in
Vietnam and its relation to
earlier projects

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UCPH-DERG in Vietnam since 2000



Examples of activities and policy challenges:

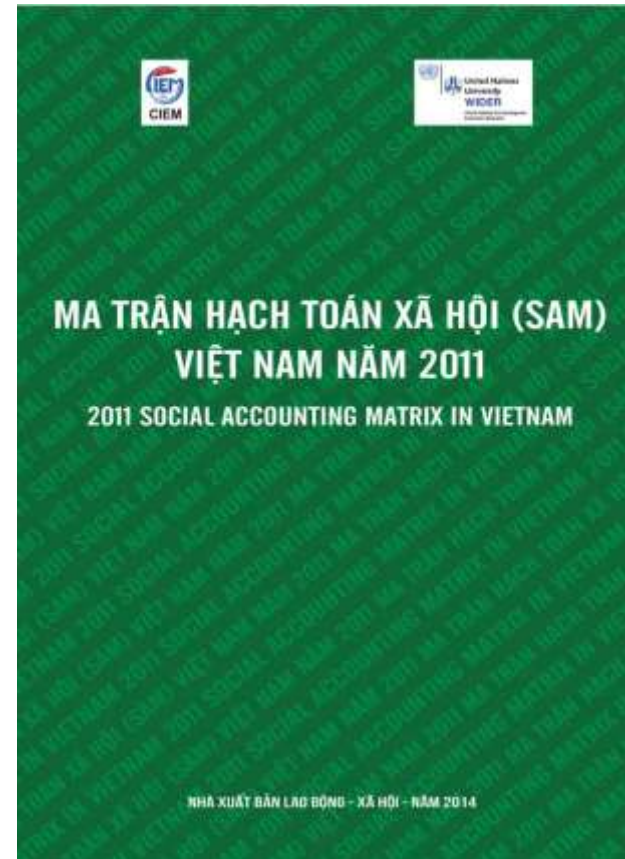
- Support for a **data “revolution”**



- Major **transformative** questions:
- Agricultural sector reforms and economic transformation
- Enterprise sector reforms and competitiveness
- Trade liberalisation
- Technological progress
- Climate change and green growth
- Household/social sector issues (poverty, inequality, subjective welfare, mental health, money transfers, gender, ethnic minorities, social capital, adaptations to shocks etc.)

From start a particular focus on building/updating Social Accounting Matrices (SAMs)

- Why: need for **economy-wide** policy modelling and analysis given focus on bigger transformative issues
- Challenging consolidation of disparate data sources of data supplied by GSO and many others
- SAMs for Viet Nam (1999, 2000, 2003, 2007, **2011**, 2012, 2015 including the very first attempt at an **ESAM**.....=>
- Capacity building and co-production of research



Quickly forward to present policy context

- Vietnam achieved high economic growth and **successful economic transformation** over past 4 decades
 - Improved living standards for most and poverty significantly reduced
- However: High growth has brought **new challenges**
- In particular: high growth → increased **energy intensity** of production
 - Greenhouse gas emissions increased 5% per annum since 2000
- Government of Viet Nam adopted **Green Growth** principles
 - Committed to net zero carbon emissions by 2050
 - National Climate Change Strategy focused on transition away from coal-fired power generation
 - Agreed Just Energy Transition Partnership (JETP)
- The needed **future transformations** - more challenging than those experienced in the past
 - Less research-based and empirical policy evidence available
 - Aligning “just” energy transition and lower emissions with economic growth is **difficult**
- New **data and economy-wide analytical tools** needed!

CIEM/IPSS + UCPH-DERG with UNDP financial support – started in 2023

- Started with informal conversations with **UNDP** focusing on:
 - Importance of economywide analysis given the policy context
 - Need for multi-sector economywide models (SUT and SAMs and multi-sectoral CGEs)
 - Old structural data made such analysis difficult
 - Constrained analytical capacity in Vietnamese institutions
 - Aware of upcoming I/O-SUT data updates by NSO
- So, UNDP took the initiative to support
 - Help putting the **basic institutional and data building blocks** in place, involving 3 activities
 - Initiate capacity building targeting new generation of data and policy analysts (**CIEM/NSO/Others**)
 - Update and expand existing SAM data to 2019
 - Develop and apply an economywide static CGE model
- Multi sectoral because output, energy use and emissions vary **across sectors**
- Multi households because **income distribution** aspects are important
- Must go beyond simple multiplier models because **prices and markets** play a role in economy
- **Computable General Equilibrium (CGE)** models fit such requirements but are analytically demanding => First focus on comparative static CGE model development with limited energy and emission representation

The static CGE model

- A **static CGE** model capturing price adjustments, substitution, and economy-wide feedback from policy interventions
- CGE model based on the GSO/IPSS 2019 Viet Nam **ESAM** with 46 activities, 41 commodity markets, 11 production factors, 20 households
- **Energy use and emissions** generated by 14 types of energy bolted on to the CGE in the same way as one would do with employment
- Fully described in **IPSS Policy Report**
- Also identifies themes of some illustrative experiments, including:
 - **Carbon Tax**
 - **Energy Efficiency**
 - **Towards renewable energy**

Key insight

- Viet Nam's **green transition** not a narrow environmental agenda
- A core component of a **new development model** — one that links
 - high economic growth
 - energy security
 - emissions reduction
 - protection of vulnerable groups, and industrial competitiveness
- We suggest these goals could be **complementary** rather than at odds, if transition policies are
 - well-designed
 - sequenced appropriately
 - anchored in the principle of leaving no-one behind

So where are we now?

- Viet Nam (IPSS) and others (MOF, ISPAE) now have the static CGE **tool** and the infrastructure to fine tune existing comparative static experiments and develop new ones
 - Do experiments that represent detailed economic policy trade-offs in Viet Nam
 - Offer an opportunity to get familiar with CGE modelling
- **Continue** with understanding comparative static CGE
 - Focus on one-off economy-wide adjustments to policy interventions and exogenous shocks
 - With limited energy & emissions representation
- **Gradual** approach name of the game here!
- **Benefit:** can be deployed at short notice for short turn around analysis of **many** different issues (oil price shocks, tariff changes etc)

Next step - way forward (with Danish funding 2026-27)

- Regular **database updates**
- The ESAM, energy, and emission accounts should be refreshed every **2–3** years to track Viet Nam's rapidly evolving energy mix, industrial structure, and household consumption patterns
- **NSO** has a key role to play together with MOF, IPSS, ISPAE and others such as MOIT
- Upgrade from static to **dynamic CGE** with more comprehensive energy and emissions representations
- Needed to simulate **transition pathways** to 2045 (high-income vision) and 2050 (net-zero target)
- Because the **timing** of investment and the path of capital scrapping are central
- But much more **complex** and analytically demanding
- In parallel: Develop a simple **operational** macro model (we can elaborate in the discussion)

