Africa Energy Efficiency Policy in Emerging Economies Training Week

Indicators and Evaluation

Nairobi
18-22 March 2024

Review – what did we learn yesterday?

Charles Michaelis and Mafalda Silva

March 20 2024

Nairobi

International Energy Agency

What did we learn yesterday

1. Jot down anything you can remember from yesterday - even if it's just words or phrases, write these down (2 mins)
2. Working in pairs (5 mins)
   - Find out what your partner learned
   - Is there anything you're not sure about or would like to recap on
3. Update your notes
4. One pair from each table will share with the room
5. Anything missing?

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International Energy Agency

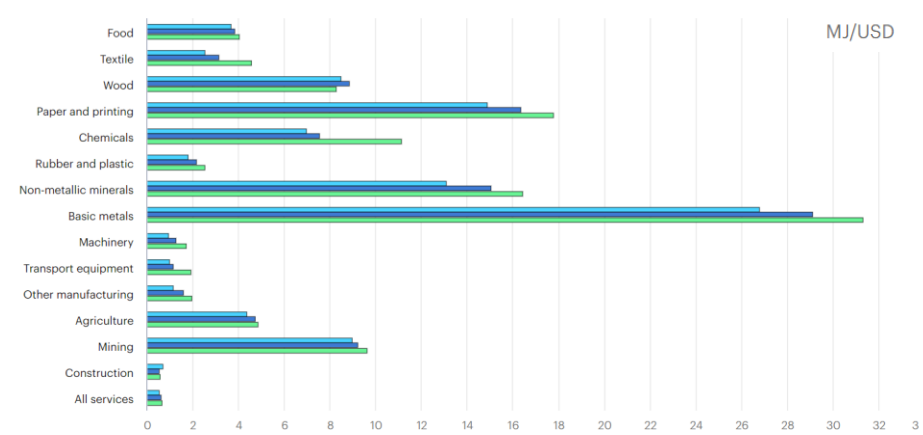
Data sources for developing efficiency indicators

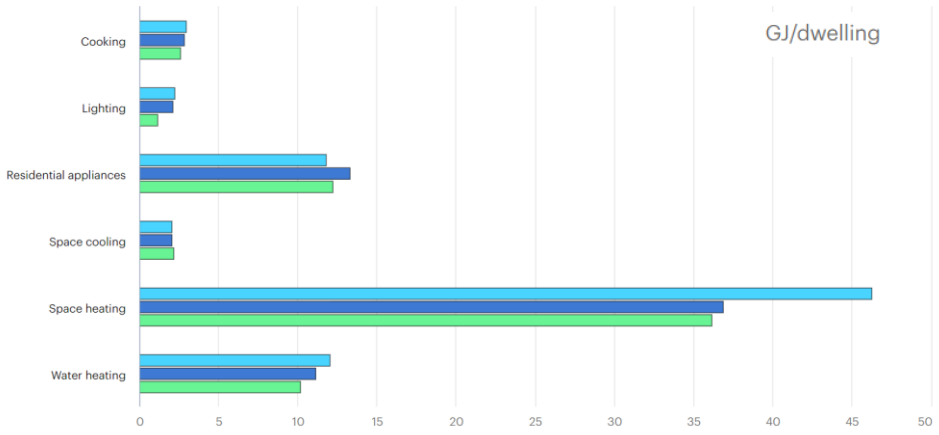
Mafalda Silva

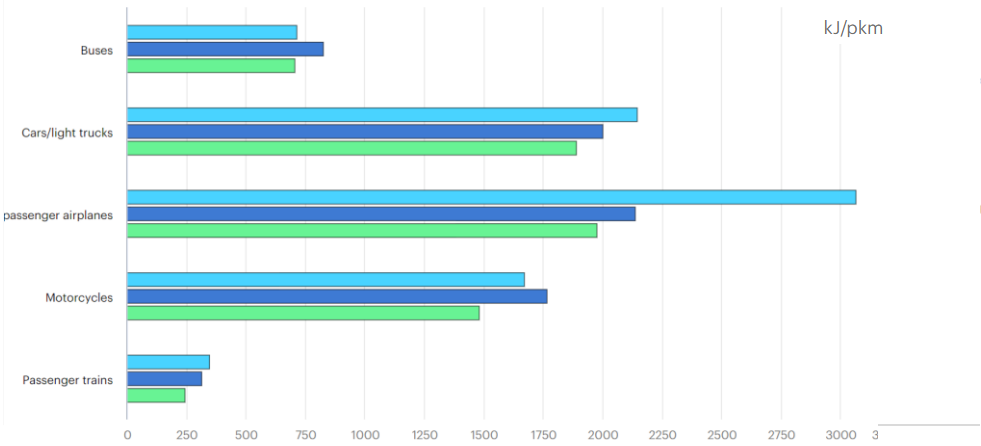
March 20 2024

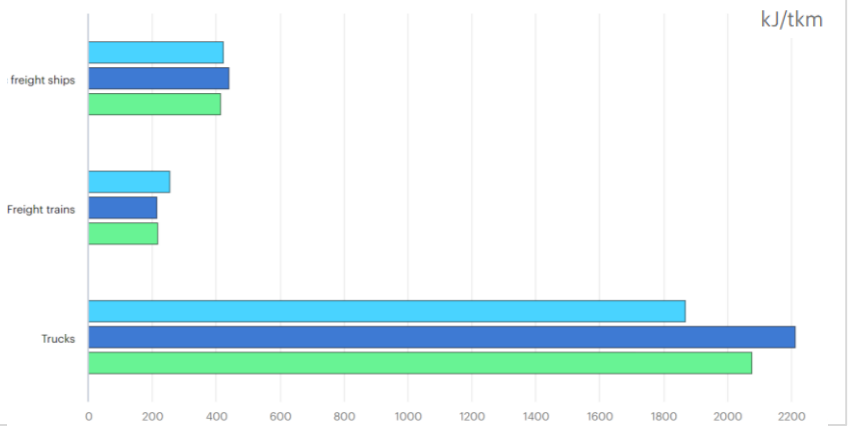
Nairobi

Efficiency indicators



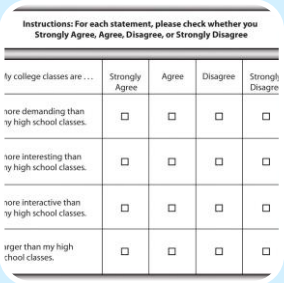






Source: IEA, *Energy Efficiency Indicators Highlights* , OECD/IEA, Paris.

Methods used by countries to collect data for indicators



Administrative sources

→ Before starting new data collection

→ **data-sharing across organizations**, identifying data

Surveys

→ representative sample (cost, time, accuracy, detail)

→ possibly expanding existing surveys

Metering and measuring

→ costly but very effective for monitoring specific equipment efficiency

→ identifying **specific energy-uses** (e.g. energy audits, smart meters)

Modelling

→ complementary to surveys or stand alone to build complete set of indicators which can be provided in a timely and stable manner.

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Administrative sources

For example; utilities, customs, national statistics

Pros	Cons
Avoids duplication by using existing data	Dependency on third parties
May allow for detailed breakdowns	May not provide exactly what you need
Relatively quick availability	May require standardization of the data collected
No sample error	Takes time to identify and negotiate
Increased synergy between institutions	Implies a certain level of bureaucracy

Source: IEA (2014), EUROSTAT (2013).

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Surveys

Pros	Cons
Designed to provide exactly the data needed	Time and resource intensive
Can provide comprehensive and good quality data	Risk of incomplete responses, biases, sampling errors
Can be used as input for modelling	May need further estimation (e.g. extrapolation between years)
	May requires dedicated skills

Consider partnering with national statistics office to use existing surveys

Source: IEA (2014), EUROSTAT (2013).

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Measuring and metering

Pros	Cons
Very detailed information	Privacy considerations
High quality and accuracy of data collected	High costs

Is there data available from smart meters?

Source: IEA (2014), EUROSTAT (2013).

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Modelling

Pros	Cons
Allows estimation of variables that cannot be measured	May not be accurate
Cost-effective	Relies on availability and quality of input data (no stand-alone methodology)
Designed based on purpose	Depends on assumptions made
Quick results	Transparency and traceability may be an issue
Can be used to improve/complement other data collection methods	

Source: IEA (2014), EUROSTAT (2013).

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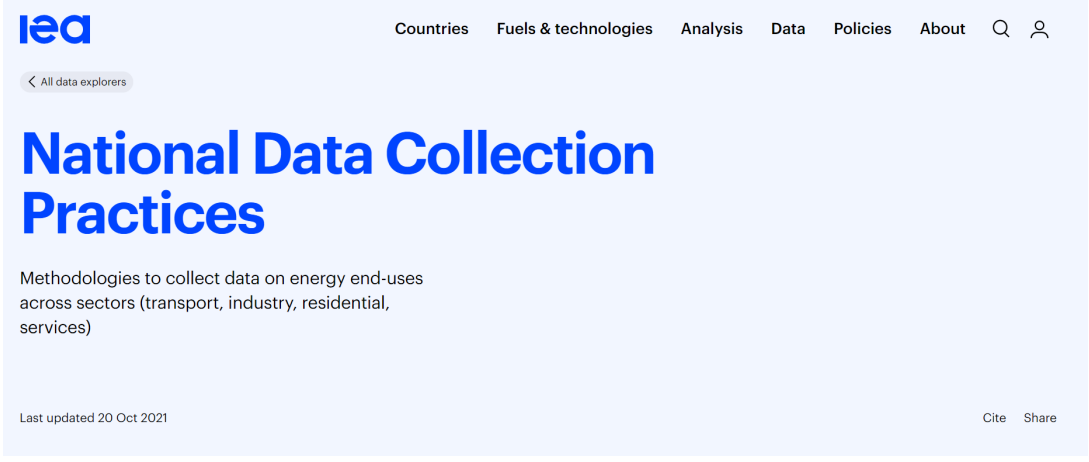
Where to get data?

Hints on data sources



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Some general principles for end use data collection

Where to start:

- Understanding data needs for policy
- Collect only what is needed – Identifying priority subsectors
- Research existing sources first (e.g. transport ministry)
- Allocation of resources
- Start with a mapping of data available and identification of gaps
- Consideration of biases for societal groups (gender, income groups etc.)

