



**Asia-Pacific  
Economic Cooperation**

# **APEC Energy Efficiency Policy Workshop Summary Report: Policy and Program Evaluation**

12 April 2016, Taichung City, Chinese Taipei

**Asia Pacific Energy Research Centre (APEREC) in collaboration with:  
APEC Expert Group on Energy Efficiency and Conservation (EGEE&C)**

15 June 2016

APEC Project: Energy Efficiency Policy Workshop as part of project EWG 03 2015A – APEC Peer Review on Energy Efficiency (PREE) Phase 5 (Follow-up PREE)

Produced by:

Charles Michaelis (Databuild)  
Edward Vine (Lawrence Berkeley National Lab)

For:  
Asia Pacific Energy Research Centre (APEREC)  
11F, 1-13-1 Kachidoki  
Chuo-ku  
Tokyo 104-0054  
Japan

On behalf of:  
Asia-Pacific Economic Cooperation (APEC) Secretariat  
35 Heng Mui Keng Terrace  
Singapore 119616  
Tel: (65) 68919600  
Fax: (65) 68919690  
Email: [info@apec.org](mailto:info@apec.org)  
Website: [www.apec.org](http://www.apec.org)  
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## **1. Background**

Evaluation of energy efficiency policy is essential to developing effective policy and to understanding the impacts of policy and program implementation. However, the practice of evaluation is lagging behind, especially in APEC developing economies. To support the development of this practice APERC coordinated the APEC Energy Efficiency Policy Workshop: Policy and Program Evaluation in Taichung City, Chinese Taipei on 12 April 2016. This workshop brought together policy makers and the evaluation practitioners to highlight the value of evaluation and discuss the idea of developing an Evaluation Community. The workshop provided insights of the value of having robust evaluation practices and opened a dialog between APEC policy makers and evaluators through the presentation of best practice, case studies and workshop sessions. The workshop was a first step in developing a platform to discuss and exchange experiences, current strategies, policies, protocols, and regulations for designing and implementing program and policy evaluations. The aim of the workshop was to begin a capacity building process through enabling a robust environment for evaluation, strengthening institutional capacity, and improving individual evaluator capacity.

## **2. Workshop Description**

The workshop introduced participants to evaluation, and helped them to understand how evaluation can support them to achieve their policy goals and give them practical tools that they can use in their work. The workshop aimed to develop participants' understanding of:

- How evaluation contributes to policy and program design
- Using evaluation to refine and improve policy and program effectiveness
- Evaluation approaches, methods and tools
- International evaluation practice
- The use of indicators to benchmark performance and support decision making

The workshop also helped participants to develop action plans to initiate evaluation of their energy efficiency policies and program and setting out their further capacity building needs.

The workshop used a combination of:

- Expert presentations of evaluation theory and practice supported by case study examples from developed and developing economies
- Workshop sessions to enable participants to identify how they can use evaluation to support their energy efficiency aims
- Workshop sessions to develop action plans
- Materials and references to support participants in implementing their action plans following the workshop

The agenda is in Appendix 1.

The slides used in the workshop are in Appendix 2 in a separate file.

### 3. Workshop sessions

#### Introduction to Policy and Program Evaluation

Presenter: Charles Michaelis, member of the IEPPEC board and planning committee.

This session provided an introduction to evaluation, giving participants an understanding of:

- Evaluation’s role in the policy making process; both ex-ante and ex-post
- The difference between monitoring and evaluation
- Developing and using theories of change
- Typical evaluation questions and how to develop a plan to answer them
- Process, impact and economic evaluation

The session explained the role of IEPPEC and encouraged participants to take part in IEPPEC activities including the Evaluation Academy.

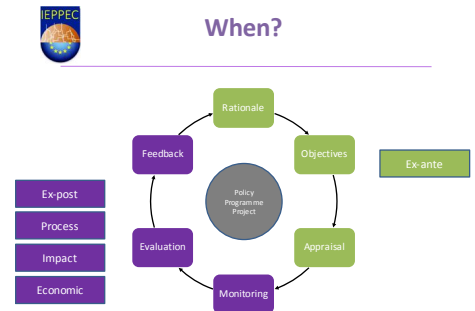
#### Impact and Process Evaluation

Presenter: Ed Vine, member of both IEPEC (US) and IEPPEC (Europe) boards and planning committees

This session built on the introduction to evaluation by providing participants with practical guidance on impact and process evaluation. The session included:

- An overview of types of evaluation, when they were appropriate and suitable research tools
- Consideration of the different audiences for evaluation results
- Explanation of impact evaluation and introduction of key concepts including gross and net impact
- Explanation of process evaluation
- An in depth explanation of theories of change building on the introduction in the first session

The session concluded with lessons that have been learned from evaluation and recommendations for policy makers



APERC Evaluation Workshop

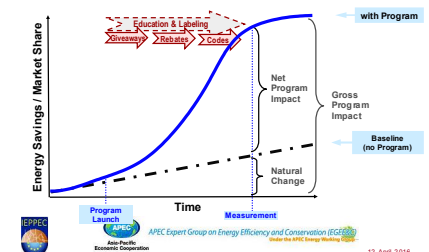
#### Program Research & Evaluation

Research Category	Program Phase Conducted	Research Type	Assessment Level
Formative	Planning (a priori)	Market assessment (includes market characterization and baseline studies)	Market or Program
	Implementation (post-hoc)	Potential or feasibility studies	Market or Program
Summative	Implementation (post-hoc) or Post-implementation (ex-post)	Impact evaluation	Program
		Market effects	Program and Market
		Cost-effectiveness	Program or Portfolio



APERC Evaluation Workshop

#### What is Impact Evaluation?



## Impact of appliance energy efficiency standards

Presenter: Hans Alarcon, Super-Efficient Equipment and Appliance Deployment Initiative (SEAD).

This presentation described the recent energy efficiency achievements in SEAD member economies and detailed savings of 700TWh/year through measures taken in 2010-14 that had been identified through modelling using LBNL's Bottom Up Energy Analysis System (BUENAS). It covered:

- How the BUENAS model works
- The regulations that were analyzed and the results of that analysis
- A breakdown of the savings by sector and end use



### Impacts of Standards in SEAD Economies

By 2030, policy measures adopted by SEAD's member governments between Jan. 1, 2010 and Dec. 31, 2014 are expected to save around 700 terawatt-hours of electricity each year equivalent to the annual electricity production of over 230 coal-fired power plants.



### BUENAS Model

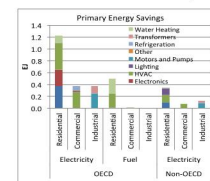
- Bottom-up strategy includes sales, usage, efficiency and costs for specific technologies.
- End uses include residential lighting, appliances, HVAC, commercial HVAC, lighting, water heating, refrigeration, industrial motors and transformers.
- Policy case driven by increased efficiency of new sales.
- Recent Achievements implemented as a scenario within BUENAS, like BAU, Cost-Effective Potential and BAT scenarios.

Source: M.A. Mehal, V.E. J. Inseher and S.A. della Riva de Cam. "Bottom-Up Energy Analysis System (BUENAS)—an International Appliance Efficiency Policy Tool." Energy Efficiency 6 (2013): 197-217.

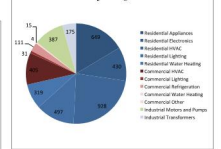


### Results

Standards in SEAD member countries could reduce emissions by 4 Gt by 2030, much of which is in residential electricity



Cumulative CO<sub>2</sub> through 2030 3.95 Gt



Savings still moderate in fuel-burning equipment, in the commercial / industrial sectors and in Non-OECD countries. (Climate analysis in Press)

## Economy presentation – Experience in evaluation in a member economy

Presenter: Eduardo Ramos Huerta, Comisión Nacional para el Uso Eficiente de la Energía (CONUEE)

This presentation described the impact evaluation of Mexico's energy efficiency appliance standards since their implementation in 2000 estimating the energy savings, environmental benefits and economic impacts.

The evaluation combined the use of modelling and primary research and drew conclusions about the effectiveness of appliance efficiency standards in Mexico.

### Energy Savings / Environmental Benefits

**Improvement** in the **average efficiency** of these appliances as a result of the standards.

- Refrigerators: 17% or 27%, depending on product class.
- Window AC: about 4%.
- Split system AC: over 7%.

Savings of about 6 TWh of electricity in 2014.

Equivalent to two 500 MW power plants.

24 million metric tons of CO<sub>2</sub> avoided through 2014.

### Economic Benefits

**For consumers / industry**

- Savings of about **\$3 billion USD** due to electricity saved by these standards between **2002 and 2014**.
- While efficiency increased, **prices did not increase** more than the rate of inflation.

**For the national economy**

- Implementation of standards **reduced peak generation capacity needs** by 1.36 GW, equivalent to **saving the need for \$180 million USD in capital investment**.
- Savings to the national treasury by **avoided subsidies**.

## Discussion

These two presentations were followed by lively discussion considering several issues:

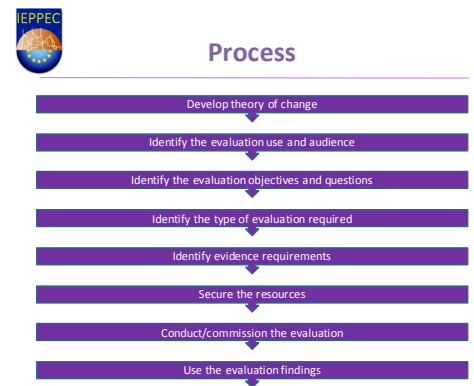
- How well the two evaluations had answered the evaluation questions identified in the presentation.
- Whether the evaluations were presenting gross or net impact as described in Ed's presentation.
- Which stakeholders the results were suitable for and how they could be used.
- The merits of modelled impacts and how they can be used in combination with primary research.

## Developing Evaluation Capacity; how to conduct an evaluation

Presenter: Charles Michaelis, member of the IEPPEC board and planning committee

This session provided attendees with simple tools and things to think about when conducting an evaluation. It set out the process they should follow and checklists for:

- Developing a theory of change
- Identifying stakeholders
- Setting evaluation questions
- Considering the evidence needed and determining the type of evaluation required
- Conducting the evaluation
- Using the findings



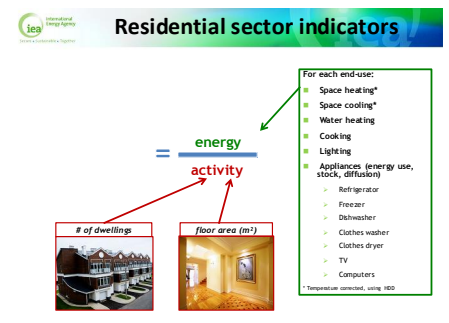
The session was followed by facilitated small group working in which participants planned an evaluation for the policies or program that they are responsible for. Participants then came back together and each small group presented their plans.

## Energy Efficiency Indicators – IEA

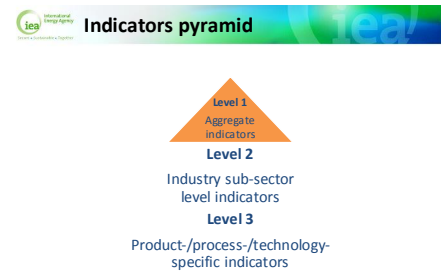
Presenter: Melanie Slade, International Energy Agency (IEA)

This presentation described energy efficiency indicators and how they can be used alongside evaluation to design policies and track progress against targets. The presentation:

- Discussed the strengths and weaknesses of energy intensity indicators.
- Described the IEA's approach to energy efficiency indicators which track the ratio of energy consumption to the activity it is used for.