GREENREFORM-EU AND GREENREFORM VIET NAM

A dynamic CGE model for Viet Nam

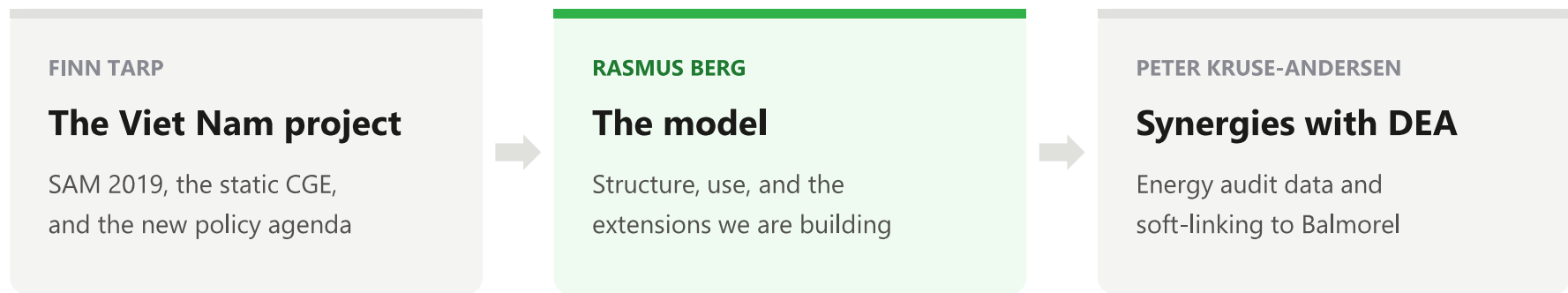
Model structure, use, and specialisation

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Danish Energy Agency · 18 September 2026

Outline



This presentation

1. What a CGE model covers, and what it does not
2. The GreenREFORM-EU framework and the Viet Nam version
3. Three ways to specialise the model

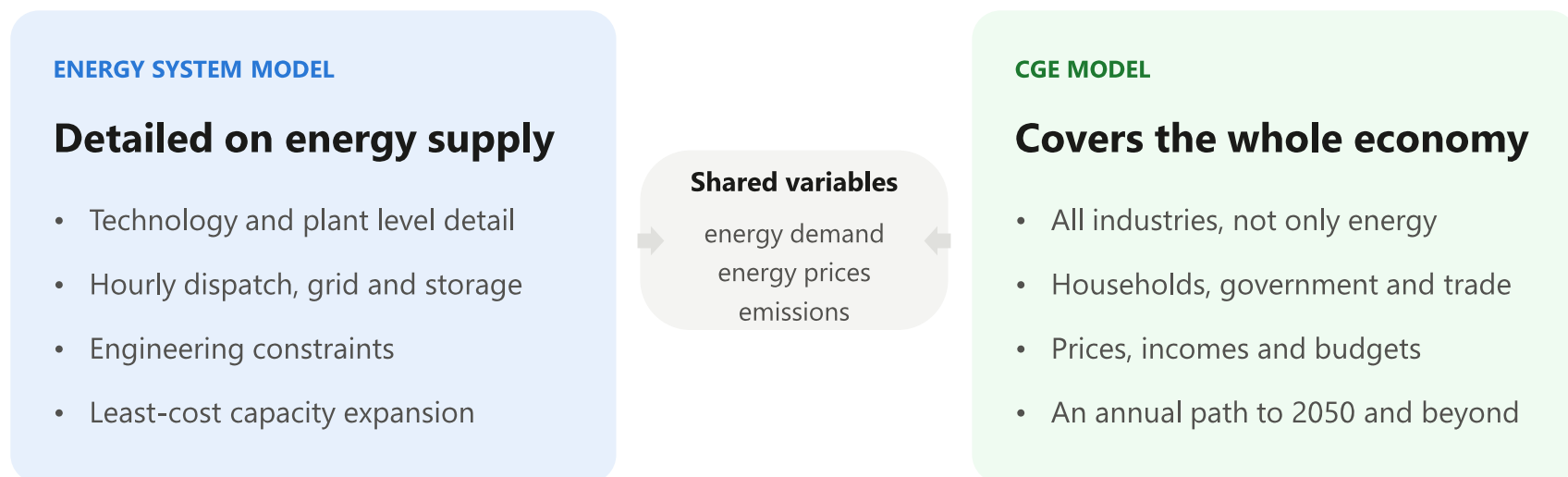
PART 1

The CGE framework

Scope, strengths and limitations

The CGE model and the energy system model

Different scope. The two overlap on energy demand, energy prices and emissions.



Neither model contains the other. The shared variables are the interface for a soft-link.

Strengths of the CGE framework

01

Economy-wide effects

A policy in one sector affects all others through prices and incomes.

Leakage and rebound follow from the model.

02

Consistent accounting

Supply equals use and every sector balance closes.

Inconsistent data does not solve.

03

Real income and distribution

Output is real income by household group and year.

Not only the cost of abatement.

The framework is suited to questions about the whole economy along the transition path, and not only at the target year.

Limitations of the CGE framework

Each limitation corresponds to one of the extensions in Part 3

Smooth substitution

Input substitution follows CES elasticities. Technology choice is discrete, and some options do not exist below a cost threshold.

→ **Technology module**

No physical energy supply

No dispatch, no grid, no hourly balance. Electricity supply is represented by a production function.

→ **Soft-link**

Aggregate households

A representative household does not show how the burden is distributed across income, region and skill.

→ **Household disaggregation**

PART 2

GreenREFORM-EU and GreenREFORM Viet Nam

Model content and implementation

Background

Three stages. Viet Nam enters at the third.



The framework is developed by DREAM. We apply it to Viet Nam and adjust it to local data, local structure and the policy questions that are relevant there.

Model structure

Three layers. Each layer can be run and tested on its own.

Accounting core

no behaviour

Input-output, sector accounts and rest of the world.
Fixed shares as default closures.

Macroeconomic core

prices and quantities

Production, consumption, investment, trade and the
labour market.

Green transition core

PJ, tonnes CO₂e

Energy in physical units, the emission inventory, and
energy and emission taxes.

OPTIONAL MODULES

Each module attaches to a core
through a named variable.

Capital adjustment costs

Import substitution

Technology choice

Household disaggregation

Labour market frictions

Fiscal sustainability

Each layer builds on the one above. Adding a layer does not change it.

Modularity

A module adds equations. It does not rewrite equations in another module.

A

Endogenise a parameter

The core sets a fixed share

$$D(p, u, o) = \mu(p, u, o) \cdot D(p, u)$$



A module supplies an equation for μ

The import substitution module makes the origin share depend on relative prices. The core equation is unchanged: a parameter becomes a variable.

B

Fill a term that is zero

The core writes the term explicitly

$$p^K = p^I - \beta(1-\delta)p^I_{+1} + \partial AC / \partial K$$



A module supplies $\partial AC / \partial K$

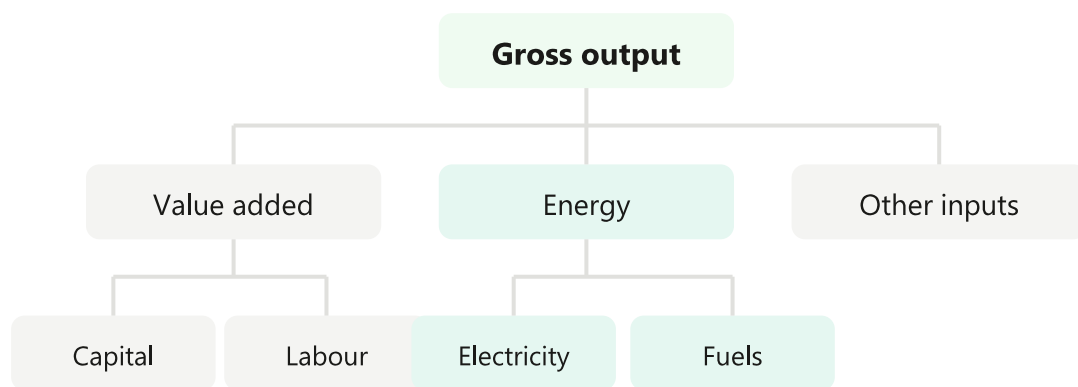
Without a capital adjustment cost module the term is zero and the user cost takes its frictionless form.