Key enablers:

- High-level awareness of detailed data needs for policy
- Defining a data collection methodology in line with national profile and allocated budget
- Sharing expertise across countries and organizations

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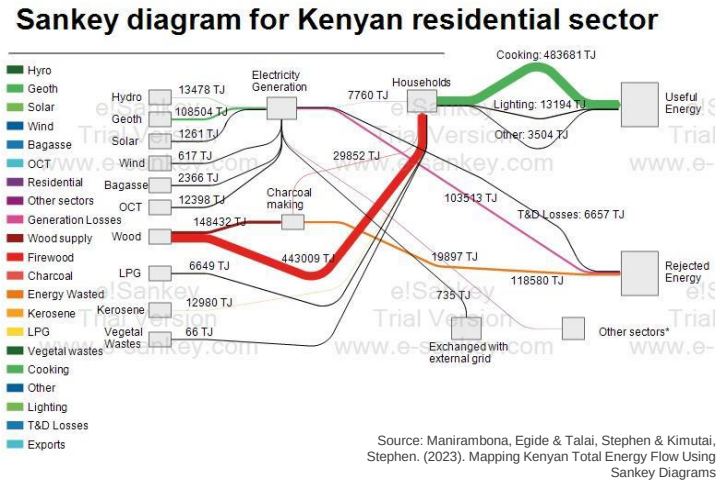
Some sources of evidence

- National statistics (e.g. product sales, ownership)
- Utilities
- Management information/reporting (e.g. building registries, energy audits)
- Measurement (e.g. meter readings)
- Modelling (e.g. LEAP)
- Surveys (e.g. household energy consumption, label compliance)
- Interviews and focus groups



Source: Manirambona, Egide & Talai, Stephen & Kimutai, Stephen. (2023). Mapping Kenyan Total Energy Flow Using Sankey Diagrams

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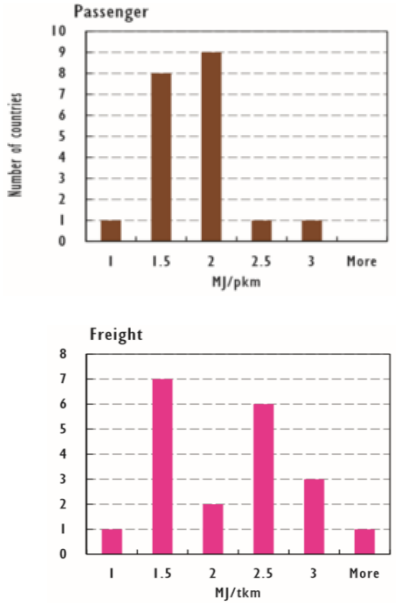
Data quality considerations

- **Coverage:** sub-sector boundary (ISIC), annual time-span, net calorific values
- **Internal consistency:** data coherence and summation, revision of historical data (changes in definition, sources, classifications, methodologies, etc.)
- **External sources consistency**: figures in national statistics or energy balances, publications from related authorities
- **Plausibility:** zero vs not-available, reasonability within expected range of values

Reported range EEI for transport (OECD 20)



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The role of new technologies in data collection

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Some digital methods

- Smart devices
- Web crawlers
- Big data
- Using AI to reveal patterns

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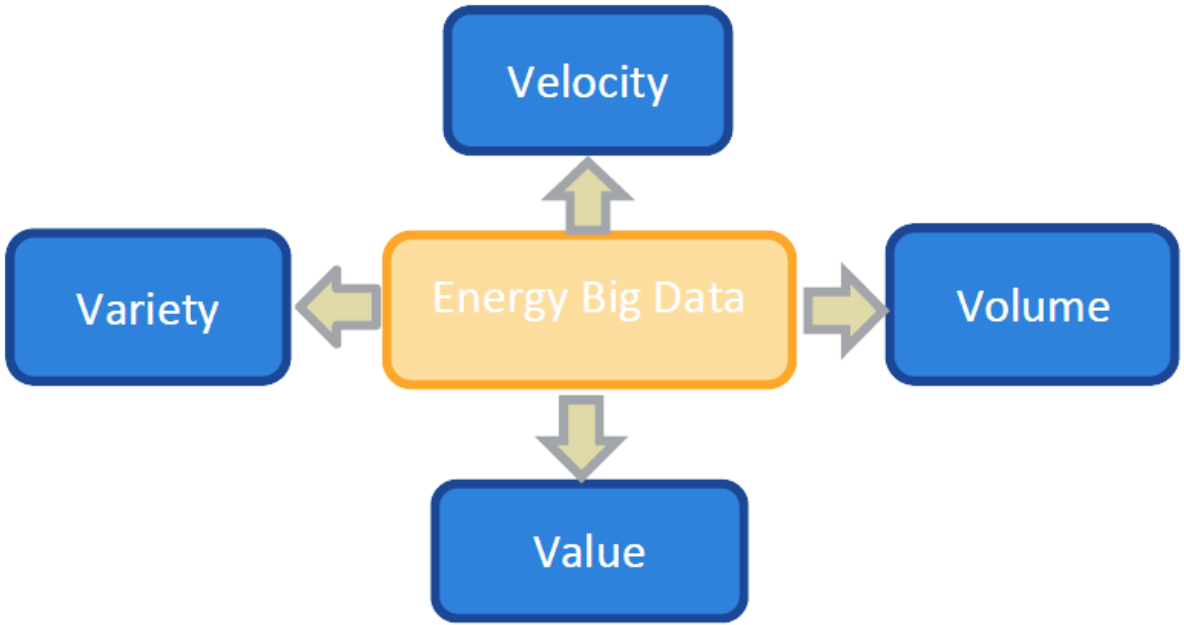
New technologies and digitalization open a world of *big data*

- The advantages of big data



Source: Koseleva and Ropaite (2017) Big data in building energy efficiency

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Examples of applications for the residential sector

Photo: PSMA Australia Photo: Geoscape - PSMA Australia

All of Australia's 15.2 million buildings have been mapped

https://www.domain.com.au/news/ai-machine-learning-helped-a-canberra-company-map-every-building-in-australia-779281/

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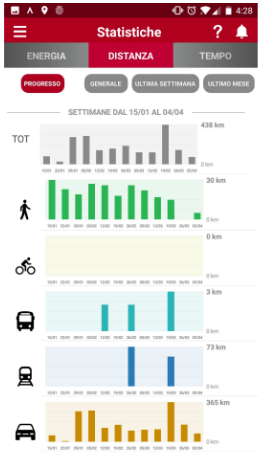
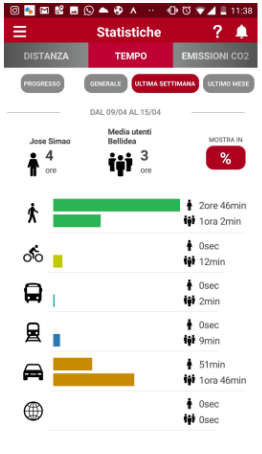
Examples of applications for the transport sector

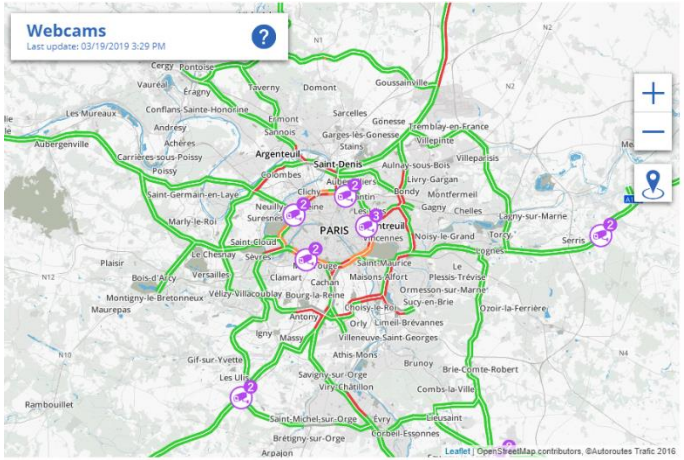




From left to right: weekly evolution of kilometers travelled; weekly share of transport modes and comparison with average Bellidea users; weekly evolution of points.

Source: Cellina et al (2018) Outcomes of a smart city living lab prompting low-carbon mobility patterns by a mobile app

Source: SmartComm Electronics Pte Ltd



Source: https://www.autoroutes.fr/en/webcams.htm

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Africa positioning on AI and smart tech

- https://www.isi-web.org/article/future-ai-statistics-africa-continent-ready

The Future of AI in Statistics in Africa: Is the Continent Ready?

16 October 2023

“Many African countries are recognizing the potential of AI in improving data collection, analysis, and decision-making.

International organizations and partnerships are also helping in this regard.”

Statistics have always been the silent force driving policy decisions, economic strategies, and social interventions in Africa. However, traditional statistical methods often grapple with challenges such as data collection from vast and remote areas, costs, timely analysis, and interpretation in the context of local nuances. AI has the potential to revolutionize these processes.

But the pertinent question remains: Are national statistical systems in Africa ready to embrace AI?

Infrastructure is the bedrock of any technological transformation. While urban centers in Africa are witnessing rapid digitalization, many rural areas still lack consistent internet connectivity and power supply. The human capital, though burgeoning with enthusiasm for technology, requires specialized training in AI-driven statistical methods. Financial constraints, often a hurdle, necessitate innovative funding models and partnerships. On the brighter side, collaborations with tech giants and international organizations are bridging some of these gaps, and institutions dedicated to AI research are sprouting across the continent.

Policy frameworks are another crucial aspect in the adoption of emerging technologies such as AI. Many countries lack robust policies and legislation on digitalization. Clear guidelines on data privacy, AI ethics, and technology adoption can expedite AI integration into statistics, ensuring transparency and fostering public trust. At the continental level, the African Union (AU) is actively engaged in AI governance. It formed an AI think-tank in 2019, and in 2022, the AU was urged to develop a continental AI strategy to enhance policy-making and address AI challenges and opportunities across African nations. This collective effort is essential for harmonizing AI policy and governance on the continent.