- Explained the indicators pyramid and how indicators can be constructed for each level of the pyramid.
- Signposted attendees to resources available from the IEA to assist them to develop indicators and benchmark performance



This session was followed by small group working to consider what indicators participants would find useful in their work and where they might be able to obtain data to populate those indicators.

#### 4. Workshop Analysis

Thirty-one individuals coming from 11 APEC economies (China, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, the Philippines, Chinese Taipei, Thailand, and the United States) and three APEC observer guests: the International Energy Agency (IEA), the Collaborative Labelling and Appliance Standards Program (CLASP), and the International Copper Alliance (ICA) participated in the workshop (Appendix 3).

The workshop was held in conjunction with the 47<sup>th</sup> APEC Expert Group on Energy Efficiency and Conservation (EGEE&C) meeting to maximize economy representation and facilitate logistical coordination.

The participants were keen to learn more about evaluation; there was a strong sense that it was an important field which they needed to know more about. They took part in the group work with enthusiasm and seemed attentive and engaged throughout.

Participants seemed to take away a good understanding of the benefits of evaluation and where they could start in implementing evaluation within their economies. Their understanding of the purpose and role of indicators was developed.

Areas that could be considered for inclusion in future workshops include training in:

- Developing monitoring and evaluation frameworks
- Qualitative and quantitative data collection techniques
- Analysis of data for impact and process evaluation
- Using evaluative techniques and insights in policy development

#### 5. Going Forward

Evaluation experience is limited in most APEC economies, for several reasons:

- Government initiatives often do not include evaluation
- Action plans or policy often focus only on actions (implementation of policies and programs)
- Funding of data collection and evaluation of programs and policies is often not available or of low priority

- Expertise (trained evaluators) is limited
- Data are lacking (need for standardization)

Nevertheless, economies are in the process of developing and implementing new policies on energy efficiency. There are opportunities to:

- Introduce evaluation as part of the process
- Increase expertise in governments for data gathering and evaluation (capacity building)
- Increase the body of knowledge on the effects of energy efficiency policy and programs
- Improve energy efficiency policy and program design and implementation

Building on this workshop, there is an opportunity to develop evaluation capacity in APEC member economies (especially, in developing economies) with the support of regional mechanisms as APEC and at economy level through economy-based organizations (e.g., China and Thailand). While the initial focus can be on workshops, an ideal outcome would be to have an evaluation community of practice that is self-sustainable, in funding terms, and can host an annual conference in Asia similar to the ones that have been held by the International Energy Program Evaluation Conference (IEPEC) in the US (since 1985) and by the International Energy Policy and Program Evaluation Conference (IEPPEC) in Europe (since 2010). The purpose of the conference would be to provide a forum for the presentation, critique, and discussion of objective evaluations, as well as for experience sharing about evaluation practices. It would also serve for gathering new ideas, inputs for current and upcoming debates, experience feedback and lessons learnt about all the stages of evaluations (design, collection of data, analysis of results, and evaluation use).



## **APPENDICES**

1. Workshop agenda
2. Presentations [see separate file]
3. Workshop participants

## Appendix 1

Asia Pacific Energy Research Centre  
APEC Energy Efficiency Policy Workshop  
Agenda

DATE

12

April

2016

Session	Time	Topic
1.	8:00-8:45	Registration
2.	8:45-9:00	Brief Introduction Welcoming Remarks – Host Economy Rep
3.	9:00-9:10	Opening remarks – <b>APERC</b> Opening remarks – <b>EGEE&amp;C Chair</b>
4.	9:10-9:40	<b>Introduction to Policy and Program Evaluation (Charles Michaelis – Databuild)</b> Presentation introducing the topic of evaluation, what it entails and how evaluations plays a role in robust EE policy and program development and achieving EE benefits. Show how evaluation contributes to funding decisions and provides evidence of cost effectiveness to funders.
5.	9:40-10:10	<b>Impact and Process Evaluation (Ed Vine – LBNL)</b> Presentation focuses on impact and process evaluation methods and a discussion of free riders, spillover and attribution, and recommendations for policymakers.
6.	10:10-10:30	<b>Coffee Break</b>
7.	10:30-11:00	<b>Evaluation case study</b> <ul style="list-style-type: none"><li>• <b>Impact of appliance energy efficiency standards (Hans Alarcón – CLASP)</b></li></ul>
8.	11:00-11:30	<b>Economy presentation – Experience in evaluation in a member economy</b> <ul style="list-style-type: none"><li>• México (Eduardo Ramos Huerta)</li></ul>
9.	11:30-12:00	<b>Discussion (Charles Michaelis)</b> Reactions to the case study presentations, how useful would that be in your economy, what would you change?
10.	12:00-13:00	<b>Lunch</b>
11.	13:00-13:30	<b>Developing Evaluation Capacity (Charles Michaelis - Databuild)</b> Present a guide to evaluation and roles and responsibilities of stakeholders. Provide as hand-out that attendees can complete in following small group session.

<b>Session</b>	<b>Time</b>	<b>Topic</b>
12.	<b>13:30-15:00</b>	<p><b>Small group discussion – (Charles Michaelis)</b></p> <p><b>Evaluation experience in member economies and developing capacity</b></p> <p>What type of program and policy evaluation is being conducted in your economy? How is evaluation used and by whom? What benefits do you get?</p> <p>What benefits could you obtain from evaluation? Who would be interested in evaluation? What are the challenges to conducting evaluation?</p> <p>Small groups will complete an evaluation action plan using hand-out provided in previous session.</p>
13.	<b>15:00-15:30</b>	<b>Coffee Break</b>
14.	<b>15:30-16:00</b>	<p><b>Energy Efficiency Indicators – IEA (Melanie Slade)</b></p> <p>Presentation discusses what indicators can be used, how and why, and how indicators are linked to evaluation and vice versa. Explores how IEA's energy efficiency indicators are being used and are expected to be used around the world.</p>
15.	<b>16:00-17:00</b>	<p><b>Group discussion on developing indicators in APEC – IEA facilitated (Melanie Slade)</b></p> <p>Small groups will discuss possible actions in their economies to improve indicators.</p>
16.	<b>17:00-17:10</b>	Summary
17.	<b>17:10</b>	<b>Close of Workshop</b>

## **Appendix 2**


**Workshop presentations**  
**[See separate file]**



# Energy Efficiency Policy Workshop


## Appendix 2: Workshop Presentations

Asia Pacific Energy Research Center (APERC)  
12 April 2016, Taichung, Chinese Taipei

### Appendix 2 contents:

- Session 4: Introduction to Policy and Program Evaluation (Charles Michaelis – Databuild) – Page 2
- Session 5: Impact and Process Evaluation (Ed Vine – LBNL) – Page 13
- Session 7: Impact of appliance energy efficiency standards (Hans Alarcón – CLASP) – Page 22
- Session 8: Impacts Evaluation of Appliance EE Standards in Mexico since 2000 (Eduardo Ramos Huerta – CONUEE) – Page 31
- Session 11: Developing Evaluation Capacity (Charles Michaelis - Databuild) – Page 38
- Session 12: Group discussion evaluation experience checklist – Page 45
- Session 14: Energy Efficiency Indicators – (Melanie Slade - IEA) – Page 48



2



## Introduction to Policy and Programme Evaluation



## Introduction



- “ **Background**
- “ **What is evaluation**
- “ **How to conduct evaluation**
- “ **Resources**




## About me







- “ 25 years evaluation experience
- “ Energy, waste, R&D
- “ UK, Australia, China, SE Asia
- “ IEPPEC planning committee and board
- “ Chairman of Databuild Research and Solutions




## IEPPEC





- “ International Energy Policy and Programme Evaluation Conference
- “ Peer-reviewed papers
- “ 200 evaluation professionals
- “ Every two years in Europe
- “ Sister conference in North America
- “ Planning conference in Asia





## Databuild



- “ Research and evaluation consultancy
- “ Established in 1985
- “ Birmingham, UK and Sydney, Australia
- “ 25 staff
- “ Specialising in energy, waste, enterprise, innovation and planning



*“I recognize that climate change is a complex subject with multiple causes, but this really isn't helping.”*





## What?

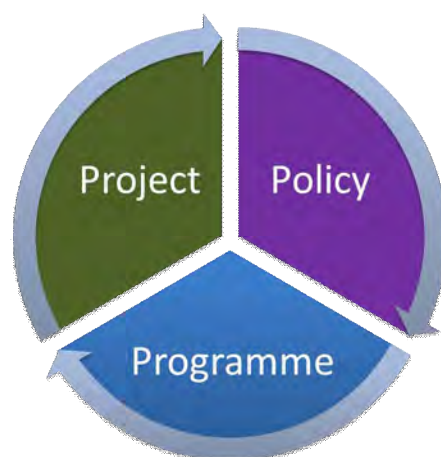


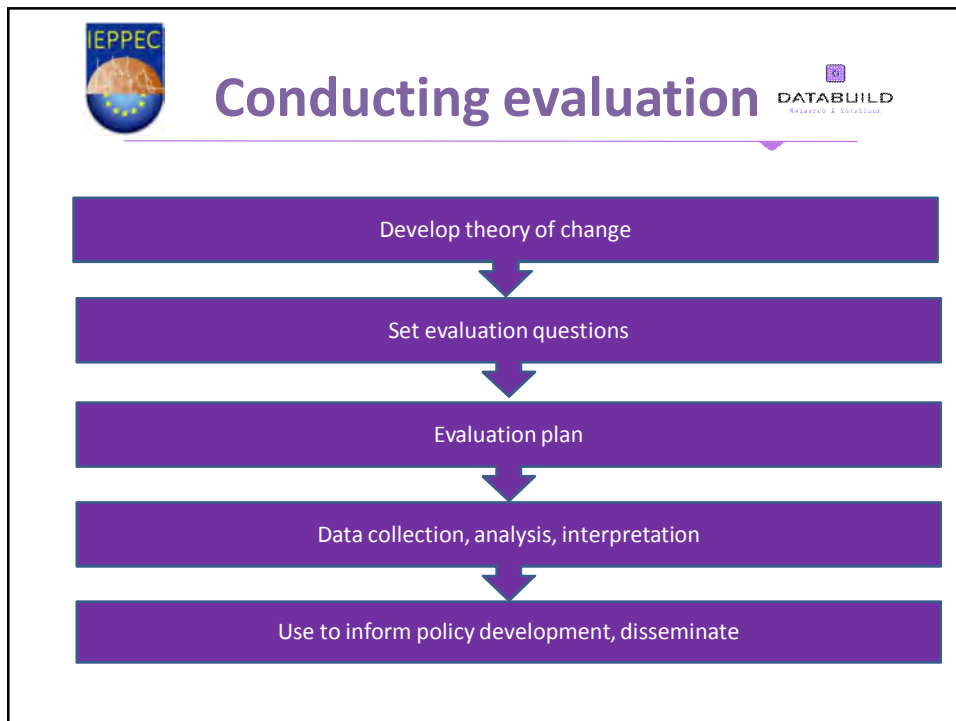
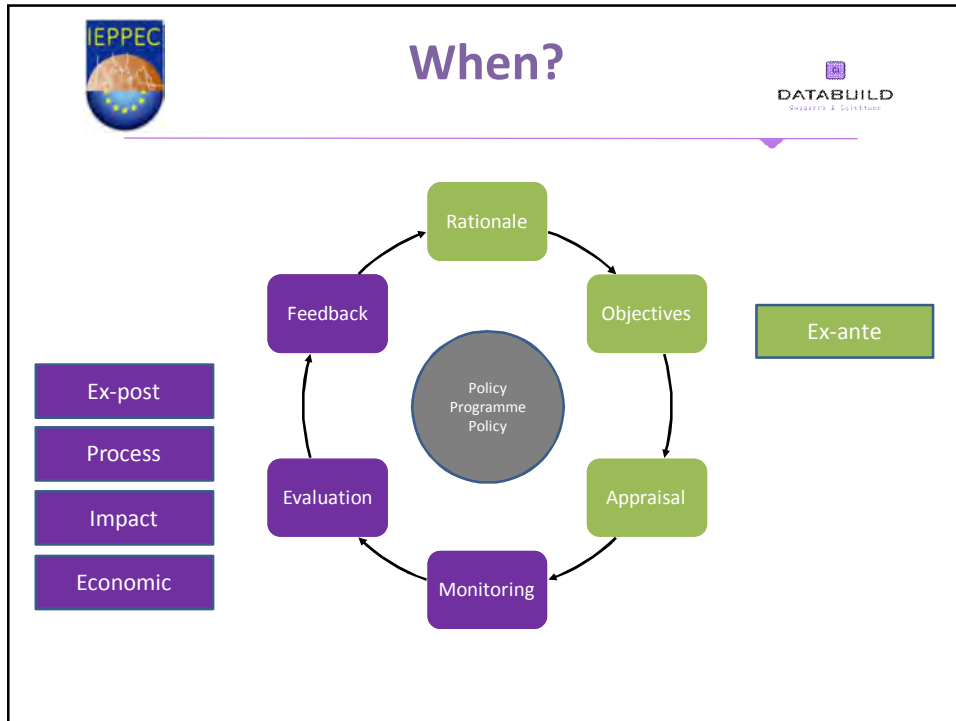
*Evaluation is an **objective** process of understanding **how** a policy or programme was implemented, **what** effects it had, for **whom** and **why***