Consequence

A module can be switched off, or replaced by a local version, without changes elsewhere. Each module can also be solved and tested on its own as a partial equilibrium model.

The macroeconomic core

Dynamic, forward-looking and multi-sector. Production is a nested cost function.



The elasticity at each nest determines input substitution. These elasticities are calibrated, not observed.

Forward-looking

Firms and households respond to an announced policy path before it takes effect.

Annual path to 2075

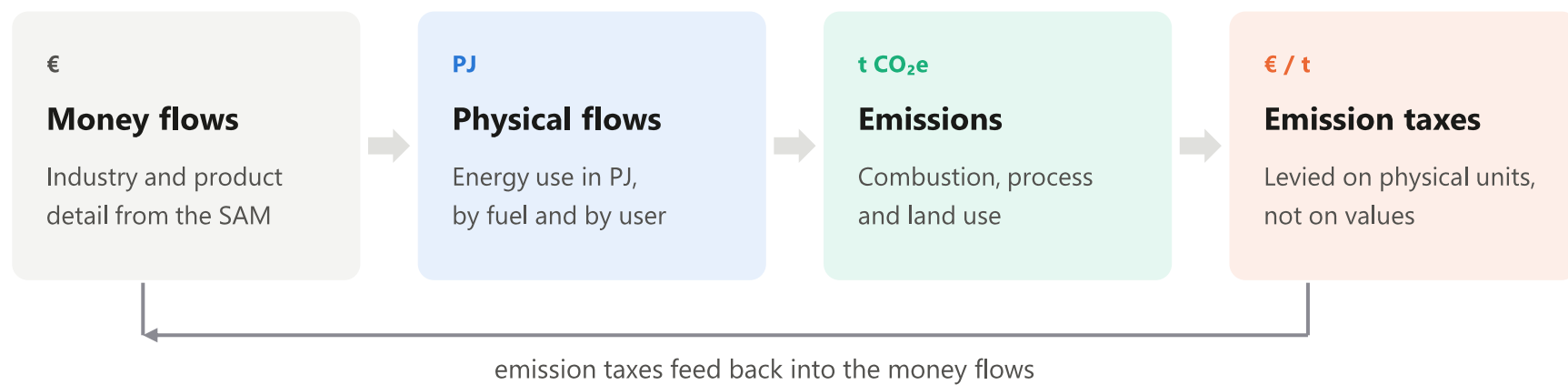
The model solves a transition path, not two comparative-static points.

Industry detail from the data

Resolution follows the input-output data. Viet Nam does not need the EU classification.

The green transition core

Physical energy quantities, the emission inventory, and emission taxes

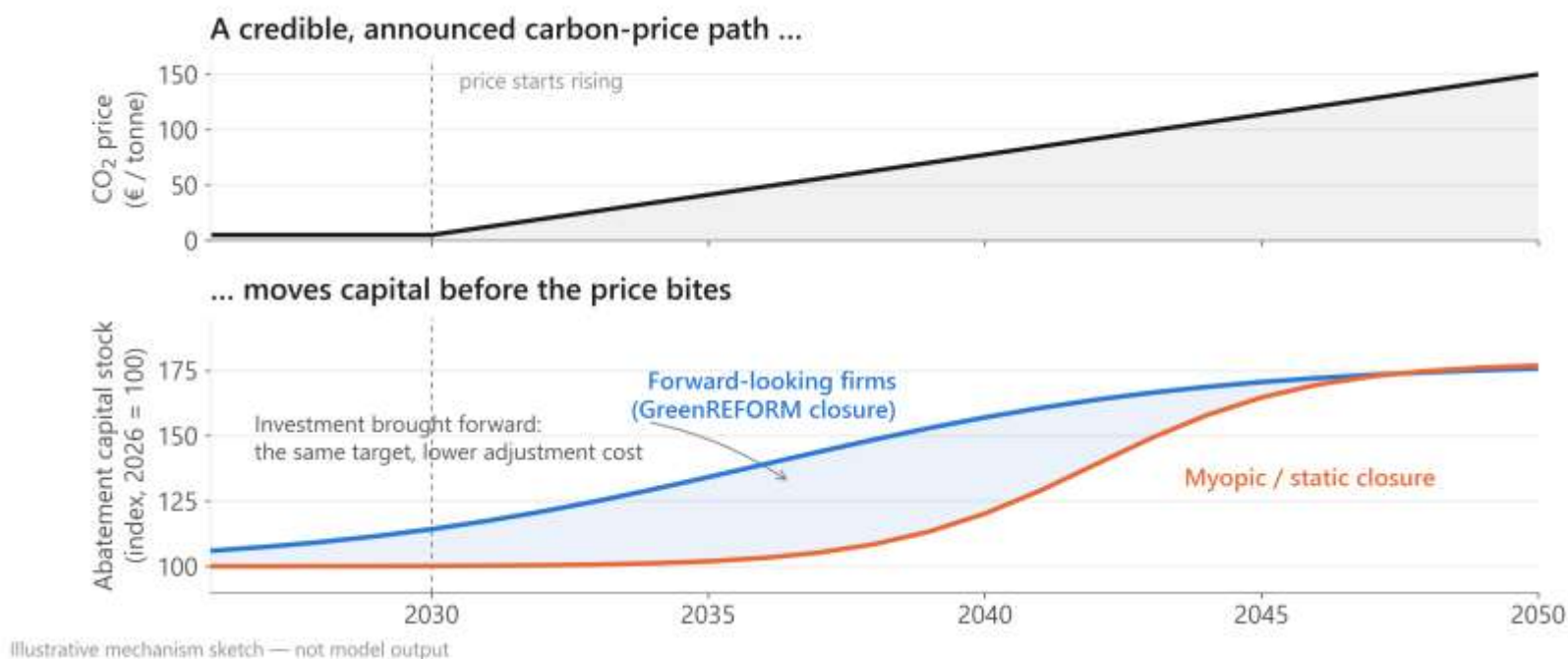


Why the physical layer is required

An emission price is set per tonne. Physical quantities are needed to apply it, and to reconcile the model with the published emission accounts.

Forward-looking behaviour

The cost of reaching a target depends on when firms react to the policy



Implementation

Julia and Python. No proprietary language and no proprietary solver.

Model equations are written in blocks

```
@block db begin
    vGDP[t=t1:T], vGDP[t] == vC[t] + vI[t] + vG[t]
                        + vX[t] - vM[t]
    pGDP[t=t1:T], pGDP[t] * qGDP[t] == vGDP[t]
end
```

Each line gives the endogenous variable and its equation. Changing which variables are endogenous is one command, so calibration and shocks use the same model.

Capacity building

A model that only the development team can run is not transferable.

Julia and Python

No licence is required to install or run the model.

Naming conventions

Variable names follow a fixed system, so the code matches the documentation.

Documentation with the source

Written so that a new user, or an assistant, can locate the relevant module.

PART 3

Specialising the model

Two ways to add behaviour

Build it into the model, or hand it to another model and manage the link

APPROACH 1

Build it into the model

Add a module with the behaviour we need, using data that a standard CGE does not use. The behaviour stays inside one equilibrium.