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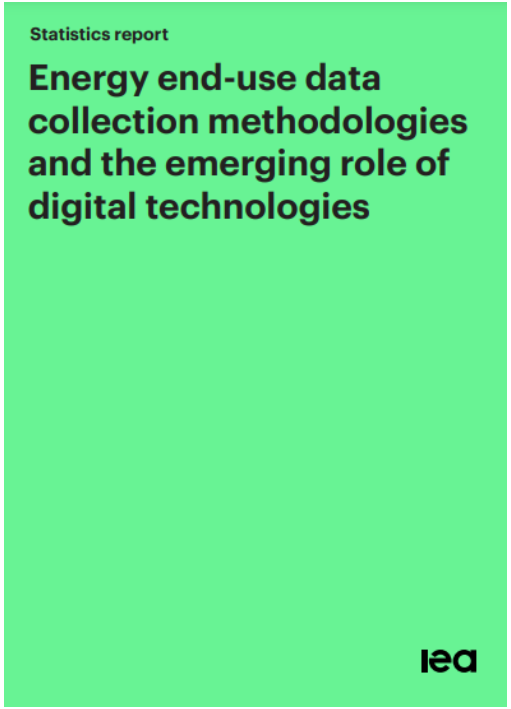
Open questions remaining

- Data ownership
- Data anonymisation and confidentiality issues
- Data security
- Data standardisation and processing: *easier to get in than out*



https://www.iea.org/reports/energy-end-use-data-collection-methodologies-and-the-emerging-role-of-digital-technologies

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Case study: Evaluation of energy audits in Industry

Mikael Togeby

March 20 2024

Nairobi

International Energy Agency

How to tell if your policy made a difference?

Charles Michaelis

March 20 2024

Nairobi

What is impact?

*Positive and negative, primary and secondary long-term effects **produced** by an intervention, directly or indirectly, intended or unintended.*

From OECD DAC

- What does impact mean – energy saving:
  - Compared to what (BAU, baseline)
  - By whom (women, men, large businesses/small)
  - What energy (e.g. gas, coal, electricity)
  - Does it translate into $$$ and CO2?
- What else might we be interested in?
  - Fairness
  - Prices
  - Jobs/economic development
  - Exports
  - Energy security

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Discussion

Our indicators show that energy efficiency increased but they do not show that the increase in energy efficiency was **caused** by the policy.

1. Does that matter? Why or why not?

2. How would you suggest we could investigate whether the policy has caused the observed change?

3. Have you got any relevant examples or experience from your work?

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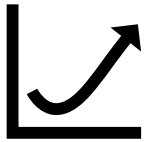
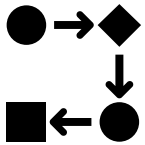
What impact is due to the policy rather than other causes?

Experiment



Statistics



Theory-based

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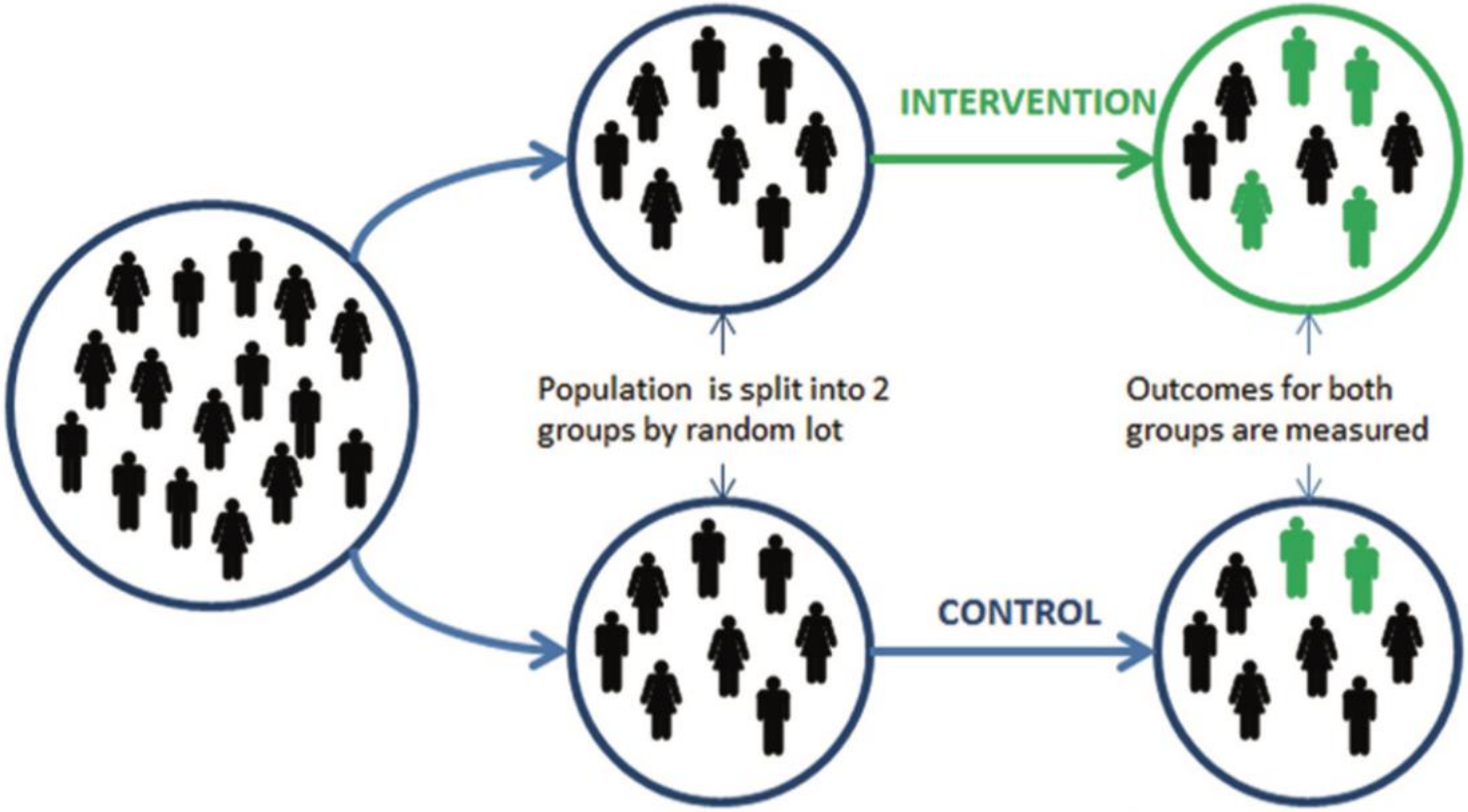
Approaches to causal attribution 1 – experimental



Experiment

How could you use an experiment to determine whether your policy had made a difference to energy efficiency?

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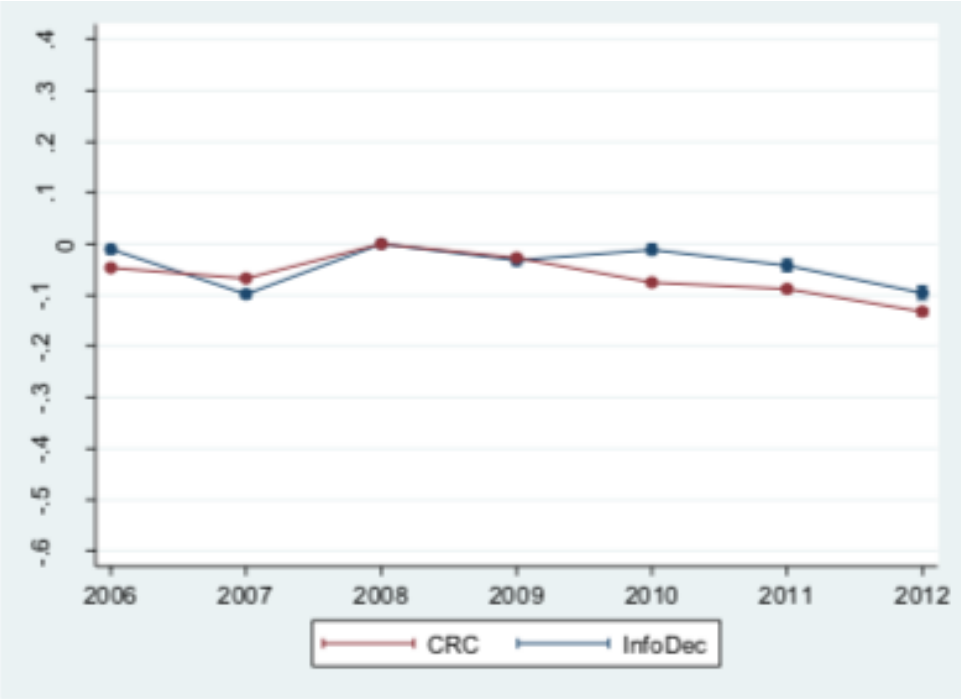
Approaches to causal attribution 2 - statistical

- Difference in difference
- Using meter data can compare changes in energy consumption between the group subject to the policy and a comparison group (difference in difference) before and after the policy implementation.



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Statistical methods

How could you use statistical methods to determine whether your policy had made a difference to energy efficiency?

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Approaches to causal attribution 3 – theory based

- A contributory cause is one that was was one of several necessary or likely necessary factors in a causal package that together brought about or influenced the changes observed (Mackie, 1974; Cartwright and Hardie, 2012; Mayne, 2012).
- Energy efficiency policy interventions are intended to be contributory causes, i.e. part of a causal package of factors that bring about or influence change.
- Contribution to impact can be measured using *Contribution Analysis* which involves
  - Developing a robust theory of change
  - Validating the causal narratives using rigorous methods such as...
    - Realist evaluation
    - Process tracing
    - Qualitative Comparative Analysis

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Theory-based methods

How could you use theory-based methods to determine whether your policy had made a difference to energy efficiency?