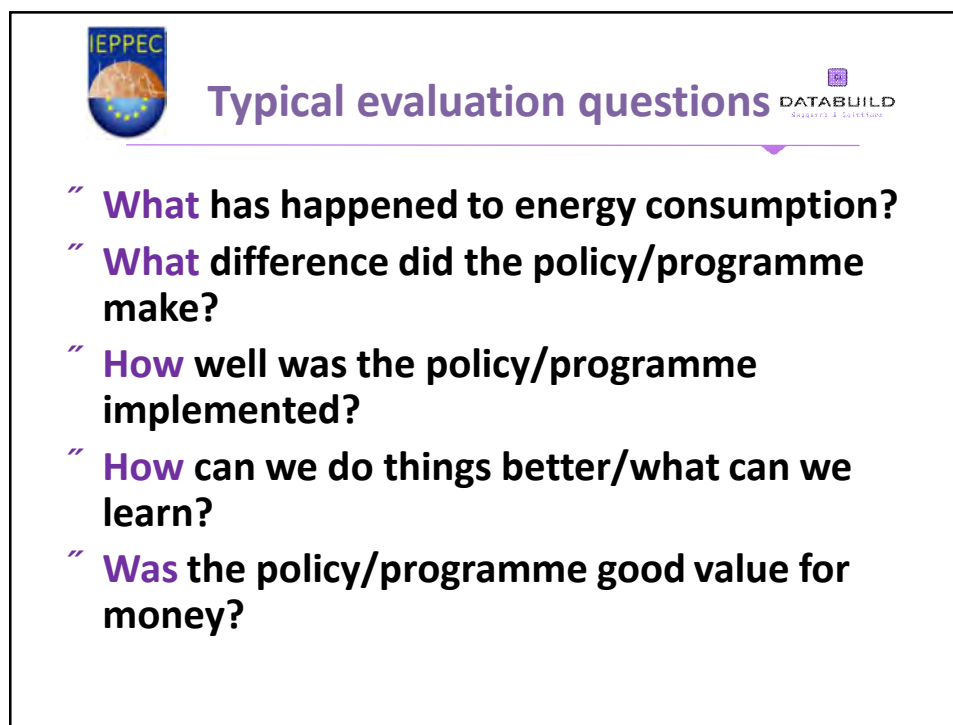
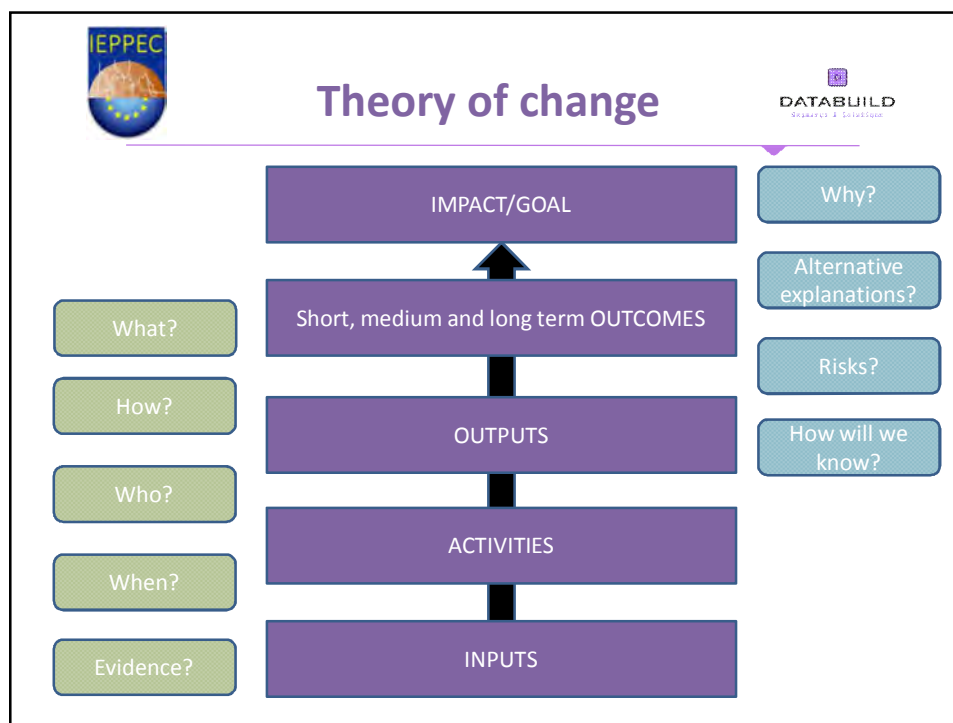
*Leads to **more effective** policies and programmes*

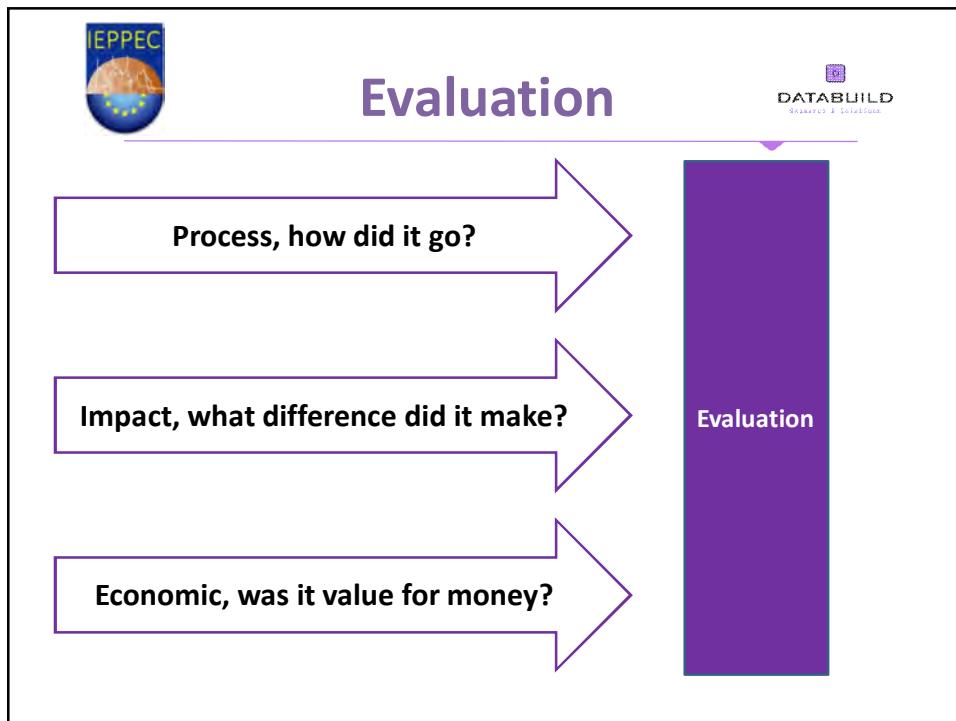


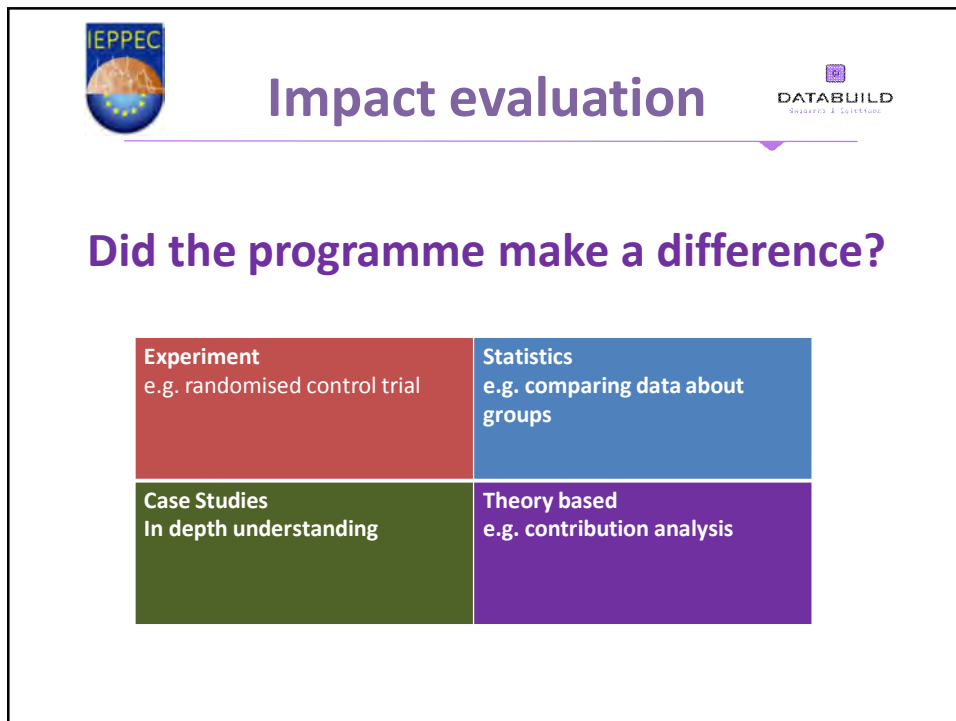
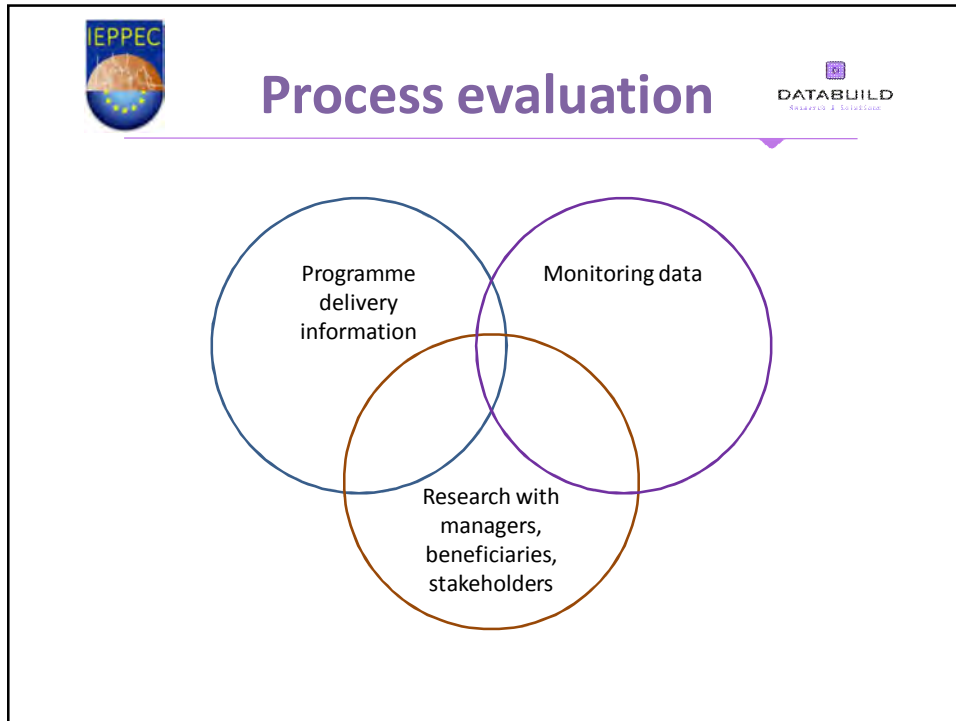
## What?

