Example: Technology choice from catalogue data

APPROACH 2

Hand it to another model

Keep the CGE for the economy and let a specialised model handle the rest. The work is consistency at the link.

Example: Soft-link to an energy system model

AND A THIRD: MORE RESOLUTION

Household disaggregation

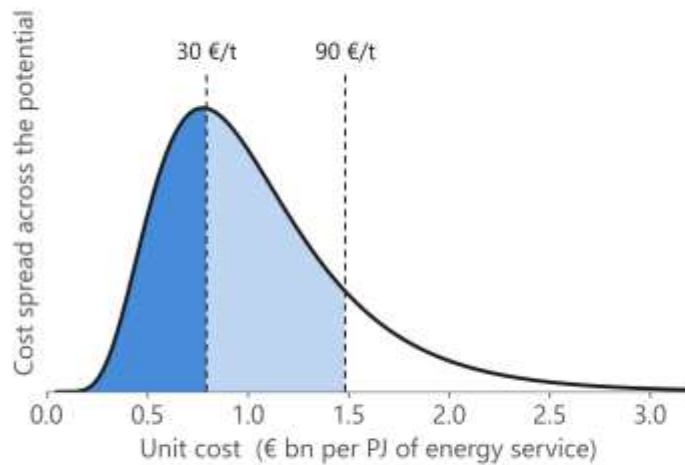
Not new behaviour, but the same behaviour at a finer level: households by income, by region and by skill.

APPROACH 1

Technology choice from catalogue data

Technology cost data replaces a calibrated substitution elasticity

Inside one technology

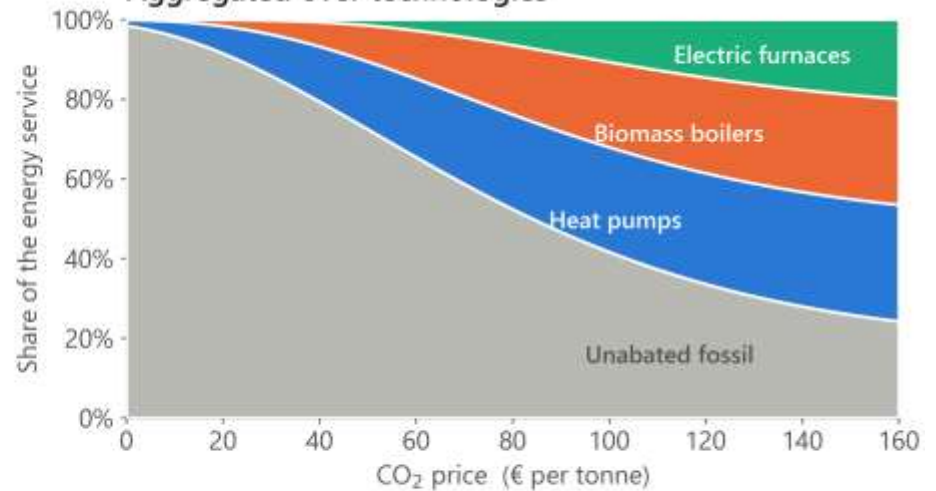


Shaded = the part of the potential that beats fossil at that price.

A bottom-up LP puts all of it on one side of the line.

Illustrative mechanism sketch — not model output

Aggregated over technologies



Each catalogue row is one band. The model solves the whole stack jointly with prices, incomes and emissions.

APPROACH 1

Data required for the technology module

One row per technology, industry and energy service

Field	What it is	Unit
Where it applies	Technology, industry, energy service	identifiers
Potential	Share of the energy service it can cover	share
Energy intensity	Fuel in, per unit of energy service out	PJ / PJ
Investment cost	Up-front capital per unit of capacity	€ bn per PJ
Running capital cost	Recurring cost per unit delivered	€ bn per PJ
Technical lifespan	Used to levelise the cost	years
Cost spread	Heterogeneity within the potential	parameter

Prices, wages, the discount rate and the emission price come from the model.

Source data

Technology catalogues report most of these fields.

The mapping to industries and energy services has to be constructed.

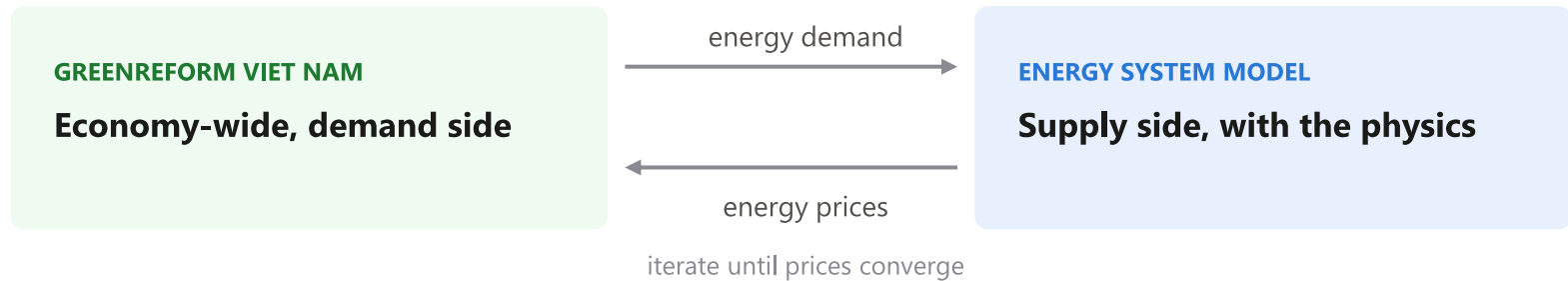
Not required

Plant-level data. The module works at the level of an energy service within an industry.

APPROACH 2

Soft-linking to an energy system model

The CGE keeps the economy. The energy system model keeps the supply side.



Consistency at the link

The two models must agree on energy quantities and prices. Sector definitions, time resolution and base year differ, and that is where the work is.

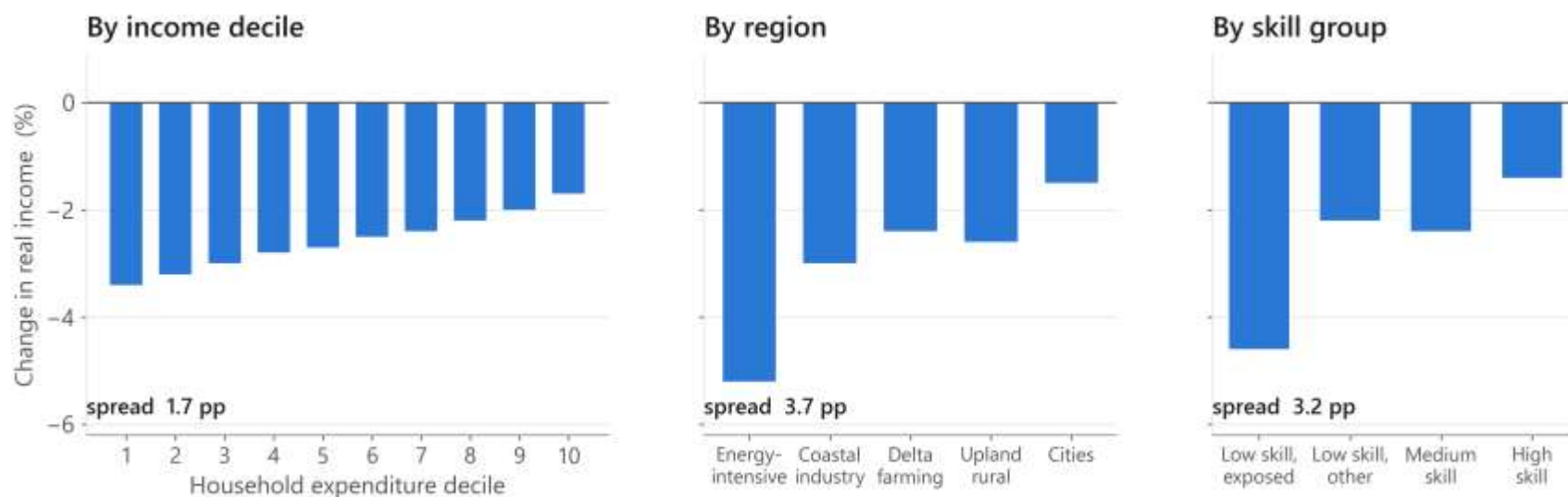
Covered by Peter

The Balmore link with DTU, and the energy audit data.