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Approaches to causal attribution

Method	Strengths	Weaknesses
Experimental and Statistical	• "Prove" effect of policy • In the circumstances of the test (when, where) • For the indicator being measured	• Doesn't tell you why the policy worked/doesn't work • Doesn't tell you if the policy will work in other circumstances • Challenging to design and implement
Theory-based	• Reflects more of the influences on outcome • Explains why and how change happens • Utilises diverse evidence • Considers alternative explanations	• Approximate impact estimate • Doesn't provide proof of impact • Complexity can be challenging to communicate

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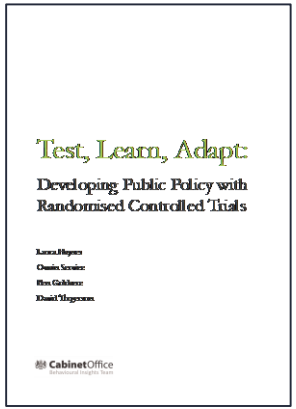
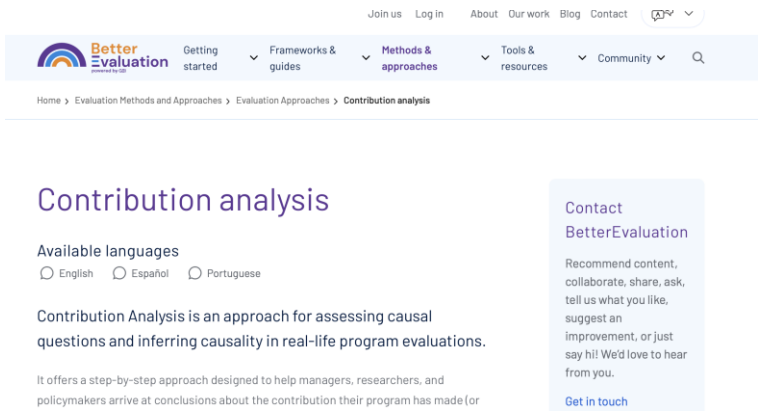
Causal attribution resources





https://assets.publishing.service.gov.uk/media/5a7488c8e5274a7f9c586c23/TLA-1906126.pdf

https://openknowledge.worldbank.org/entities/publication/ebbe3565-69ff-5fe2-b65d-11329cf45293

https://www.researchgate.net/publication/337852477_Revisiting_Contribution_Analysis

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How does the policy affect different people?

Charles Michaelis

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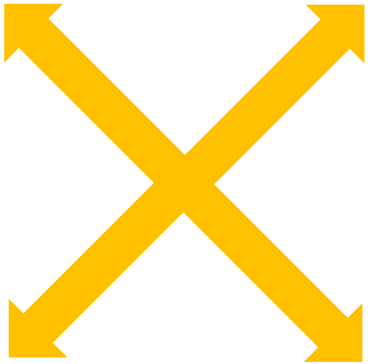
Dimensions of GESI in Evaluation

Economic

- Distribution of costs
- Distribution of benefits

Process

- Involvement of societal groups
  - Women
  - Young people
  - People with disabilities
  - Minorities



Operational

- Diversity in the evaluation team
- Accessible reports

Impact

- Equitable distribution of
  - Energy savings
  - Multiple benefits

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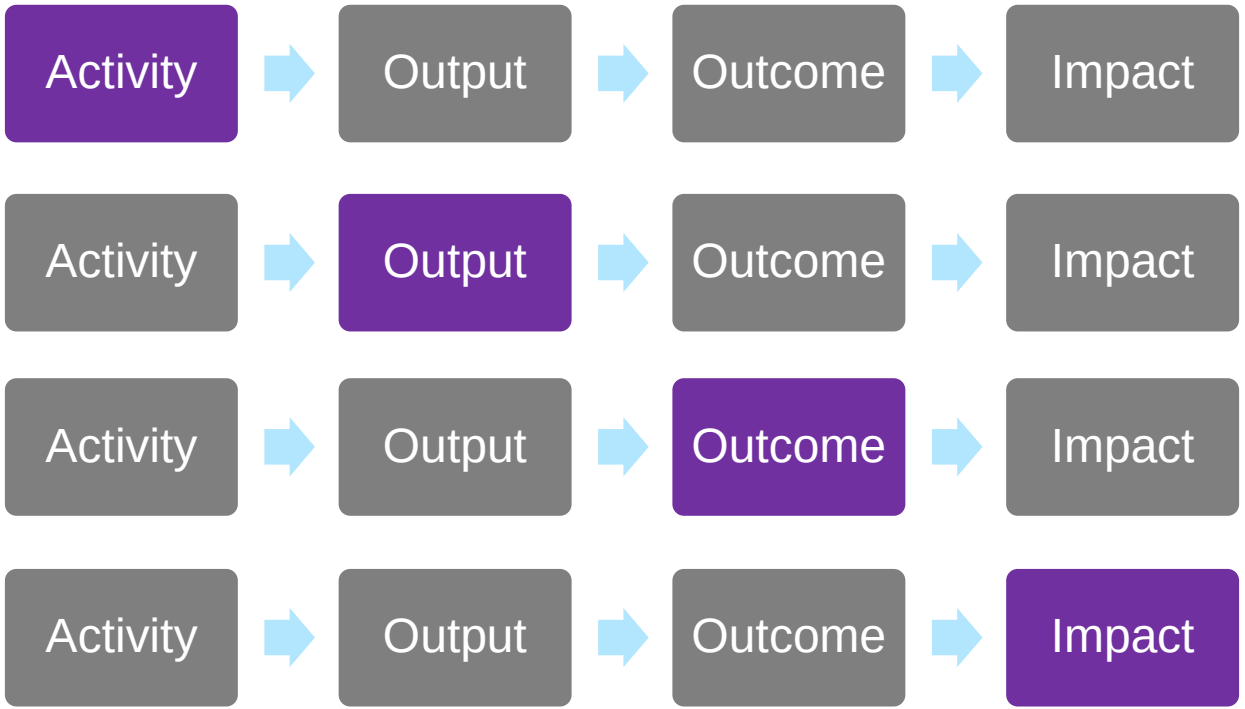
Gender Equality and Social Inclusion (GESI) evaluation questions



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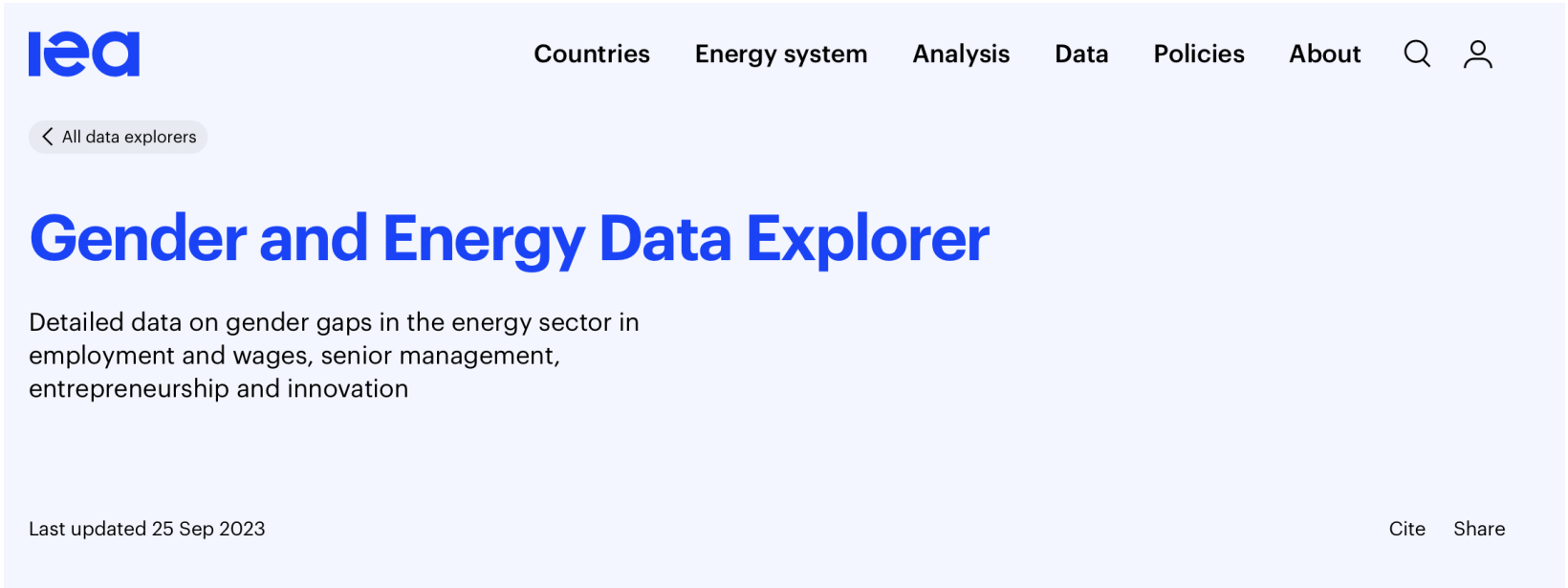

https://www.iea.org/data-and-statistics/data-tools/gender-and-energy-data-explorer?Topic=Employment&Indicator=Gender+wage+gap+conditional+on+skills

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Developing an evaluation framework for doubling energy efficiency

Charles Michaelis and Mafalda Silva

March 20 2024

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OECD Development Assistance Committee criteria for evaluation

http://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

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Breakout groups - developing an evaluation framework

- What questions do you want to address?
  - **Effectiveness**
  - **Efficiency**
  - **Impact**
  - **Relevance**
  - **Coherence**
  - **Sustainability**
- How will you tell if your policy made the difference?
- What data and evidence will you need?
- Who will use this evidence and how will they be engaged in the process?

You will need to build on the Theory of Change and indicators that you have already developed.

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Report back from breakout groups

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Using indicators and evaluation

Mafalda da Silva and Charles Michaelis

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Discussion – think, pair, share

- What are the key things you have learned?
- How will you use them in your work?
- What are your next steps?
- Do you need any help?

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Where to get help

Mafalda da Silva and Charles Michaelis

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Useful evaluation resources

www.betterevaluation.org

https://www.gov.uk/government/publications/the-magenta-book

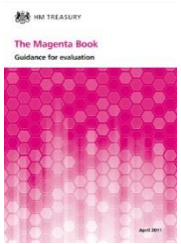
www.energy-evaluation.org

https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

https://www.oecd.org/dac/evaluation/Integrating-Gender-into-IEG-Evaluation-Work.pdf

https://assets.publishing.service.gov.uk/media/57a08a6740f0b6497400059e/DFIDWorkingPaper38.pdf

BetterEvaluation
Sharing information to improve evaluation



ENERGY EVALUATION

OECD
BETTER POLICIES FOR BETTER LIVES

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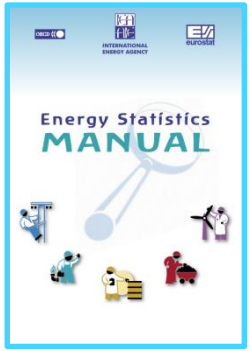
Resources on Energy Statistics

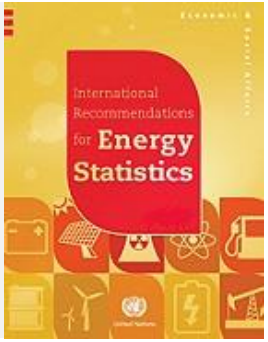
The IEA produced a comprehensive Energy Statistics Manual covering most of our data collection methodologies, consistently with the IRES framework.