## Impact evaluation



Method	Strengths	Weaknesses
<b>Experiment</b>	Proof programme caused impact	Difficult in practice May not provide an answer Doesn't tell you: ~ Why/how impact ~ More? ~ Work elsewhere
<b>Statistical</b>	Strong evidence	Data only available in some circumstances Needs a large sample Doesn't tell you: ~ Why/how impact ~ More? ~ Work elsewhere
<b>Case based</b>	Rich understanding of outcomes Why and how outcomes are achieved	Hard to generalise Doesn't prove causality Seen as less rigorous
<b>Theory based</b>	Rigorous approach Considers alternative explanations Rich understanding of outcomes Why and how outcomes are achieved	Doesn't prove causality Seen as less rigorous



## Economic evaluation



- “ **Cost benefit analysis**
  - . Three levels – government, participant, society
  - . Consider all **additional** costs and all **additional** benefits
  - . Consider **lifetime** costs and benefits
- “ **Consider multiple benefits of energy efficiency**
  - . Energy security/peak demand
  - . Economic; jobs and growth
  - . Health and wellbeing
  - . Productivity
  - . Air quality



## Summary



- “ Evaluation leads to **more effective** policies and programmes
- “ Should be **embedded** in policy/programme design process
- “ Include **process, impact and economic** evaluation
- “ Structure around **theory of change**
- “ Use **transparent** process, **engage** stakeholders, **integrate** learnings
- “ Use **IEPPEC** resources



## Thank you






**Charles Michaelis**  
**Databuild Research and Solutions**  
**[charles.michaelis@data-build.co.uk](mailto:charles.michaelis@data-build.co.uk)**  
**+447813 799580**



[www.data-build.co.uk](http://www.data-build.co.uk)  
[research@data-build.co.uk](mailto:research@data-build.co.uk)  
21 Graham Street, Birmingham, UK, B1 3JR  
0121-237-1144





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# Impact and Process Evaluation

Edward Vine  
Lawrence Berkeley National Laboratory

APEREC Evaluation Workshop  
Taichung City, Chinese Taipei  
April 12, 2016

APEREC Evaluation Workshop

## About me

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- “ 36 years evaluation experience
- “ Energy programs & R&D
- “ Primarily US, focus now is Asia
- “ IEPEC planning committee and board
- “ IEPPEC planning committee and board
- “ Rehired Retiree at LBNL

12 April 2016

## Introduction

Program evaluation has been conducted for many years - it uses

- “ professional methods, protocols, and guidelines
- “ to quantify the impacts from energy efficiency programs,
- “ to improve program effectiveness, and
- “ to help resource planning.



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12 April 2016

## Program Research & Evaluation

Research Category	Program Phase Conducted	Research Type	Assessment Level
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		Potential or feasibility studies	Market or Program
	Implementation (post-hoc)	Process evaluation	Program
Summative	Implementation (post-hoc) or Post-implementation (ex-post)	Impact evaluation	Program
		Market effects	Program and Market
		Cost-effectiveness	Program or Portfolio



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## Audience for Results

Who are the key stakeholders?

- “ Program implementers
- “ Funders
- “ Regulators
- “ Planners
- “ Elected and appointed officials
- “ Special-interest groups



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## Program Evaluation – Why we do it

- “ **To Reduce Uncertainty**  
Provide the information necessary to make good decisions regarding investments in programs
- “ **To Assess Impacts**  
Estimate the change in energy usage and other targets due to programs
- “ **To Improve Program Design**  
Prioritize program & portfolio budgets, inform resource planning
- “ **To Finalize Utility Incentive Payments (rarely)**



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Under the APEC Energy Working Group

12 April 2016



# What is Impact Evaluation?

## ” Purpose/Objective

Estimate the change due to programs

- Change in energy use, greenhouse gas (GHG) emissions, the market share for efficient products, other benefits, etc.

## ” Methods

Data collection (measurement and verification . M&V)  
 Engineering algorithms (deemed/stipulated savings),  
 statistical/econometric analysis  
 Surveys, modeling, statistical analysis

## ” Key Outcomes

**Gross** energy and demand savings

**Net (attributable)** energy and demand savings

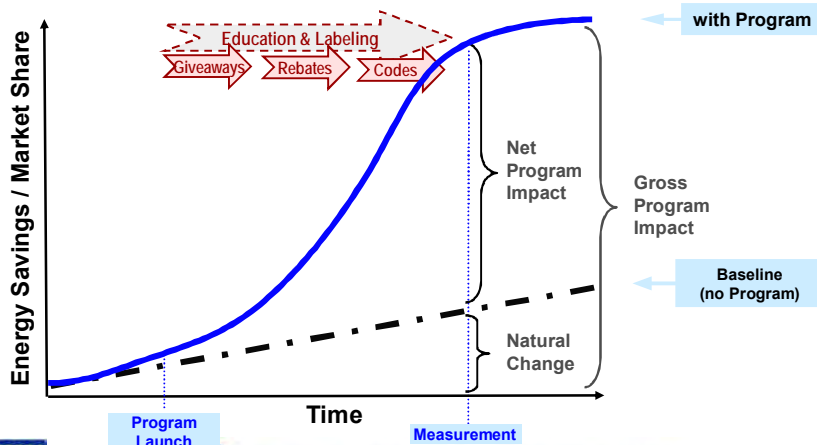
- reflecting free riders & spillover



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# What is Impact Evaluation?



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## Which Impacts?

- “ **Energy**
  - Electricity: use (kWh) and demand (kW)
  - Natural gas
- “ **Time period**
  - Annually, seasonally, weekly, daily, hourly
- “ **Increasing interest in multiple benefits**
  - Employment, indoor and outdoor air quality, health, climate change, etc.



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## What is Process Evaluation?

- “ Process (formative) evaluation focuses on **how** a program is **implemented** and **operating**
  - Identifies **procedures** and program **logic**
  - Describes how it **operates**, the **services** delivered and the **functions** (roles and responsibilities)
  - Assesses** reasons for success or problems
- “ Results in **recommendations** to improve program effectiveness and efficiency
  - Energy and GHG impacts, risk reduction and other multiple benefits, and cost-effectiveness



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## Process and Impact Evaluation

- “ Distinction is often blurred
  - Impact evaluations typically focus on quantifying the energy and demand savings (resource characterization)
    - In aggregate
    - Customer by customer
    - End-use specific
  - Process evaluations typically focus on explaining why the program succeeds or fails to deliver savings (resource optimization)
    - Barriers to participation
    - Unanticipated behavioral response
    - Program operations



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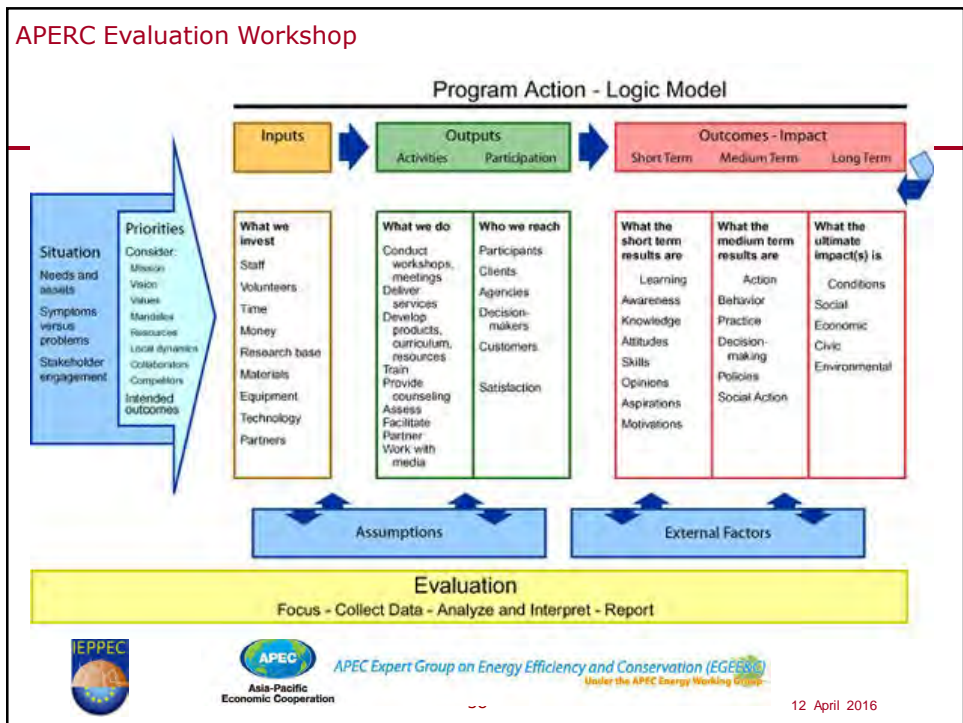
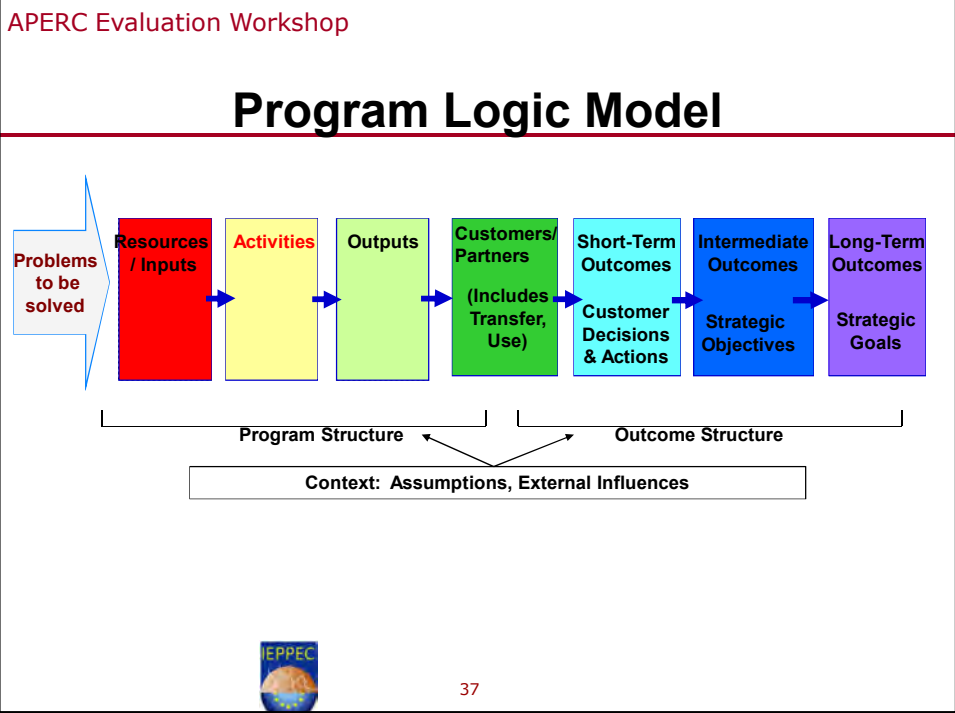
## Value of Evaluation

- “ Evaluations provide a systematic way to learn from program experiences, both within a particular program over time and across programs being fielded simultaneously or contemplated for the future
- “ Evaluations provide assurance to interested parties that programs are being implemented effectively and modified or refined as necessary



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## What Have We Learned from Evaluation?