MORE RESOLUTION

Household disaggregation

Income is one dimension. Region and skill are at least as important.



Illustrative — the form of output the household link produces, not Viet Nam estimates

Energy resources and energy-intensive industries are not evenly distributed across a country. A national average does not show where the adjustment falls.

Summary

1 **A CGE covers the whole economy, not the energy system in detail**

Consistent accounts, real incomes, and an annual transition path. It does not model dispatch.

2 **GreenREFORM-EU is a framework, not a single model**

Three layers and optional modules, rewritten in Julia and open source. Viet Nam uses the current version, adapted to local data and local questions.

3 **The work now is in the extensions**

Technology choice inside the model, soft-linking to an energy system model, and household disaggregation by income, region and skill.

Peter continues with the synergies with DEA's work.

Synergies between DEA's work in Global Cooperation and our research agenda

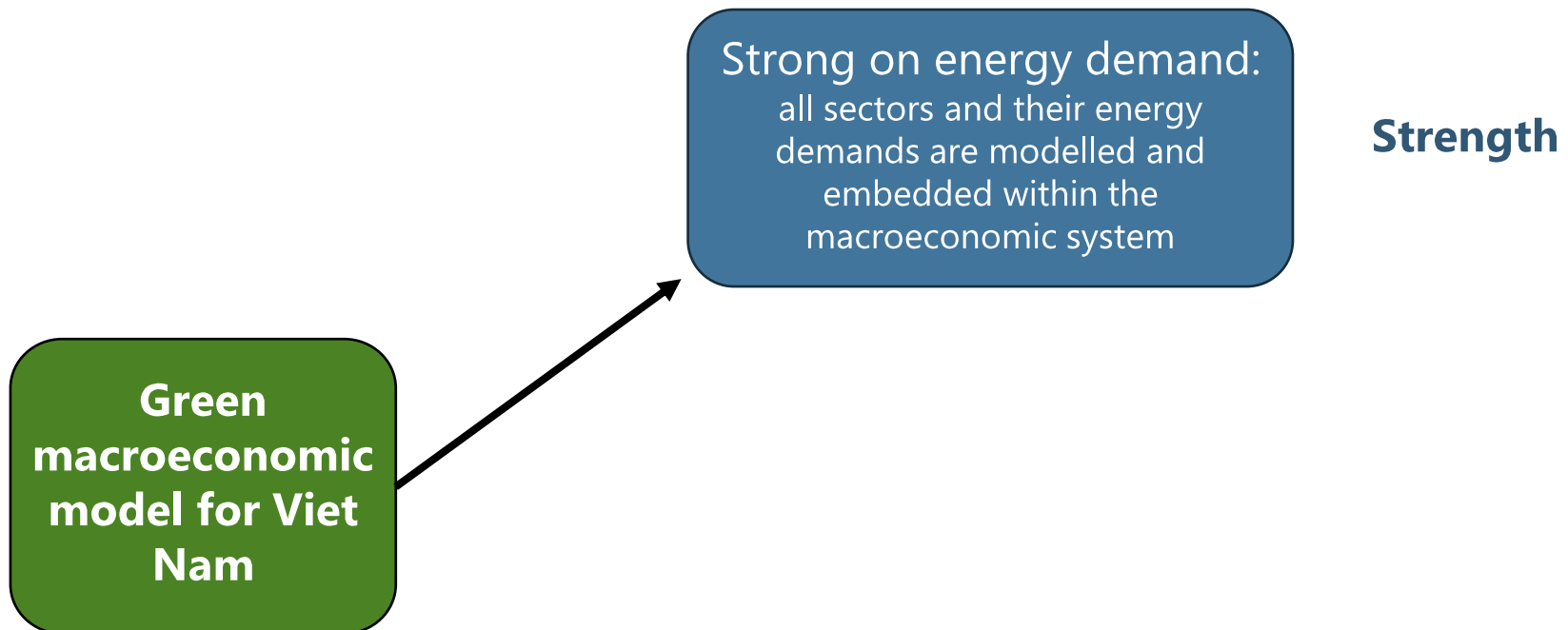
18.09.2026

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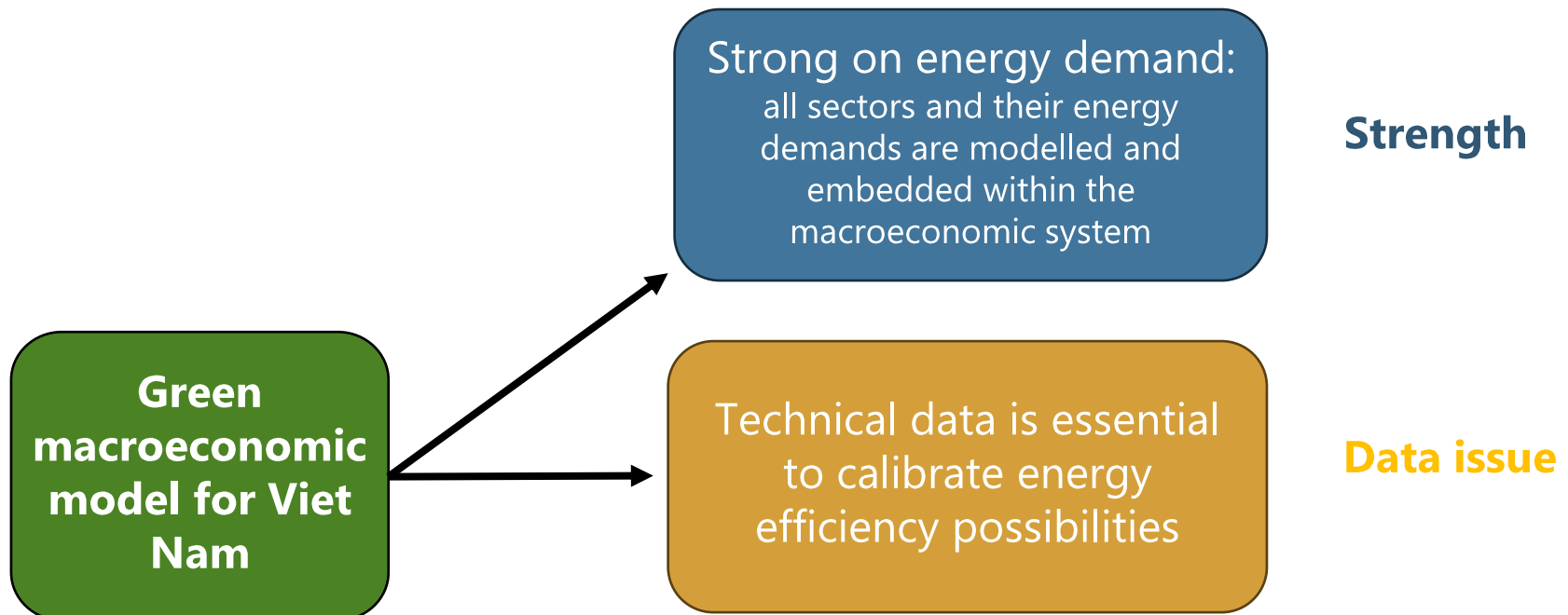
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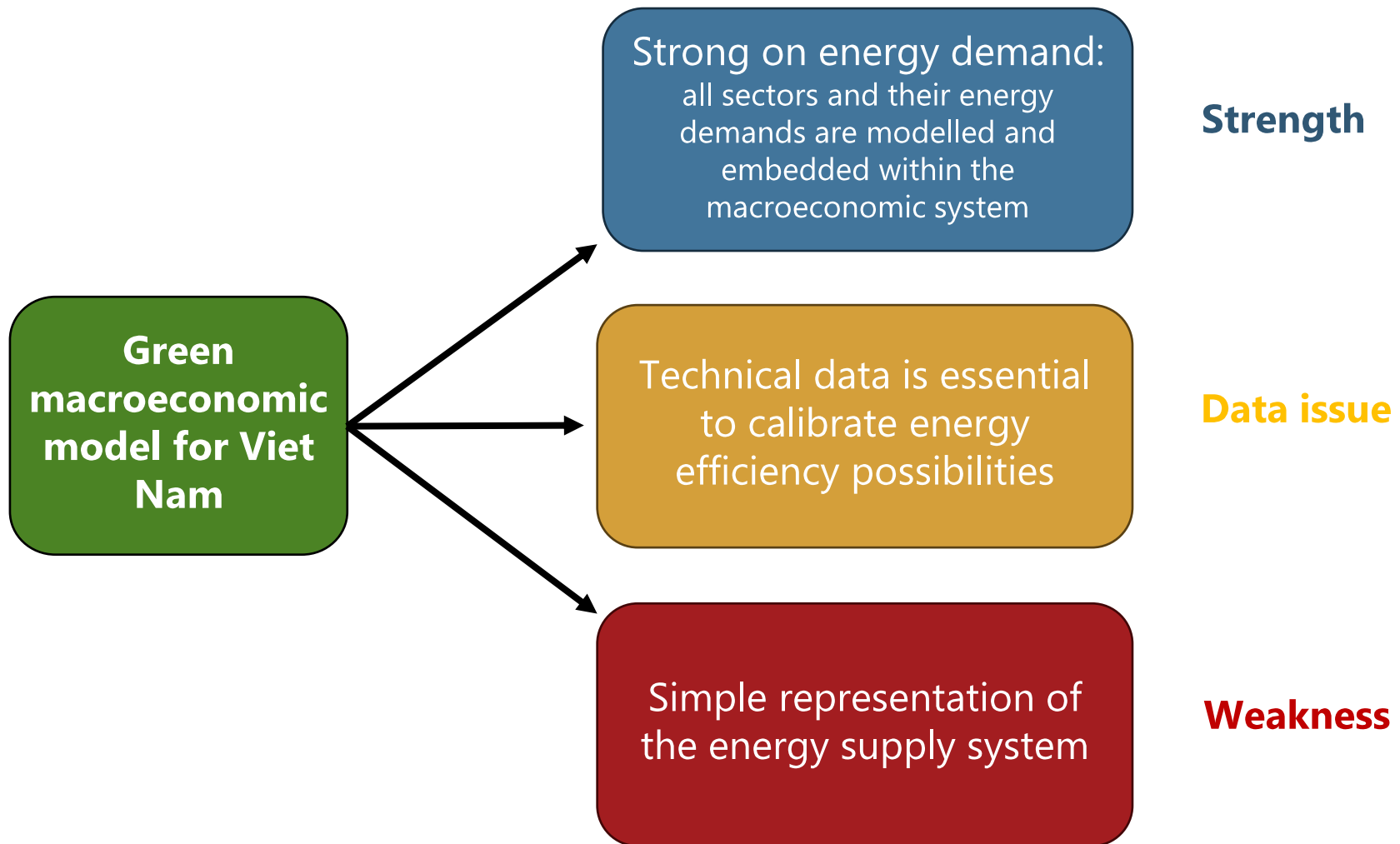
Strengths and weaknesses of our framework