A comprehensive Energy Statistics Manual available in 10 languages.



Visit the IEA's Statistics website to access additional resources, including our questionnaires, glossary and documentation related to our data collection methodologies.

To learn more about the international framework for energy statistics, please refer to the United Nations' International Recommendations for Energy Statistics (IRES).



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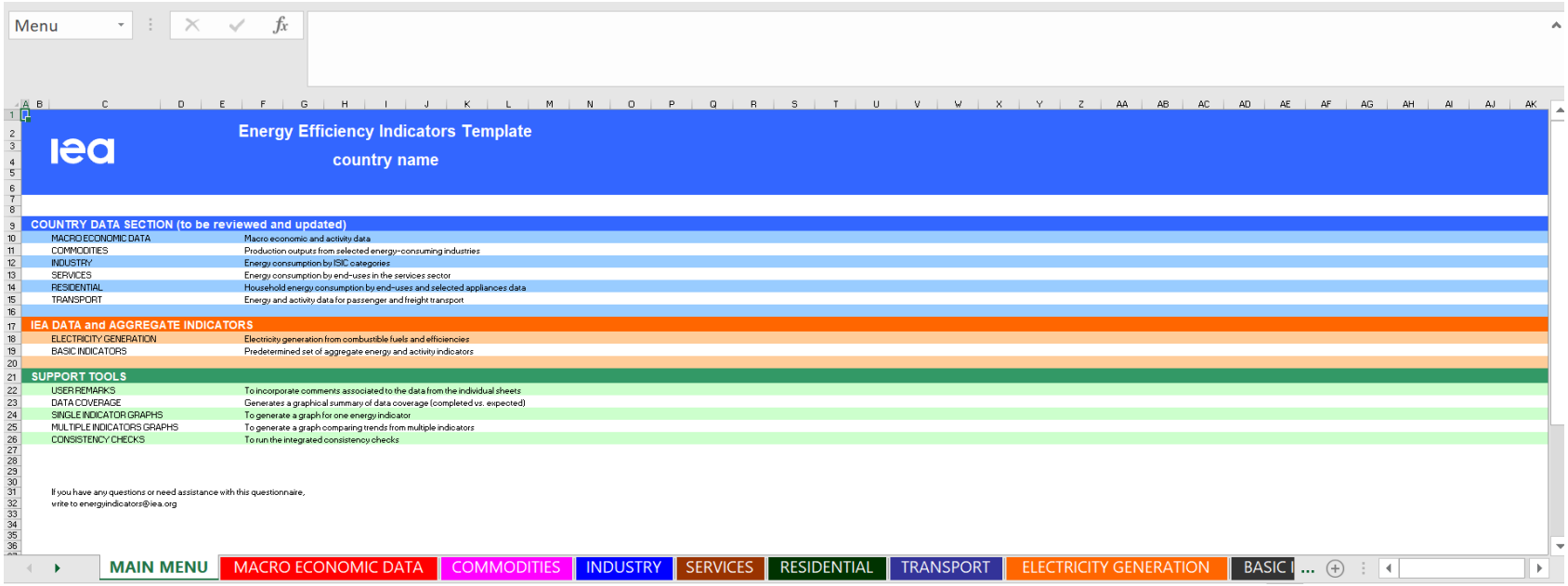
IEA energy efficiency indicators questionnaire

- A user-friendly **Excel questionnaire** (available online)



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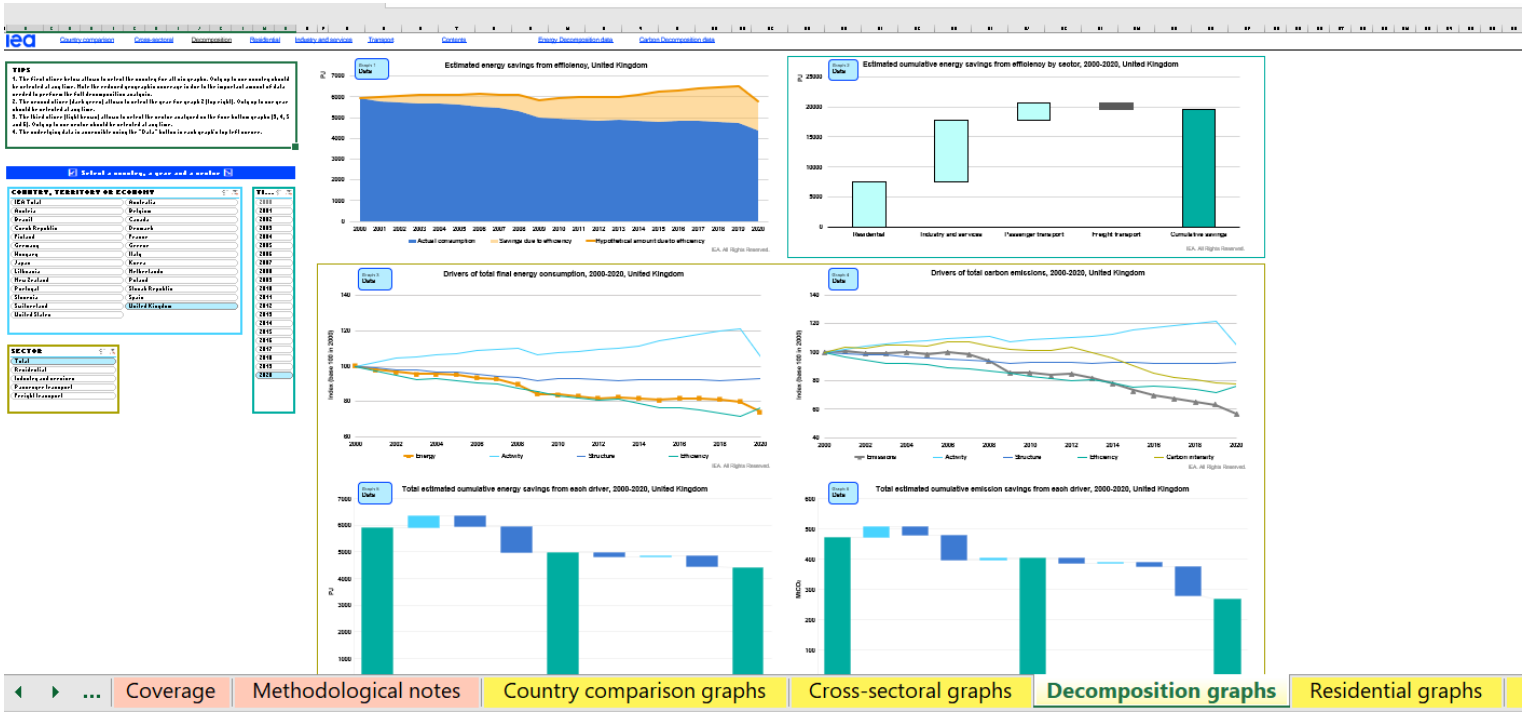
Energy Efficiency Indicators Highlights

- https://www.iea.org/data-and-statistics/data-tools/energy-efficiency-indicators-data-explorer



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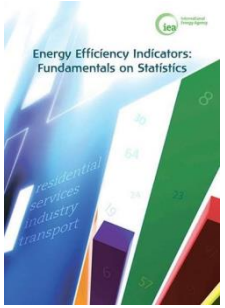
IEA resources : methodologies on indicators

- International guidelines are key to ensure comparability of data and indicators across countries

Fundamentals on statistics:

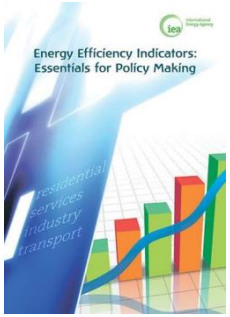
to provide guidance on how to collect the data needed for indicators

- Includes a compilation of existing practices from across the world
- https://webstore.iea.org/energy-efficiency-indicators-fundamentals-on-statistics



Essentials for policy makers:

- To provide guidance to develop and interpret indicators
- https://webstore.iea.org/energy-efficiency-indicators-essentials-for-policy-making



Both available also in:
Spanish
Russian
Chinese

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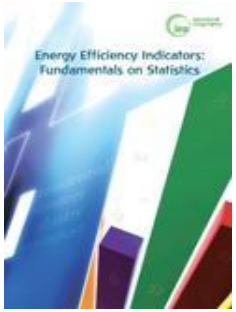
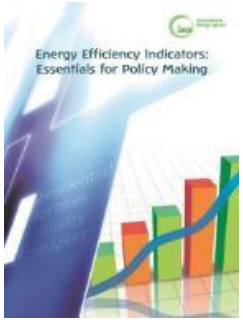
IEA e-learning courses: capacity building on energy efficiency data

- **Energy Efficiency Indicators: Fundamentals on Statistics**



- **Energy Efficiency Indicators: Essentials for Policy Making**



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IEA Energy Statistics videos: resources for everybody

Training

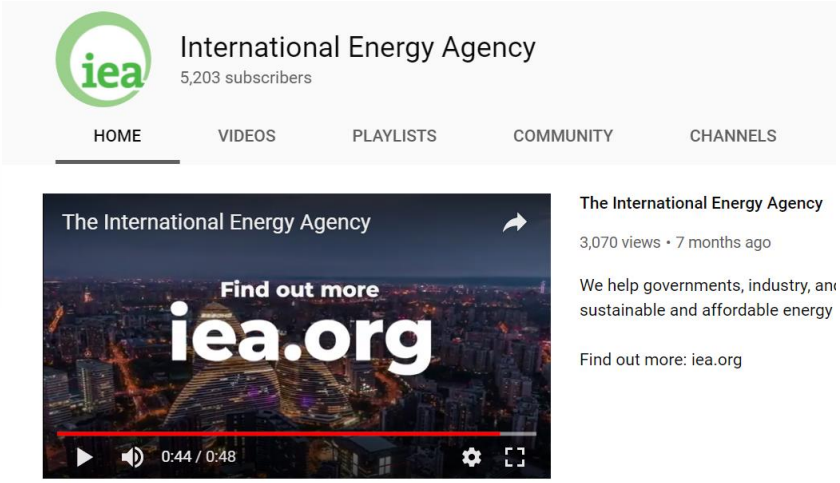
The IEA offers hands-on training for energy statisticians, analysts and others working on energy policy, as well as webinars and an online training programme for those who cannot attend training in person.