- “ Evaluations show that well-established types of energy efficiency programs can save significant amounts of energy
- “ Good design and implementation plans matter because they influence the level of savings achieved
- “ Regulation and incentives programs work in different contexts, implying that a range of different energy efficiency policy instruments is needed
- “ Some newer types of policy instruments need to be thoroughly evaluated (e.g., behavior change and new financing mechanisms)



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## Recommendations for Policymakers

- “ Continue to support energy efficiency policies and programs . they work and are cost-effective!
- “ Support new approaches but they need to be piloted and evaluated
- “ Learn from program experience and evaluation in other countries and jurisdictions
- “ Encourage experimental design . learn from successes and failures
- “ Support evaluation . the benefits outweigh the costs!



APEC Expert Group on Energy Efficiency and Conservation (EGEES&C)  
Under the APEC Energy Working Group

12 April 2016



APERC Evaluation Workshop

# 2016 IEPPEC



More details on: <http://www.ieppcc.org/>



APEC Expert Group on Energy Efficiency and Conservation (EGEESC)  
Under the APEC Energy Working Group

12 April 2016



**SEAD** | SUPER-EFFICIENT EQUIPMENT AND APPLIANCE DEPLOYMENT INITIATIVE

Governments Working Together to Save Energy.


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## Evaluating Recent Energy Efficient Achievements in SEAD member economies

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APERC Energy Efficiency Policy Workshop, Taichung . April 12 2016  
Hans Alarcon, Coordinator, SEAD  
Prepared by Lawrence Berkeley National Laboratory (LBNL)

[www.superefficient.org](http://www.superefficient.org)



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## Outline

- Introduction to SEAD
- BUENAS Tool Overview
- Methodology of Recent Achievements Analysis
- Minimum Energy Performance Standards (MEPS) Analyzed
- Results

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## The SEAD Initiative

Governments working together to save energy

Australia	Brazil	Canada	Chile
European Commission	Germany	Indonesia	Japan
Korea	Mexico	Russia	South Africa
Sweden	United Arab Emirates	United Kingdom	China - Observer
<b>United States – Co-Chair</b>		<b>India – Co-Chair</b>	

Visit [www.superefficient.org](http://www.superefficient.org) for more information

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## Impacts of Standards in SEAD Economies

By 2030, policy measures adopted by SEAD’s member governments between Jan. 1, 2010 and Dec. 31, 2014 are expected to save around 700 terawatt-hours of electricity each year — equivalent to the annual electricity production of over 230 coal-fired power plants.



Year	Projected Savings (TWh)
2010	~100
2012	~150
2014	~200
2016	~250
2018	~300
2020	~350
2022	~400
2024	~450
2026	~500
2028	~550
2030	~600

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## Appliance Efficiency Modeling . Bottom-Up Energy Analysis System (BUENAS)

**Purpose and Scope**

- Global projection of appliance energy demand and greenhouse gas emissions through 2030
- By economy - Currently covers 13 major economies that account for ~80% of global energy demand
- Covers 15 building and industrial appliances and equipment ~200 equipment / economy combinations

**Policy Scenarios**

- Best Practices . Identifies achievable efficiency targets based on alignment of MEPS across regions to model harmonization potential
- Cost-Effective Potential . Integrates BUENAS and Global Energy Efficiency Cost (GEEC) Database developed at LBNL to model economic potential
- Best-Available Technology . Most Aggressive scenario represents technical potential

**Recent Applications**

- Analytical Framework for Super-Efficient Appliance Deployment (DOE/Clean Energy Ministerial Initiative)
- Input to IEA World Energy Outlook 2012
- Featured in IIASA Global Energy Assessment, IPCC 5th Assessment
- IEA . Tracking Clean Energy Progress report

Source: Letschert et al. 2013  
Includes Australia, Brazil, Canada, China, EU, India, Indonesia, Japan, Korea, Mexico, Russia, South Africa, USA

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## SEAD Recent Achievements Analysis

- Each year, SEAD analyzes impacts of recent efficiency regulations using LBNL's Bottom Up Energy Analysis System (BUENAS).
- The goals are to:
  - Go beyond an enumeration standards activity toward a quantitative assessment of the strength and scope of standards by evaluating energy savings through 2030.
  - Track progress towards achieving energy savings and associated benefits for meeting energy conservation goals of energy security, reduction of capital investments and air pollution and climate goals.
  - Allow comparison across impact and sector in a consistent way, and compare progress to remaining EE potential in these areas.
- The Recent Achievements analysis covers minimum energy performance standards announced since Jan 1, 2010 through December 31, 2014. The 2015 analysis is coming soon.

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## BUENAS Model

- ~ Bottom-up strategy includes sales, usage, efficiency and costs for specific technologies.
- ~ End uses include residential lighting, appliances, HVAC, commercial HVAC, lighting, water heating, refrigeration, industrial motors and transformers.
- ~ Policy case driven by increased efficiency of new sales.
- ~ Recent Achievements implemented as a %scenario+ within BUENAS, like BAU, Cost-Effective Potential and BAT scenarios.

The flowchart illustrates the BUENAS calculation process. It starts with 'Stock' and 'Diffusion' (Data or Assumption) leading to 'Unit Sales' (Calculation). 'Unit Sales' is influenced by 'Baseline Unit Energy Consumption' (Data or Assumption) and 'Replacement (Survival) Function' (Data or Assumption). 'Unit Sales' leads to 'Business as Usual Energy Final Energy Demand' (Calculation) and 'Efficiency Case Final Energy Demand' (Calculation). 'Business as Usual Energy Final Energy Demand' is also influenced by 'Target Unit Energy Consumption' (Data or Assumption). The difference between 'Business as Usual' and 'Efficiency Case' is 'Final Energy Savings' (Calculation). 'Final Energy Savings' leads to 'CO2 Mitigation' (Calculation), which is also influenced by 'Carbon Factor' (Data or Assumption). A legend defines the symbols: black circles for 'Data or Assumption', white boxes for 'Calculation', and grey boxes for 'Data or Calculation'.

Fig. 1 Flowchart of BUENAS calculation. Note: Stock and Diffusion can be entered directly into the model as data, but this is rare

Source: M.A. McNeil, V.E. Letschert and S.A. de la Rue du Can. "Bottom-Up Energy Analysis System (BUENAS)—an International Appliance Efficiency Policy Tool." *Energy Efficiency* 6 (January): 191–217.

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## Regulations Analyzed

Sector	Residential					Commercial*				Industrial		Grand Total		
	Appliances	HVAC	Lighting	Electronics	Water Heating	Subtotal	HVAC	Refrigeration	Other	Subtotal	Motors and Pumps		Transformers	Subtotal
Country														
Australia		2		1	1	4			1	1				5
Brazil											1			1
Canada		3		3	1	7		1		1	1			9
Chile	1		1			2								2
European Union	6	3		2	1	12	1			1	1	1	2	15
India	2	2	1			5						1	1	6
Japan	1	1		1	1	4		1		1	1			6
Korea	2			2	1	5		1		1				6
Mexico	2	1			1	4					2			6
South Africa	4	1			1	6	1			1				7
United States	6	5	1	1	1	14	1	3	2	6	3	1	4	24
<b>Total</b>	<b>24</b>	<b>18</b>	<b>3</b>	<b>10</b>	<b>8</b>	<b>63</b>	<b>3</b>	<b>6</b>	<b>3</b>	<b>12</b>	<b>9</b>	<b>3</b>	<b>12</b>	<b>87</b>

87 MEPS analyzed

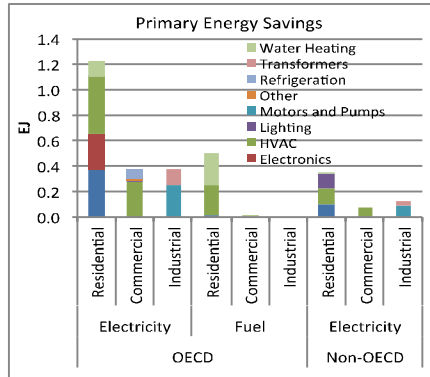
+ 27 % data+

+ 9 % impact+

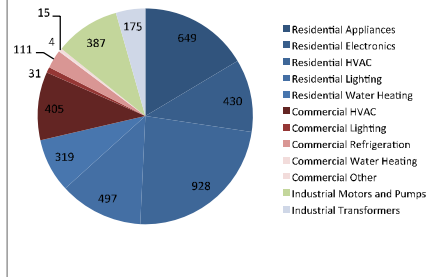
- ~ U.S. and E.U. (FR, GER, SWE, UK) continue to be leaders in number and scope of coverage of MEPS
- ~ Level of analysis and availability of data is highly variable . a major limitation
- ~ Not uncommon to see published MEPS with below-market efficiency levels
- ~ China not a member of SEAD, so not included, but have been analyzed by LBNL

## Results

Standards in SEAD member countries could reduce emissions by 4 Gt by 2030, much of which is in residential electricity

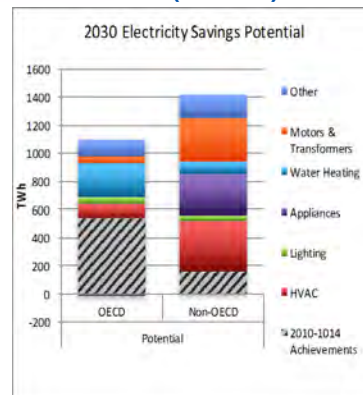
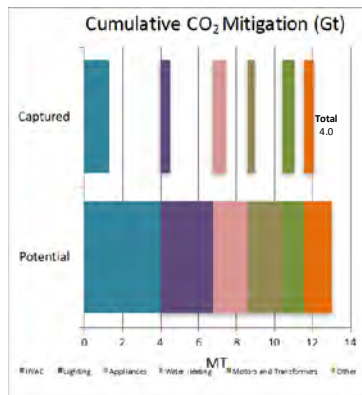