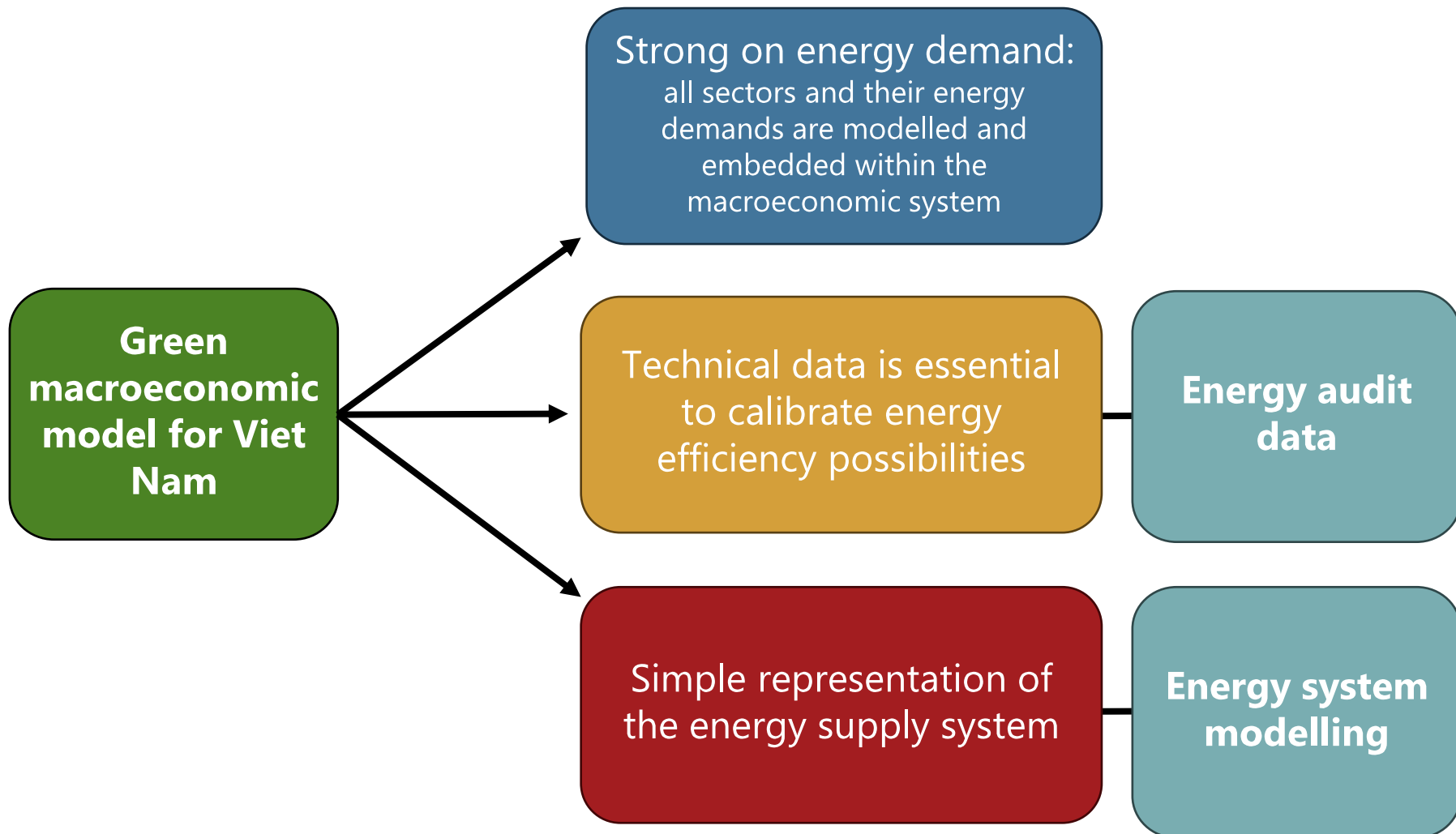
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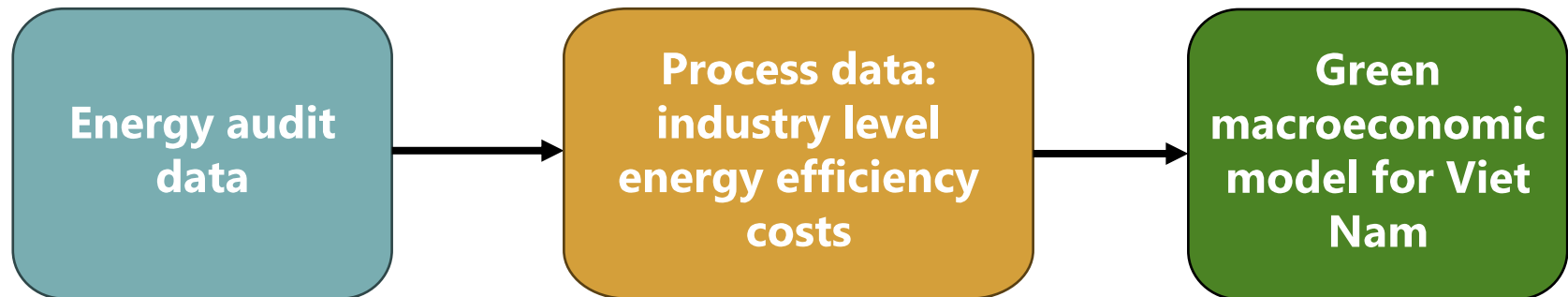
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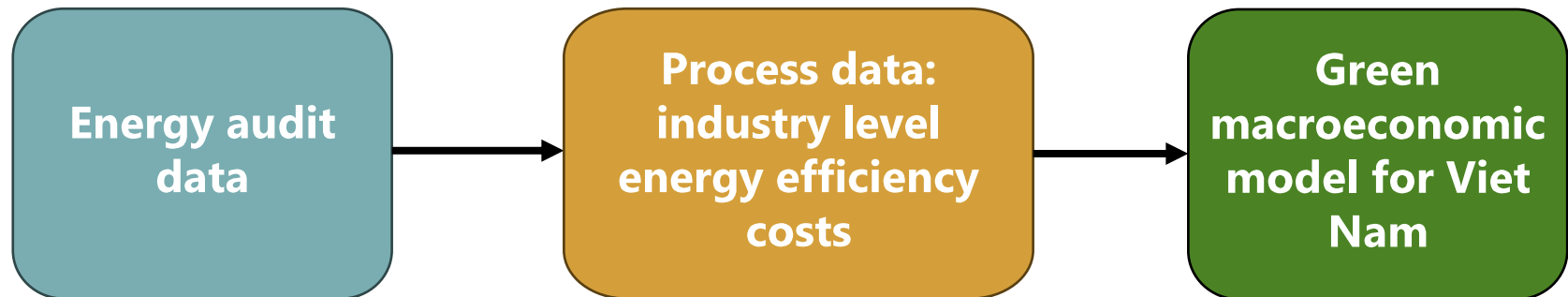
Strengths and weaknesses of our framework