Energy Statistics Weeks

Statistics webinars

Online statistics training programme

YouTube



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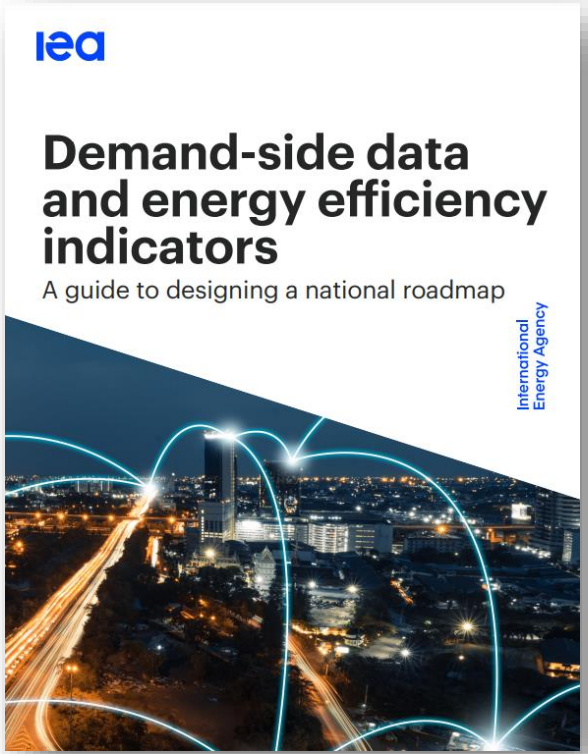
Roadmap on demand-side data and energy efficiency indicators



https://www.iea.org/reports/demand-side-data-and-energy-efficiency-indicators

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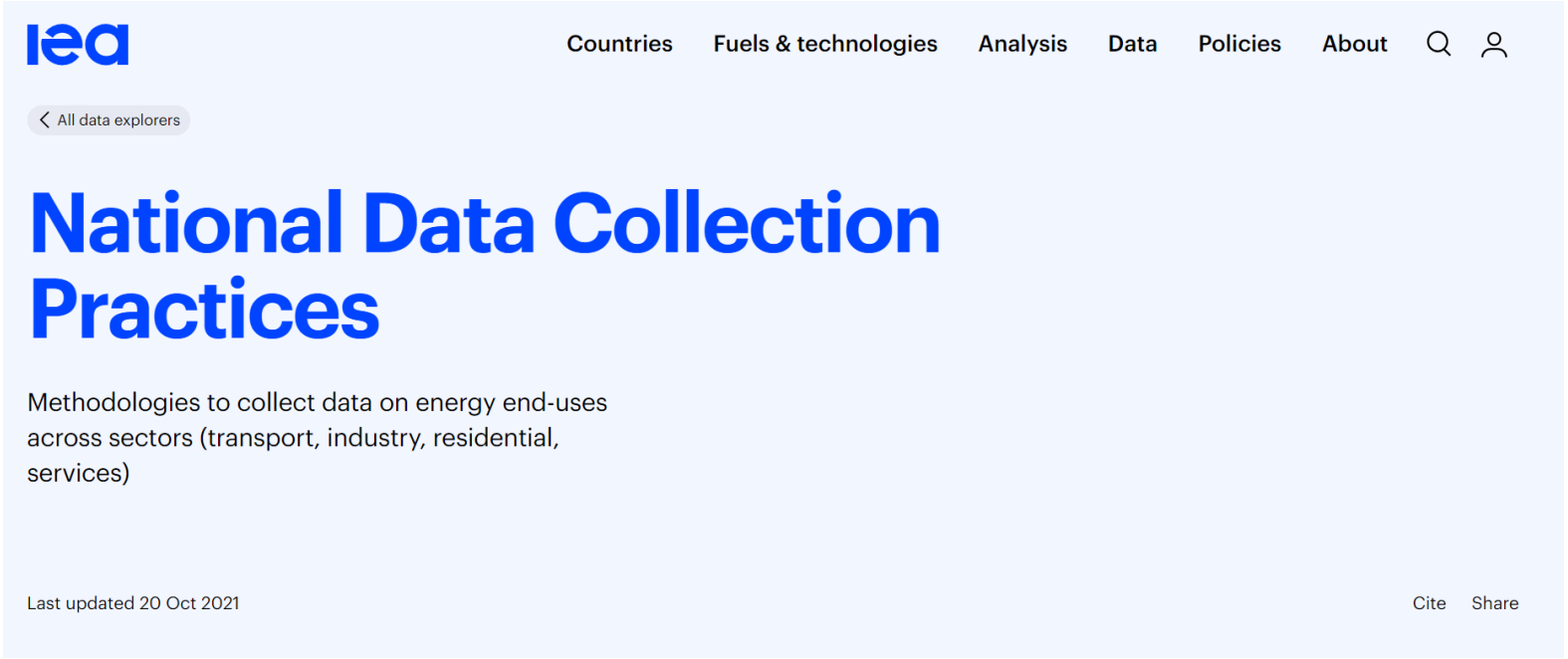
IEA database on national data collection practices



https://www.iea.org/data-and-statistics/data-tools/national-data-collection-practices

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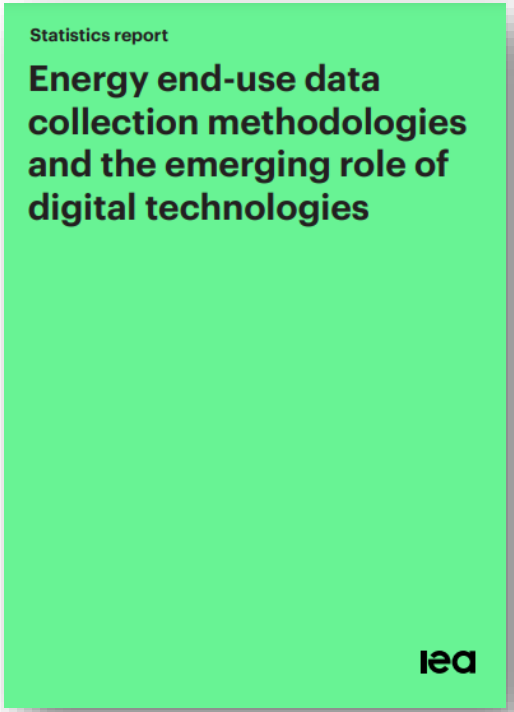
The emerging role of digital technologies for data collection



https://www.iea.org/reports/energy-end-use-data-collection-methodologies-and-the-emerging-role-of-digital-technologies

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International Energy Agency

Feedback and close

Mafalda Silva and Charles Michaelis

March 20 2024

Nairobi

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EVALUATION OF INDUSTRIAL ENERGY AUDITS

Mikael Togeby, miktog@um.dk
Sector counsellor, Energy
Royal Danish Embassy
Addis Ababa

ABOUT ME

Responsible for Many evaluations of Danish Energy efficiency instruments

Evaluation of the **Energy Efficiency Obligation** in Denmark

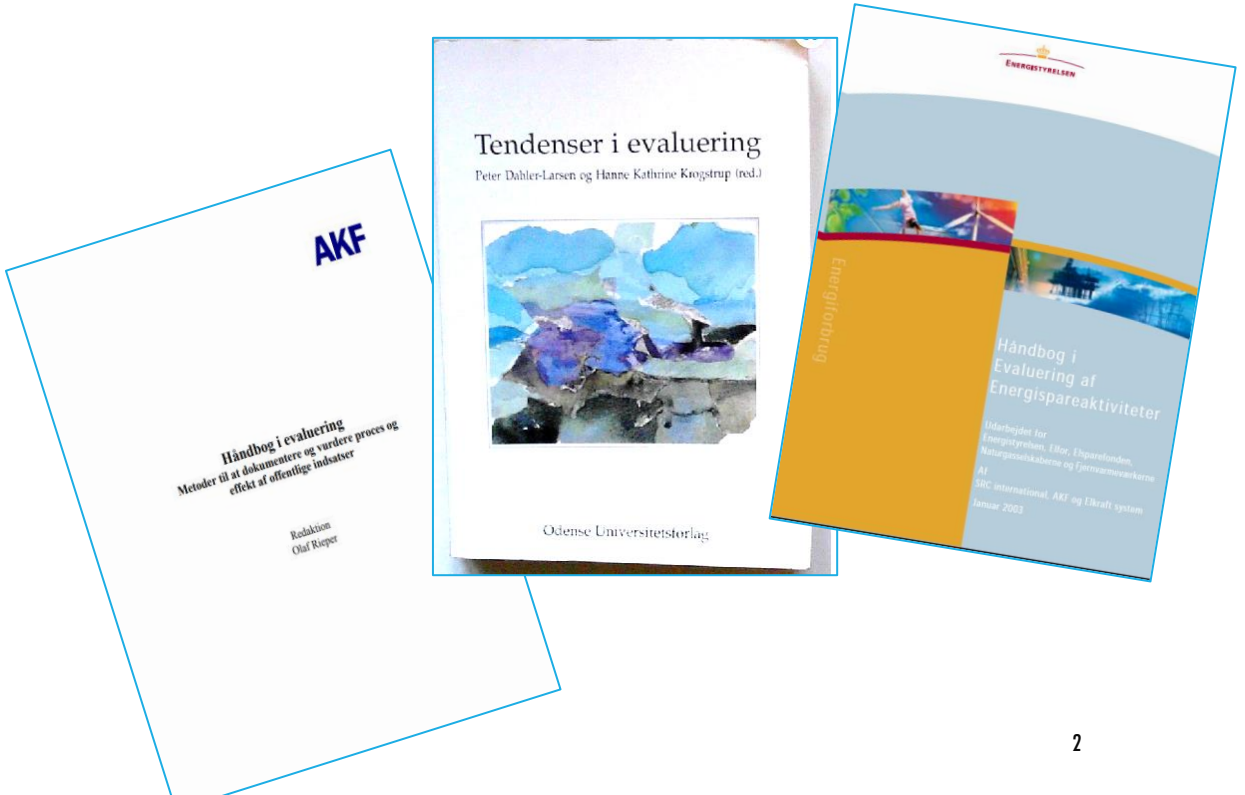
Evaluation of **"Knowledge centre for energy efficiency in buildings"**