Cumulative CO<sub>2</sub> through 2030 3.95 Gt



Savings still moderate in fuel-burning equipment, in the commercial / industrial sectors and in Non-OECD countries (*China analysis In Press*)

## Achieved vs. Potential (BAT)



- ~ Only about a quarter of savings from Best Available Technologies has been achieved, while technology keeps advancing and cost of efficiency is decreasing
- ~ Electricity growth will occur in developing countries, where most savings is untapped

Source: M.A. McNeil, et al. *SEAD Member Economy Recent Achievements: Projected Savings from Energy Performance Standards since 2010*. Forthcoming. LBNL



## Key References

- " Kalavase, Puneeth, Michael A. McNeil, Virginie Letschert, Jing Ke, and Ana Maria Carreño. 2012. "Projected Impacts of Global Energy Efficiency Standards for Appliances Implemented in SEAD Countries since 2010." In .
- " Letschert, Virginie, Louis-Benoit Desroches, Jing Ke, and Michael McNeil. 2013. "Energy Efficiency . How Far Can We Raise the Bar? Revealing the Potential of Best Available Technologies." *Energy* 59: 72–82. doi:<http://dx.doi.org/10.1016/j.energy.2013.06.067>.
- " Lowenthal-Savy, Danielle, Michael A. McNeil, and Lloyd Harrington. 2013. "Evidence of Progress - Measurement of Impacts of Australia's S&L Program from 1990-2010." In . Coimbra, Portugal.
- " M. A. McNeil, and V. E. Letschert. 2010. "Modeling Diffusion of Electrical Appliances in the Residential Sector." *Energy and Buildings* 42: 783. 90.
- " McNeil, Michael A., Virginie E. Letschert, Stephane Rue du Can, and Jing Ke. 2013. "Bottom. Up Energy Analysis System (BUENAS) - an International Appliance Efficiency Policy Tool." *Energy Efficiency* 6 (January): 191. 217. doi:10.1007/s12053-012-9182-6.
- " Zhou, Taylor, and Michael A. McNeil. 2014. "Measuring Market Transformation: Quantitative Analysis of Appliance Energy Efficiency Labeling Program Impacts in the European Union, Australia and India." In . Asilomar, CA.



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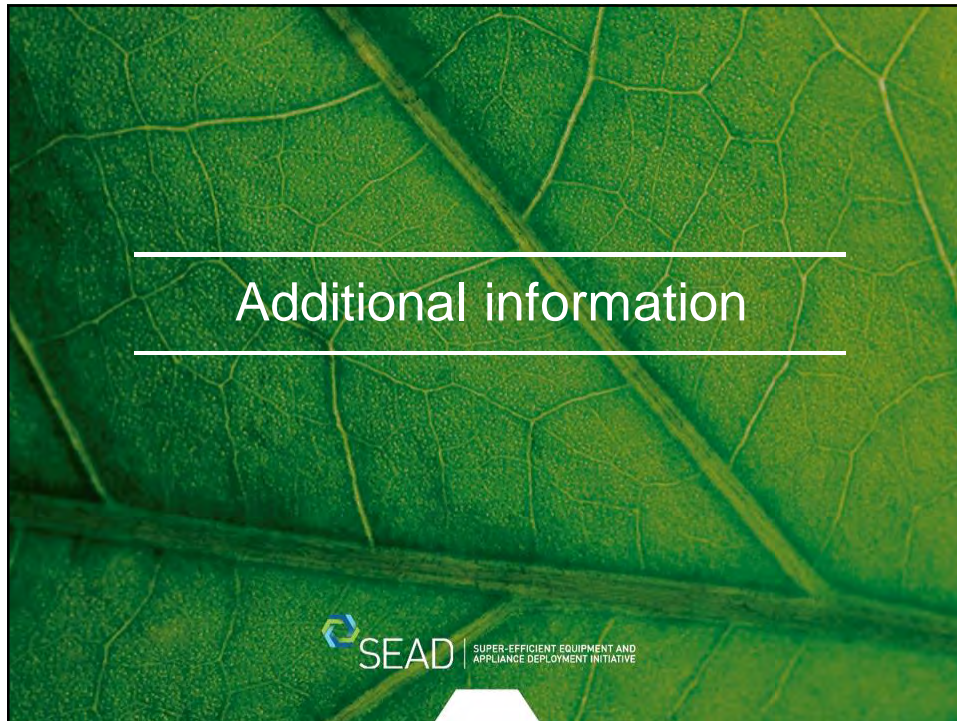
For more information or questions please contact:


Michael McNeil, [mamcneil@lbl.gov](mailto:mamcneil@lbl.gov)  
Jenny Corry, [jcorry@clasp.ngo](mailto:jcorry@clasp.ngo)

SEAD . [www.superefficient.org](http://www.superefficient.org)  
LBL-BUENAS tool . <https://ies.lbl.gov/research-area/appliance-energy-efficiency>  
CLASP - [www.clasp.ngo](http://www.clasp.ngo)

[www.superefficient.org](http://www.superefficient.org)






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## Sources of Data Forecasting

- " 1st priority - %Complex+Sales Forecast . Forecast of product taken from secondary source, such as U.S. TSD or EcoDesign Preparatory Studies, takes into account economic growth, population, housing and technology shifts
- " 2nd priority - %Simple+Sales Forecast . Forecast of product taken from recent historical trends and then trended with growth rate, either constant, or tapering.  
*Sales-based activity 60% of branches*
- " 3rd priority - %Stock Forecast (rare) . Stock forecast taken from secondary documents, sales derived from stock.  
*Stock-based activity 9% of branches*
- " 4th priority - %Saturation Forecast (esp. dev. countries) . stock from ownership rates forecast according to macroeconomic parameters (GDP, urbanization, electrification). See McNeil & Letschert Energy & Buildings paper. Applies to refrigerators, washing machines, lighting, televisions, air conditioners & ceiling fans.  
*Saturation-based activity 31% of branches*



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## BUENAS Model Approach

- “ Bottom-Up . BUENAS is Bottom-Up Energy Analysis System
- “ Demand Side . Projects need for energy services by energy carrier, regardless if if/how demand will be met
- “ Appliances Equipment and Lighting . Includes both electricity and fuel. Mostly buildings end uses + motors and transformers
- “ Efficiency Policy Oriented . Emphasis on calculating savings from EE scenarios
- “ Planning Tool Applications . Especially for developing countries

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## Econometric Modeling for Appliance Ownership

Ownership per HH of Ref, WM, AC, TV, Fans, and lighting bulbs – or use sales data

Logistic Function:

Aggregate model for: lighting, space heating, standby power.  
Climate dependent

$$Diff_c = \frac{\alpha}{1 + \gamma \exp(\beta_{inc} I_c + \beta_{elec} E_c + \beta_{Spe} SPE_c)}$$

maximum diffusion

diffusion of the appliance for the economy  $c$

monthly household income

electrification rate

Appliance-specific variable

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## BUENAS Technology Database

See McNeil and Bojda, Energy Policy 2012

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## BUENAS Methodology

- ~ Consistent framework to analyze standards using data from:
  - Pre-standards studies performed as part of the regulatory process (preferred)
  - Secondary sources on baseline efficiency, use patterns, sales and market growth
  - Assumptions (unusual)
- ~ Data for ~450 products differentiated by economy and sub-class, including: macroeconomic parameters, sales, lifetimes, unit energy consumption (UEC), equipment prices, fuel prices

## Impacts Evaluation of Appliance EE Standards in Mexico since 2000

Energy Efficiency Policy Workshop April 12, 2016

## What is Conuee?

<p>Ministry of Energy's technical branch on energy efficiency.</p>	<p>It coordinates the efforts coming from the federal government on EE.</p>	<p>It supports EE in the public and private sectors.</p>
--	---	--

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**CONUEE** COMISIÓN NACIONAL PARA EL USO EFICIENTE DE LA ENERGÍA

### Conuee's Most Representative Programs

-  **Buildings**
-  **SMEs**
-  **Large Energy Users**
-  **State-owned Companies**
-  **Residential Sector**
-  **States and Municipalities**

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**CONUEE** COMISIÓN NACIONAL PARA EL USO EFICIENTE DE LA ENERGÍA

### Conuee's Most Representative Programs

-  **International Cooperation**
-  **Solar Water Heating**
-  **Transport**
-  **Standardization**

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## Conuee's MEPS Program




<p><b>Mexico's most effective EE program.</b></p>	<p><b>Began in early 1990's with 4 standards.</b></p>
<p><b>It now covers 30 major appliances, equipment and building components.</b></p>	<p><b>Few times there is opportunity to evaluate its impact: LBNL (2006) and LBNL &amp; CLASP (2015).</b></p>

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## Impacts Evaluation of Appliance EE Standards in Mexico since 2000

- “ Developed by LBNL and CLASP upon request from CONUEE.
- “ It analyzes the impacts from MEPS for domestic refrigerators, and window AC (harmonized with U.S. standards in the early 2000s), plus the standard for mini-split AC (implemented in 2011).
- “ It provides us with information on the benefits and impact of these standards, as well as other relevant information...








## Energy Savings / Environmental Benefits

Improvement in the average efficiency of these appliances as a result of the standards.

- “ Refrigerators: 17% or 27%, depending on product class.
- “ Window AC: about 4%.
- “ Split system AC: over 7%.

Savings of about 6 TWh of electricity in 2014.	Equivalent to two 500 MW power plants.	24 million metric tons of CO <sub>2</sub> avoided through 2014.
--	--	---

## Economic Benefits

For consumers / industry

- “ Savings of about \$3 billion USD due to electricity saved by these standards between 2002 and 2014.
- “ While efficiency increased, prices did not increase more than the rate of inflation.

For the domestic economy

- “ Implementation of standards reduced peak generation capacity needs by 1.36 GW, equivalent to saving the need for \$180 million USD in capital investment.
- “ Savings to the treasury by avoided subsidies.

## Other Benefits

### Awareness

- “ Introduction of these standards and associated energy levels has led to increased awareness of EE among consumers (it makes the top 3).

### Private sector support

- “ The study shows private sector support to the MEPS program as it allows manufacturers to compete under similar conditions.

## Another Relevant Conclusions

- “ A clear efficiency shift in major appliance markets in Mexico attributable to implementation of efficiency standards.
- “ Savings of about 6TWh in 2014, making appliance standards program Mexico's most effective energy efficiency programs.
- “ Harmonization with U.S standards has been successful, moving the efficiency of the domestic market and benefiting manufacturers allowing them to compete in the U.S market.
- “ Recent updates to refrigerators and AC standards were virtually identical to the previous version, therefore there are savings potential to aligning our standards to U.S. MEPS.

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## Why is this study important for us?

- “ It strengthens the culture to evaluate our programs.
- “ For future evaluations, it highlights the importance to include stakeholders directly involved in the programs we are evaluating.
- “ It provides us with accurate information to share with relevant government agencies (Ministry of Finance).
- “ It was particularly important for the private sector (chambers and associations) to be well positioned in the very competitive North America market.

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## Methodology and Data Requirements

- “ Bottom-up Model used for the quantitative assessment.
- “ Interviews with stakeholders for a qualitative assessment.

→

- “ Energy savings, monetary savings for consumers, improvements in the average efficiency, changes in average product price.
- “ Other non-energy benefits: awareness of EE, improvements in conformity assessment infrastructure.