Energy audit data and energy efficiency possibilities in a macroeconomic model

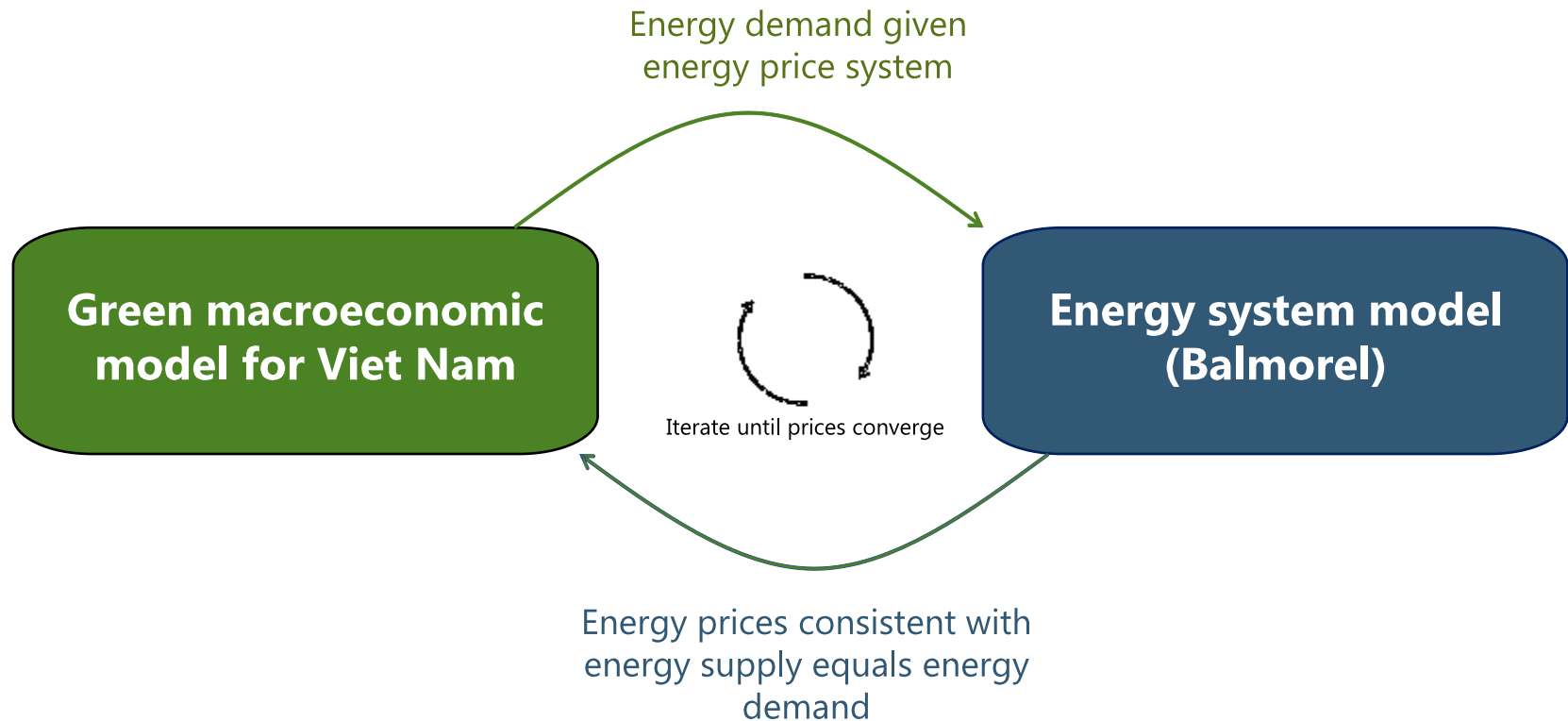


Energy audit data and energy efficiency possibilities in a macroeconomic model

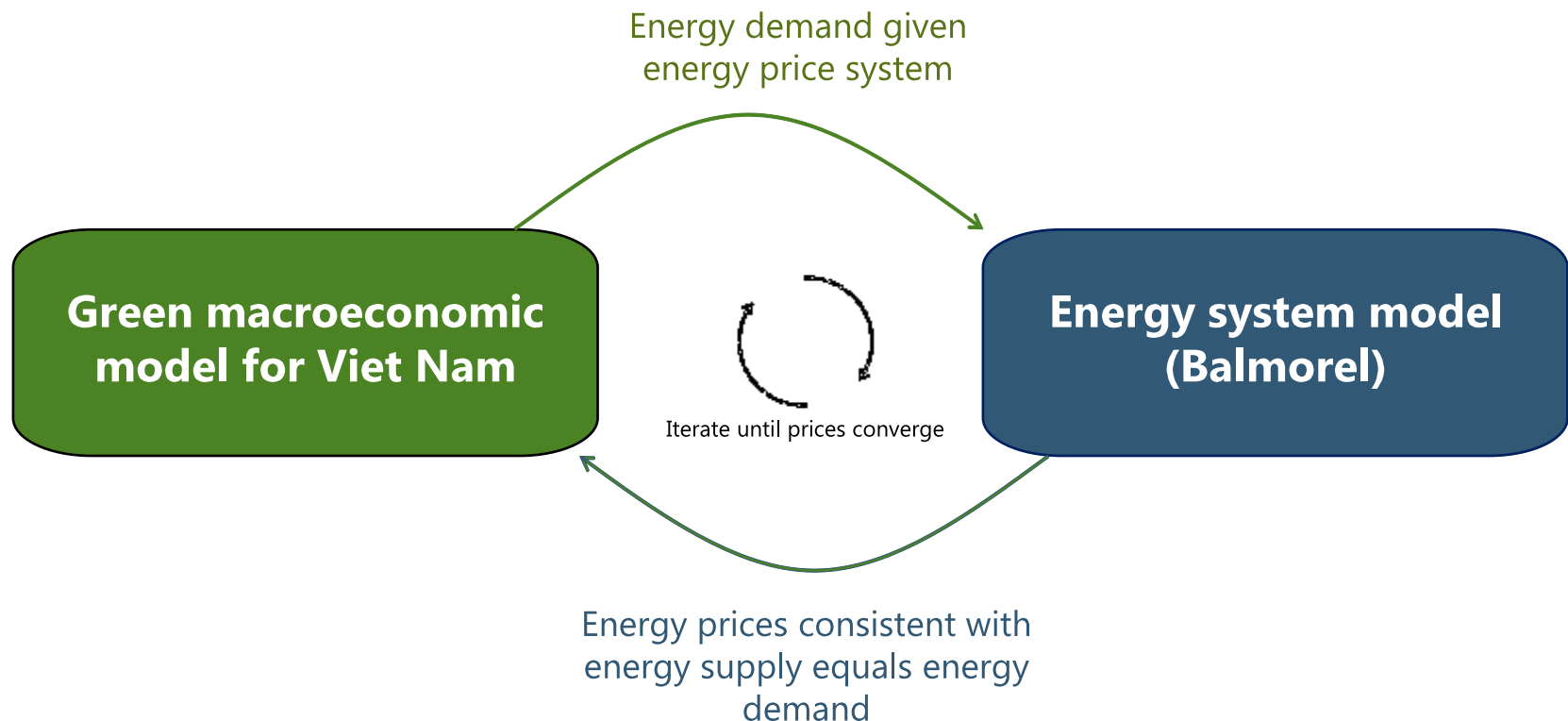


We want to develop a method to process the energy audit data into a technological possibilities frontier that can be utilized within the green macroeconomic model.

Energy system model and soft-linking: a potential research project with DTU



Energy system model and soft-linking: a potential research project with DTU



Together with DTU we hope to integrate our green macroeconomic model with the energy system model Balmorel. This will enable more holistic analyses and utilize the strengths of both models.

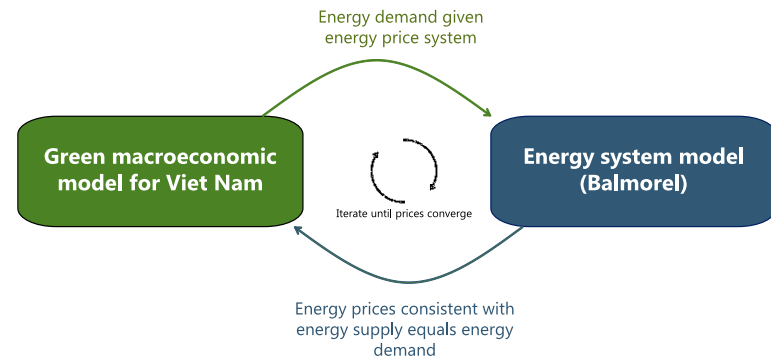
The wider implications

Viet Nam as a pilot project

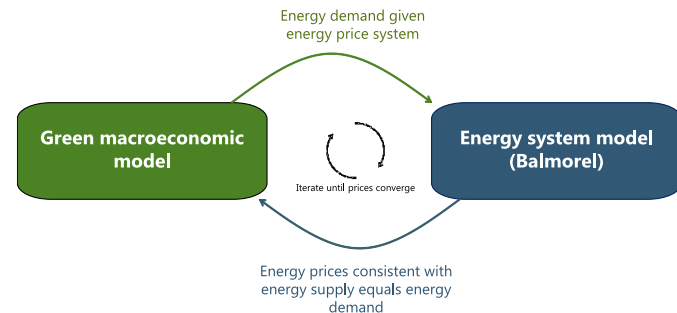
Method for processing energy audit data



Method for soft-linking models



A large number of other developing countries ...

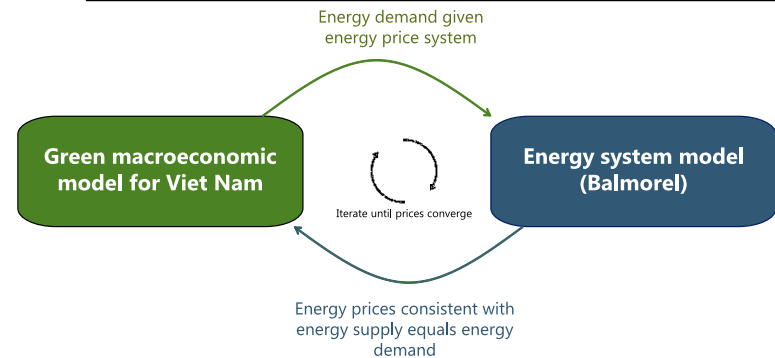


The wider implications

Note: Our aim is to develop the methods using Viet Nam as a pilot project. The developed techniques could then be used in many other settings around the world where DEA is active.

Viet Nam as a pilot project

Method for processing energy audit data



A large number of other developing countries ...