Evaluation of **"Energy utilities energy efficiency obligations"**

How to manage **"additionality"** in relation to the Danish energy efficiency obligation

Evaluation of **all Danish energy efficiency programme**

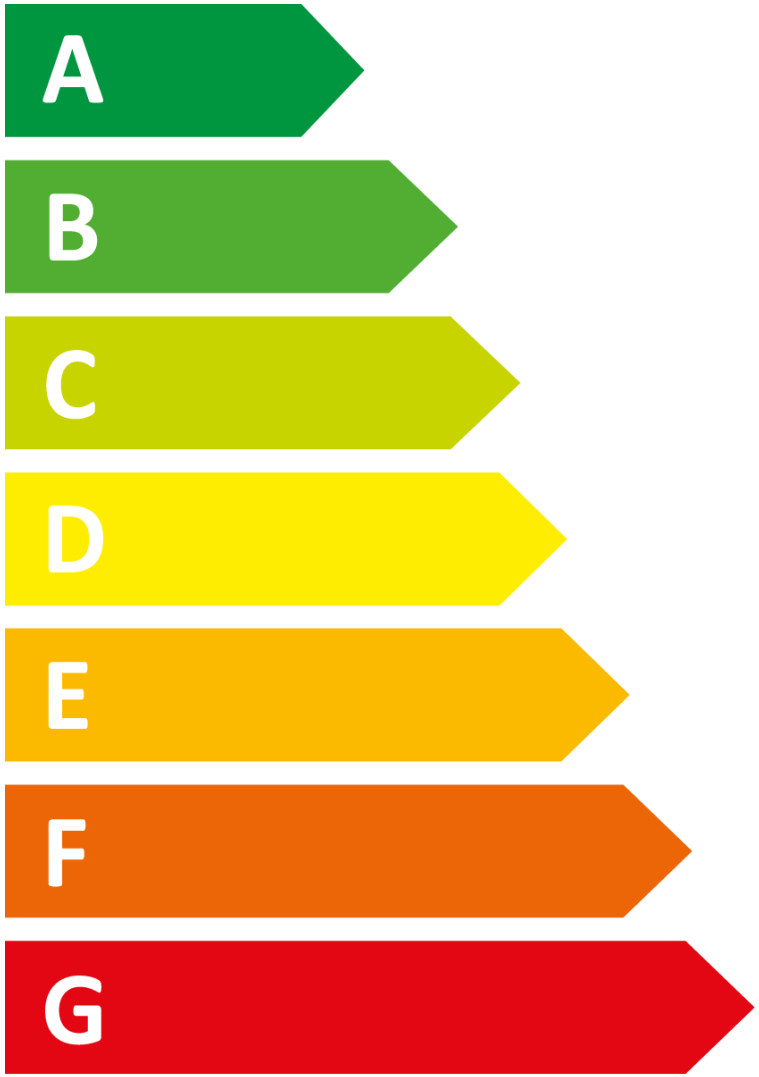
Co-authored three handbooks about evaluation



INDUSTRIAL ENERGY AUDITS

POLICY INSTRUMENTS

- Informative
  - Campaigns
  - Labelling
  - **Energy audits**
- Economic
  - Taxes and tariffs
  - Subsidies
- Normative
  - Minimum Energy Performance Standards (MEPS)
  - Building codes



ENERGY AUDIT

"Provision of technical and economical information about potential energy efficiency improvements – adapted to the individual location"

- Focus
  - Boiler
  - House
  - **Industry**

Energy audits can be good to capture the complexity of industrial processes and energy demand

Cost/Benefit balance very good for energy audits for large end-users, but very challenging for households and companies with small energy demands (shops, service sector)

TWO DANISH EXAMPLES

CO_2-tax exemption: Voluntary, but with strong economic incentive

- Heavy industry could get CO_2 tax refunded, if they performed an energy audit
- Energy audit, energy management, special investigations, mandatory implementation
  - Audit was defined by rules, auditor should be certified

Energy utilities (electricity, natural gas, oil, district heating) EE obligation: Voluntary for companies to participate

- Energy utilities mandated to work for energy efficiency (GJ goal of realised savings)
- Free to select type of instrument, energy type and area
- Energy audits was often used
  - Some time combined with subsidy
- Voluntary for companies to participate and to decide on investments

NET SAVINGS

"The concept of net energy savings is fairly simple:

What were the true effects produced by a program or intervention in terms of energy savings, separated out from what would have otherwise occurred absent the program or intervention?

Unfortunately, this simple concept is exceptionally difficult to measure in practice…" (Vine et al., 2010)

FREE-RIDERS

Important to correct for free-riders

- Good to recommend project, that the company already knew about.
  - Higher rate of implementation
  - However, this could also result in more free-riders

Difficult to measure free-riders:

- Self reporting, e.g.
  - *Did you know about this possibility before the audit?*
  - *Would you have realised this project without the audit?*

SOCIO-ECONOMIC BALANCE

- Cost and benefit for all stakeholders
  - The highest level of economic analysis
  - Can be supplemented by stakeholders analyses, e.g. participants and non-participants

- If the socio-economy is good, a way exist to give surplus for all stakeholders

* For industry, a life time of 5 years was used

Socio-economic balance

Costs	Benefits
Investments (of additional projects)	Net present value of energy savings (of additional projects) *
Audit	

Note: Subsidies are only transfer and not included. "True costs" are used – not tariffs that are not cost-reflective

ENERGY AUDITS IN EE OBLIGATIONS SCHEME

- Select energy utility
- Select energy audits

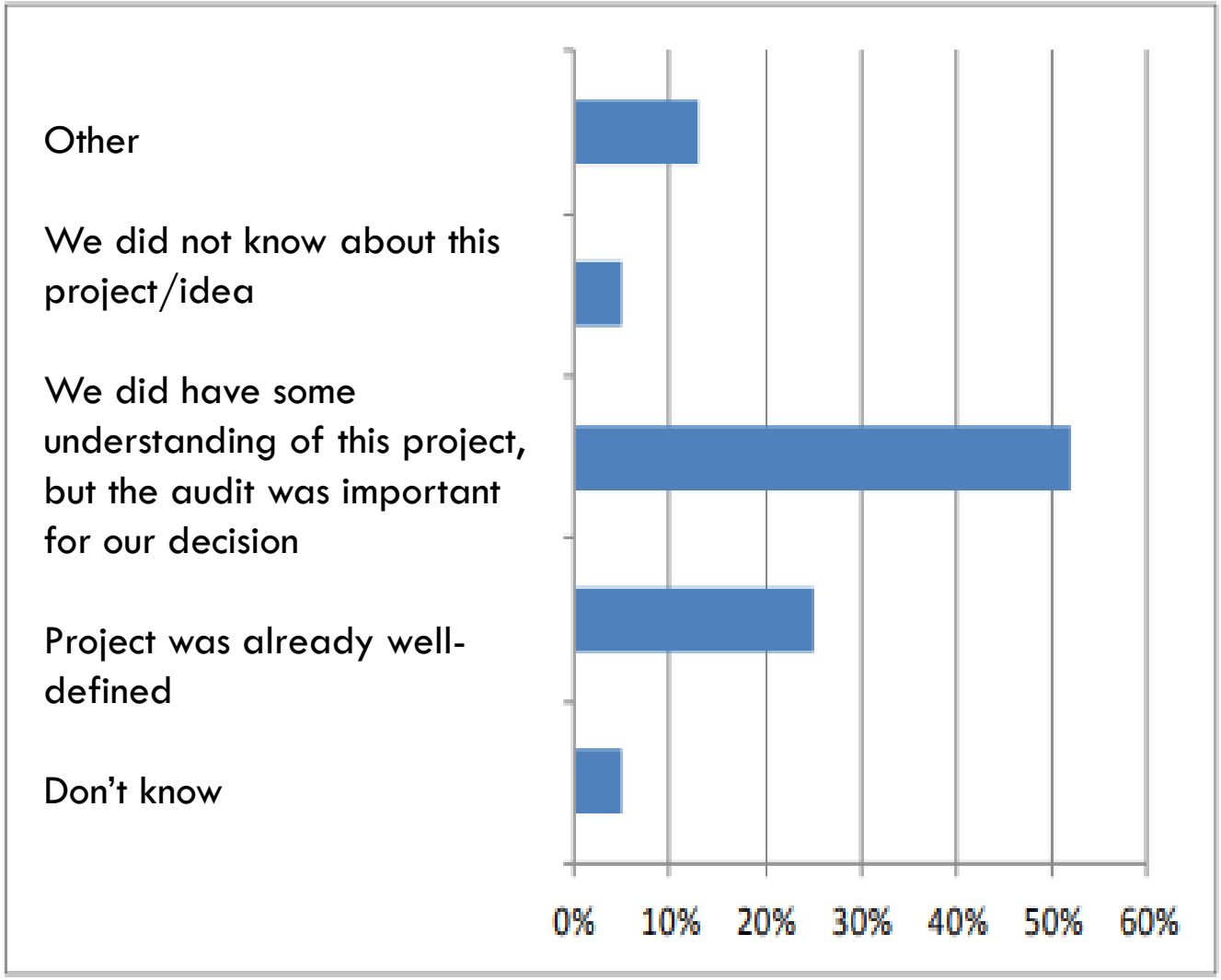
Large variation in the size of savings: The select was weighted by savings: All kWh-savings had the same probability to be selected

- Interview company managers
  - All interviews focused on concrete projects, quoting the title of the project