- “ Data sourced primarily from Mexican government agencies, gathered by IIE with CONUEE support.
- “ Model-level data on product capacity and energy consumption from certification agency's product registry (ANCE).
- “ Baseline selection: market trends before MEPS were revised.



 (+52 55) 3000 1000 (1035)  
eduardo.ramos@conuee.gob.mx

[www.conuee.gob.mx](http://www.conuee.gob.mx)

 @CONUEE\_mx

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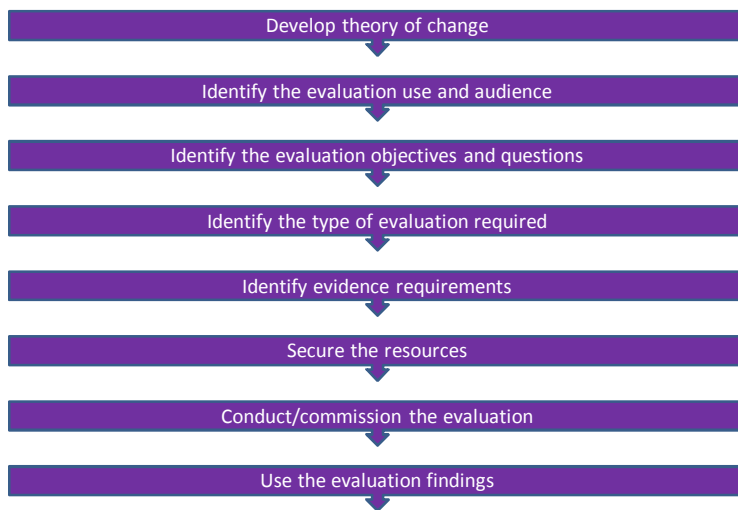



# Developing Evaluation Capacity

## How to conduct an evaluation




### Process







## Theory of change checklist



Context and issues	What are the stated objectives of the policy? What contextual factors may influence the outcomes and impacts? Who will the policy affect – directly and indirectly? What do we know already? What else might affect the outcomes – policies/other?
Impacts	What is the overall goal of the policy? What is the policy aiming to achieve in the long term? What policy objectives will it address?
Outcomes	What is the policy expected to achieve in the short/medium term? What changes would you expect to see?
Outputs	What will be delivered as a direct result of the policy? What activities will directly result from the policy? Who will participate as a direct result of the policy?
Inputs	Financial, activities, other – government and partners



## Theory of change checklist



Assumptions	How will inputs => outputs => outcomes =>impacts? What is necessary/sufficient? Effect of different contexts?
Risks	What could go wrong?
Alternative explanations	What else could lead to the outcomes that are seen?
Unintended consequences	What else might happen?
Bias	Known unknowns Addressing confirmation bias



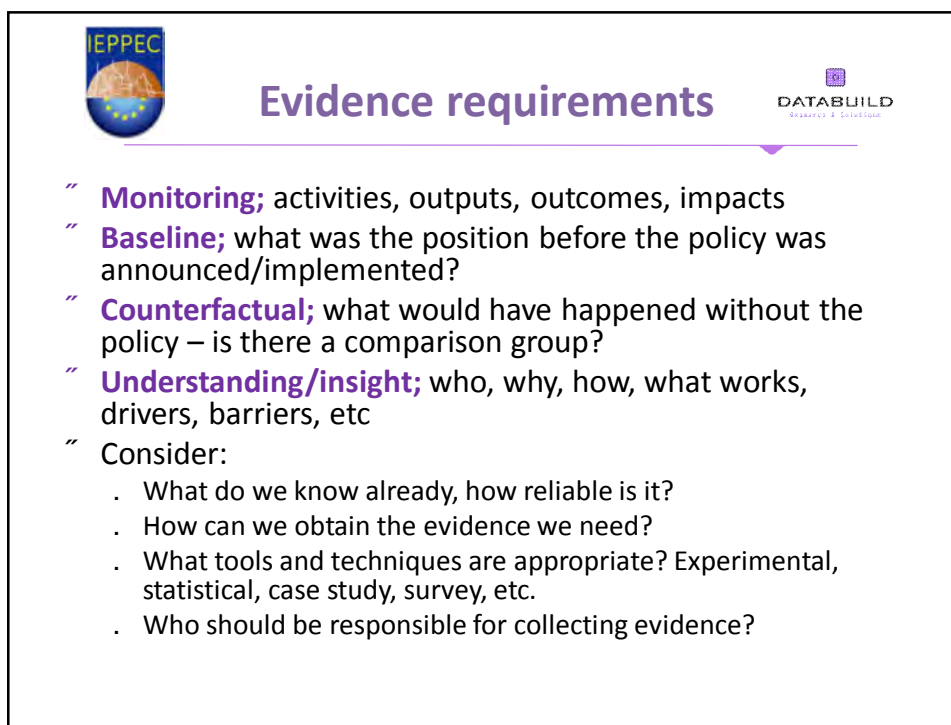
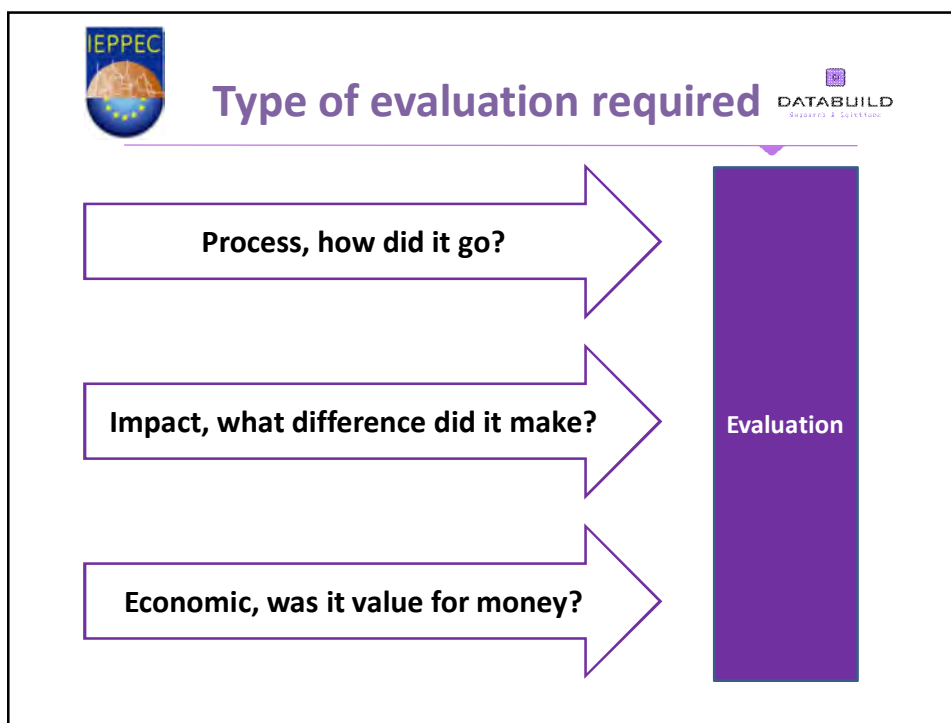
## Evaluation use and audience DATABUILD Data-based Analysis & Collection

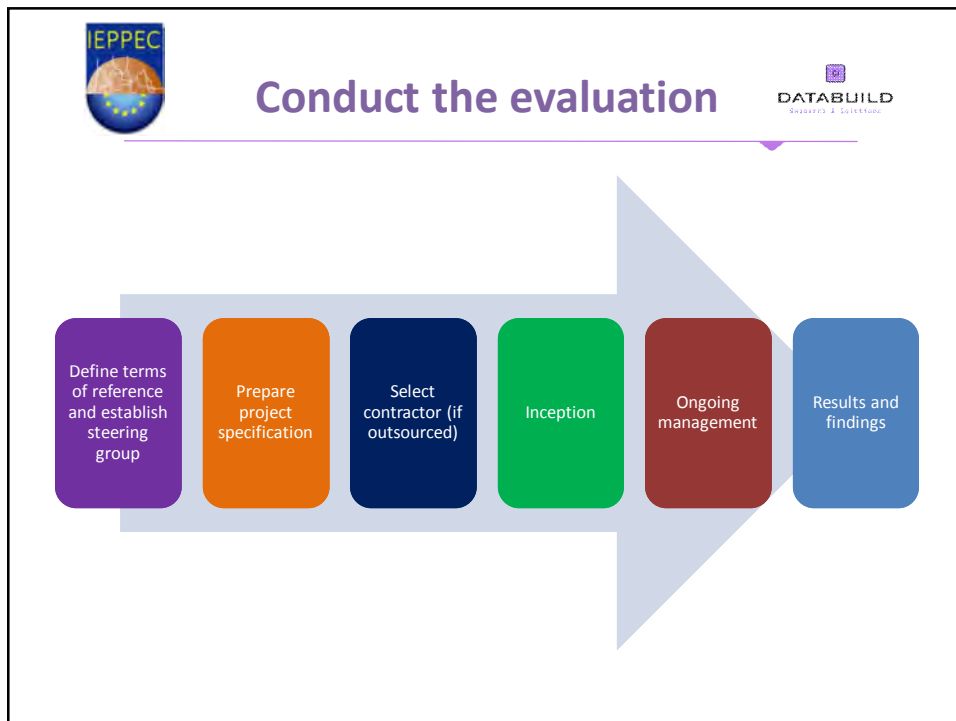
- “ **Who** will use the findings? What for?
- “ **When** do they need them?
- “ **What** evidence do they need?
- “ **How** is it best to communicate findings so that they make an impact?



## Typical evaluation questions DATABUILD Data-based Analysis & Collection

- “ **What** has happened?
- “ **What** difference did the policy/programme make?
- “ **How** well was the policy/programme implemented?
- “ **How** can we do things better/what can we learn?
- “ **Was** the policy/programme good value for money?







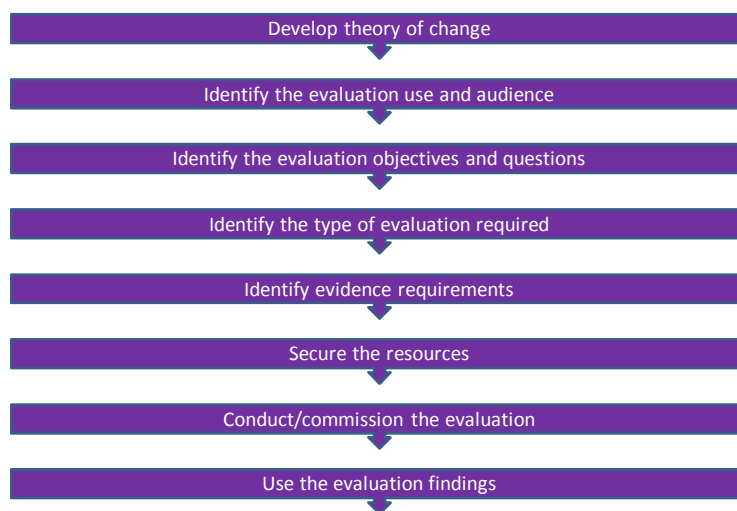
## Using the findings



- ” Inform current and future policy development
- ” Provide value for money evidence to funders
- ” Secure stakeholder engagement
  
- ” Plan from the start
- ” Use early results
- ” Disseminate:
  - . Outcomes and impacts
  - . Specific and general lessons learned
- ” Share with evaluation community



## Summary





Thank you



**Charles Michaelis**  
**Databuild Research and Solutions**  
**[charles.michaelis@data-build.co.uk](mailto:charles.michaelis@data-build.co.uk)**  
**+447813 799580**



[www.data-build.co.uk](http://www.data-build.co.uk)  
[research@data-build.co.uk](mailto:research@data-build.co.uk)  
21 Graham Street, Birmingham, UK, B1 3JR  
0121-237-1144






## Evaluation Checklist




## Checklist


1. Develop Theory of Change	
<b>Impacts</b>	What is the overall goal of the policy? What is the policy aiming to achieve in the long term? What policy objectives will it address
<b>Outcomes</b>	What is the policy expected to achieve in the short/medium term? What changes would you expect to see?
<b>Outputs</b>	What will be delivered as a direct result of the policy What activities will directly result from the policy Who will participate as a direct result of the policy
<b>Inputs</b>	Financial, activities, other – government and partners
<b>Assumptions</b>	How will inputs => outputs => outcomes => impacts? What is necessary/sufficient? Effect of different contexts?
<b>Risks</b>	What could go wrong?
<b>Alternative explanations</b>	What else could lead to the outcomes that are seen?
<b>Unintended consequences</b>	What else might happen?
<b>Bias</b>	Known unknowns Addressing confirmation bias



# Checklist



2. Evaluation use and audience	
	Who will use the findings?
	What will they use them for?
	When do they need them?
	What evidence do they need?
	How is it best to communicate findings so that they make an impact?
3. Set evaluation questions	
	What has happened?
	What difference did the policy/programme make?
	How well was the policy/programme implemented?
	How can we do things better, what can we learn?
	Was the policy/programme good value for money?