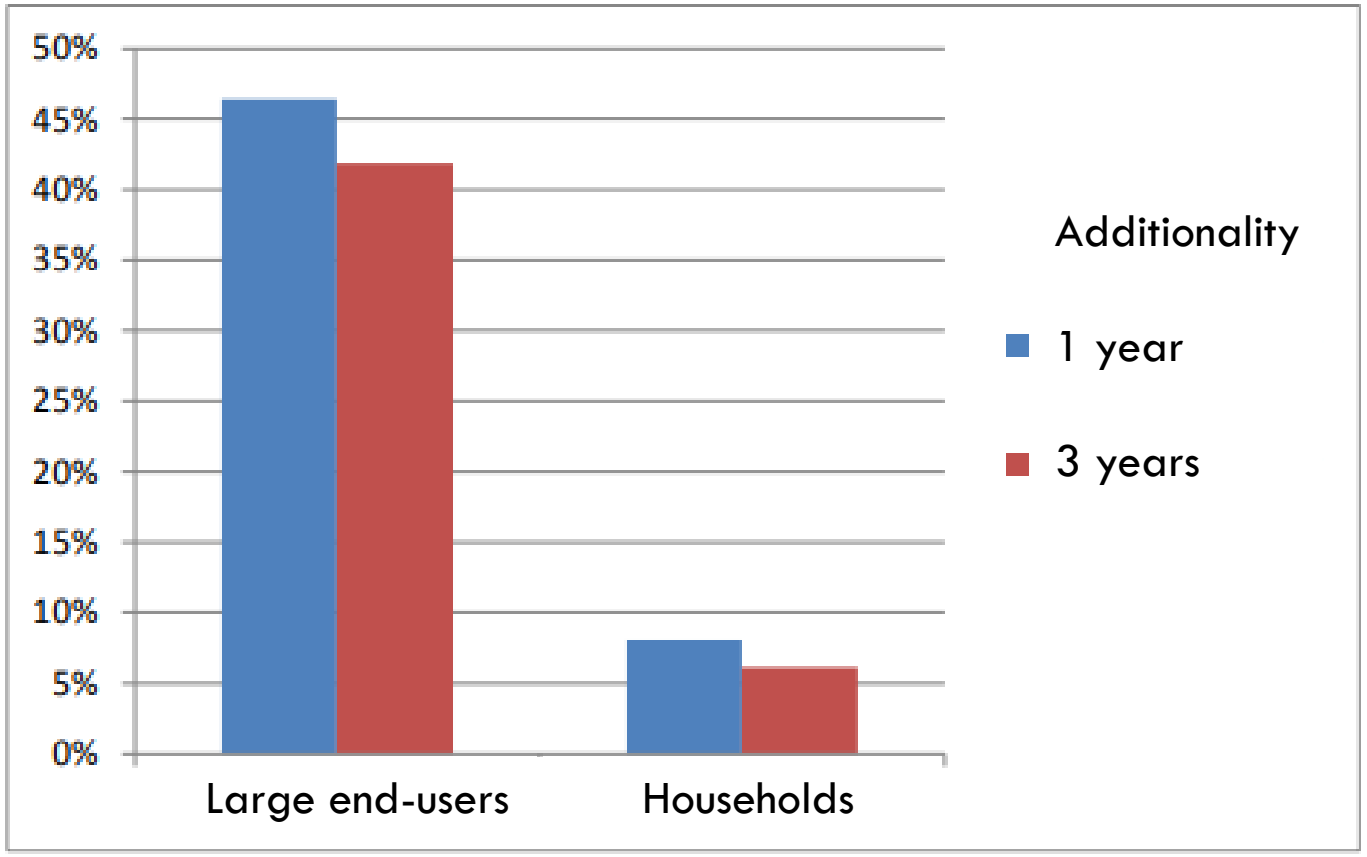
FREE RIDERS

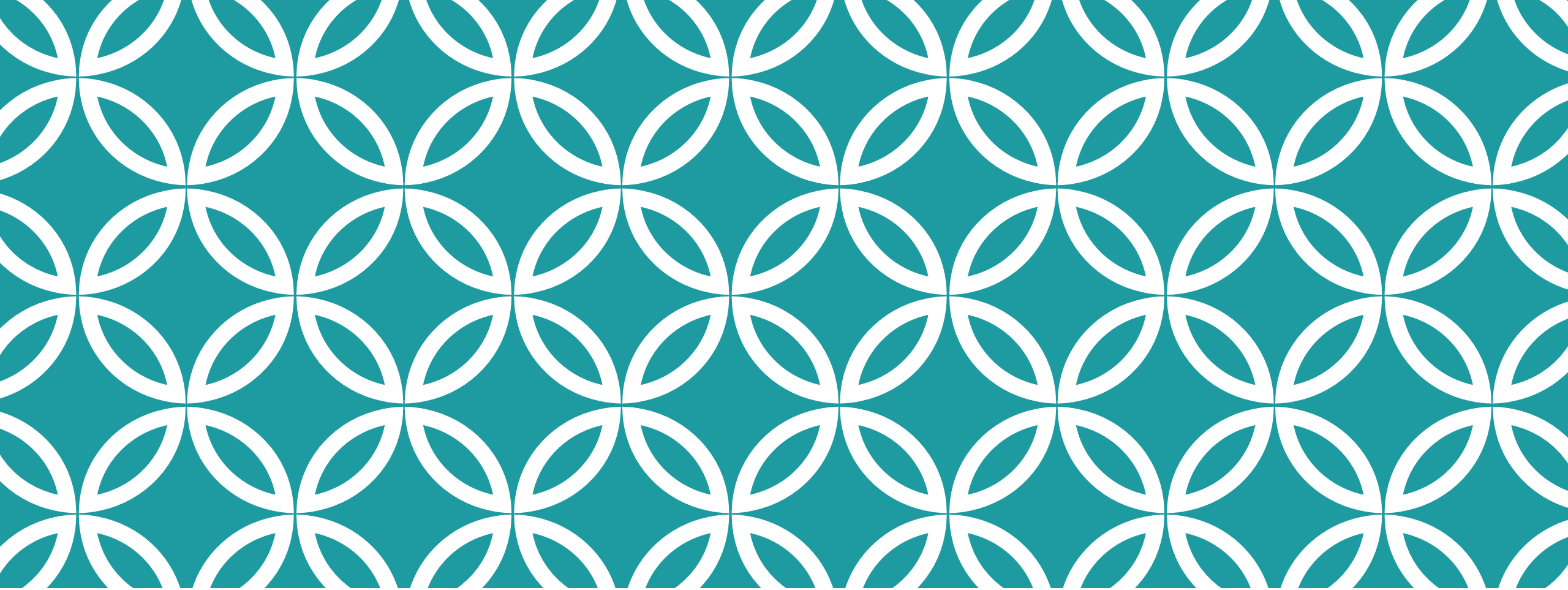
Also: What is the probability that the project would have been realised without the audit?

- Within 1 year?
- Within 3 years?



ADDITIONALITY





SUMMING UP

SUMMING UP

Conclusion for audits in industry:

- 50% free-riders
- Very good socio-economy: Positive balance (around half of energy price)
  - Positive for participants
  - Marginally negative for non-participants (the pay for the audit over the tariff)

Energy audits in industry can be an attractive instrument

- Can capture the complexity of industrial processes and energy demand
- Important to evaluate audit schemes
- Socio-economic cost/benefit of industrial energy audits can be very attractive

COOPERATION WITH AFRICAN UNION AND AFREC

- Denmark plan to work with African Union (AU) and African Energy Commission (Afrec) about energy efficiency
  - Minimum energy performance standards
  - Technical losses in distribution systems
  - Monitoring and evaluation

Handbooks / training / implementation

- We hope to work with MANY member states
  - All will be invited, results will be public

REFERENCES

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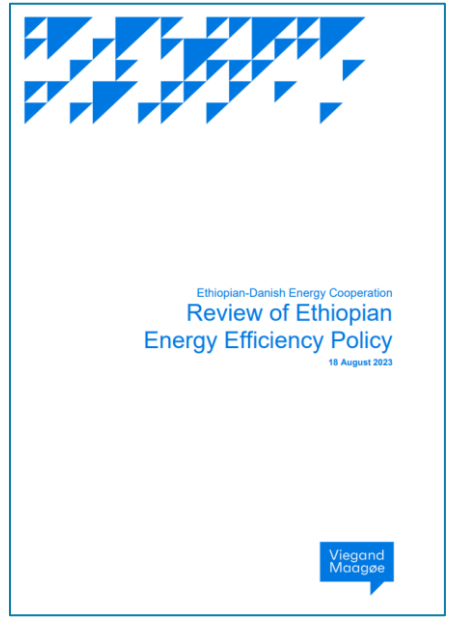
- Clean Energy Transitions in the Greater Horn of Africa, IEA, 2022 (Chapter 4: Making progress in energy efficiency)
- African Energy Efficiency Programme (au-afrec.org/energy-efficiency-programme)
- Regional Savings Assessment. SADC, AU, AfREC, U4E.
- Accelerating Energy Efficiency: Initiatives and Opportunities, Africa. Copenhagen Denmark. Copenhagen Centre on Energy Efficiency (2015). (unepccc.org/wp-content/uploads/2015/08/african-regional-report.pdf)
- Energy Efficient Lighting and Appliances: E-Learning Platform (https://training.eela-project.org/)
- East African Centre for Renewable Energy and Energy Efficiency (EACREEE). (www.eacreee.org)
- International Energy Efficiency Scorecard, ACEEE, 2022
- Review of Ethiopian Energy efficiency Policy (2023) etiopien.um.dk/en/denmark-in-ethiopia/climate-and-trade/energy-planning-and-modelling



HANDBOOKS – FOR INSPIRATION

- Guidebook for Energy Efficiency Evaluation, Measurement, and Verification. A Resource for State, Local, and Tribal Air & Energy Officials. U.S. Environmental Protection Agency, 2019 (www.epa.gov/sites/default/files/2019-06/documents/guidebook_for_energy_efficiency_evaluation_measurement_verification.pdf)
- Energy Efficiency Program Impact Evaluation Guide. Evaluation, Measurement, and Verification Working Group. State and Local Energy Efficiency Action. Network2012 (www.energy.gov/eere/articles/energy-efficiency-program-impact-evaluation-guide)
- International Performance Measurement and Verification Protocol. IPMVP. Generally Accepted M&V Principles. 2018 (www.evo-world.org)
- Håndbog i Evaluering af Energispareaktiviteter (in Danish). S R C INTERNATIONAL, AKF, ELKRAFT SYSTEM 2002. (In Danish) (www.srci.dk/Files/Images/PDF/evalueringshaandbog_m_forside.pdf)