# Checklist




4. Decide on the type of evaluation required	
	Process?
	Impact?
	Economic?
5. Consider the evidence requirements	
Monitoring	Activities, outputs, outcomes, impacts
Baseline	What was the position before the policy was announced/implemented?
Counterfactual	What would have happened without the policy?
Understanding/insight	Who, why, how, what works, drivers, barriers
Consider	What do we know already, how reliable is it? How can we obtain the evidence we need? What tools and techniques are appropriate? Experimental, statistical, case study, survey, etc. Who should be responsible for collecting evidence?




# Checklist



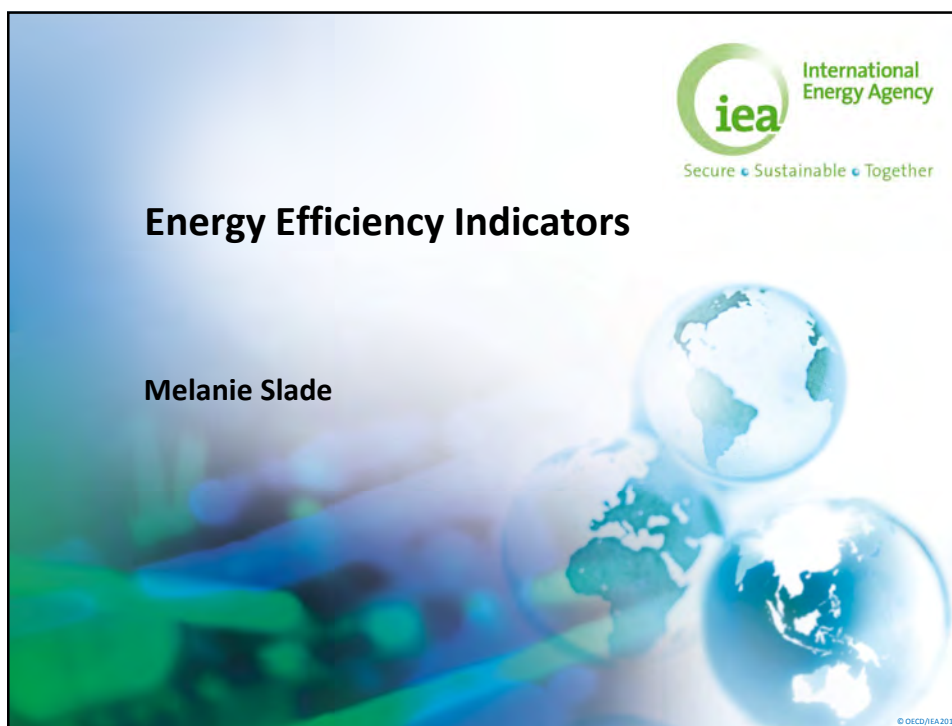
6. Secure the resources	
	Determine a steering group/review process
	Identify management responsibilities and processes
	Secure financial resources
	Allocate time to staff responsible
7. Conduct the evaluation	
	Define terms of reference and establish steering group
	Prepare a project specification
	Select a contractor (if outsourced)
	Hold an inception meeting
	Ongoing management
	Results and findings




# Checklist



8. Using the findings	
	Mechanisms to feed into policy making process
	Communicate to funders and stakeholders
	Capture generic lessons and mechanisms to communicate
	Share with evaluation community

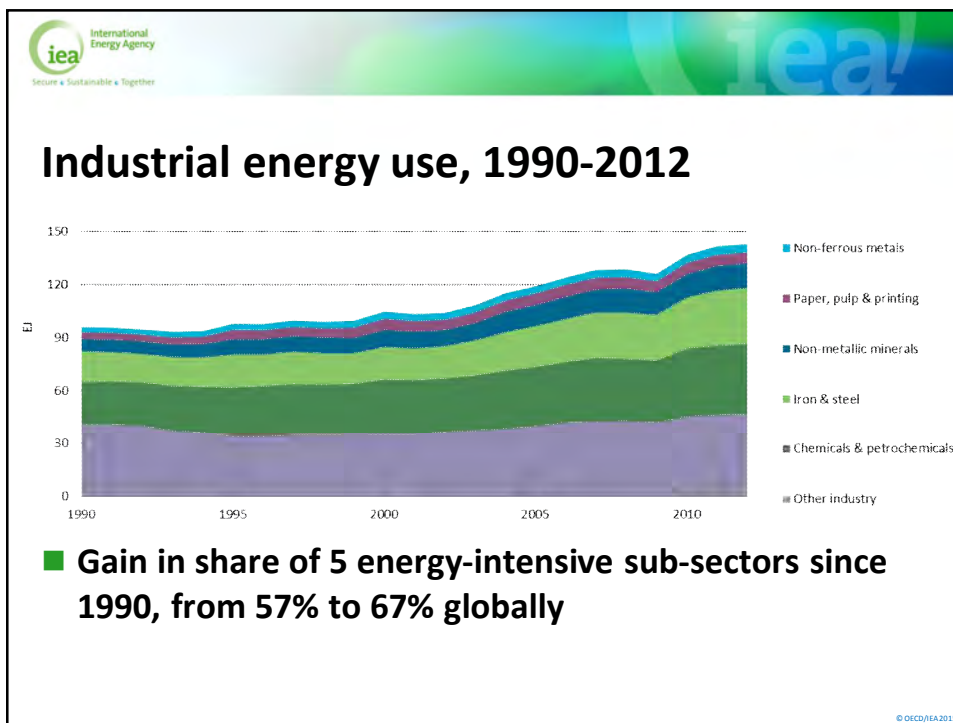
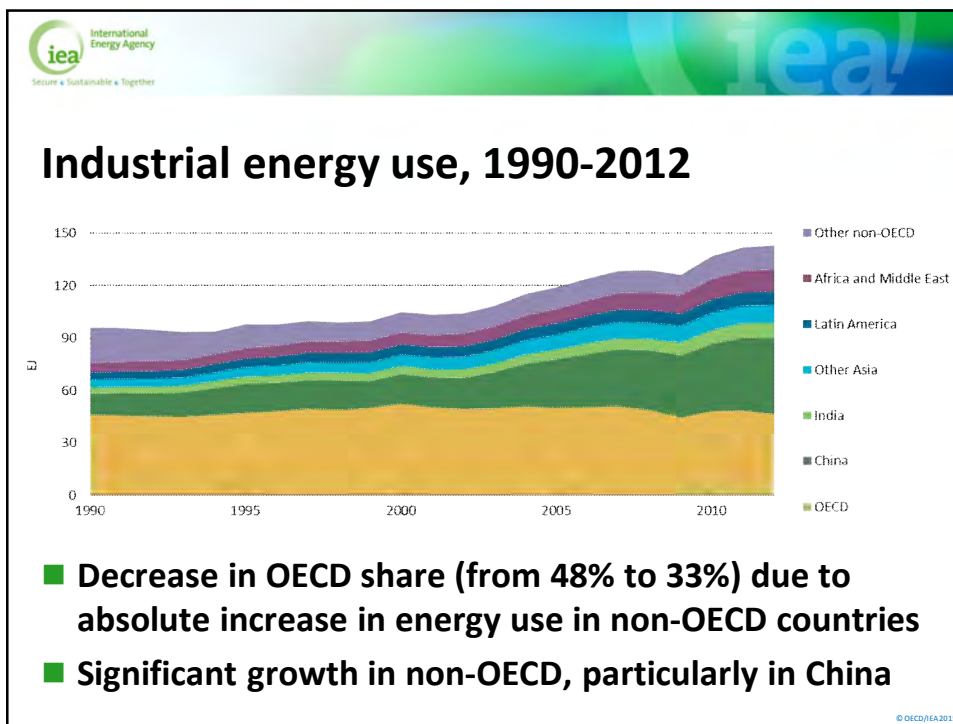


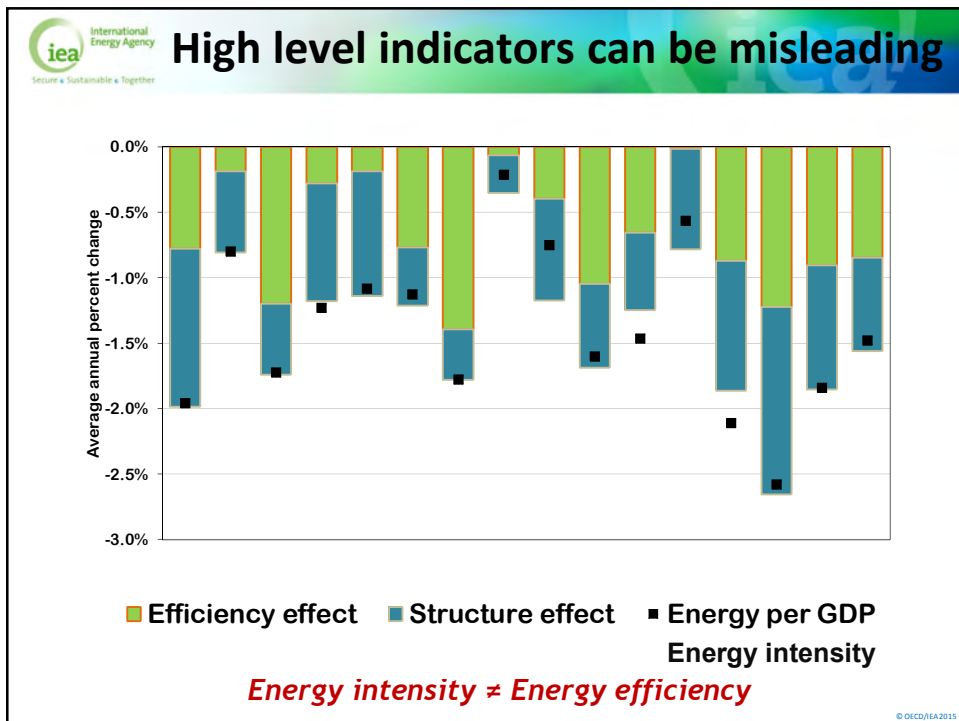
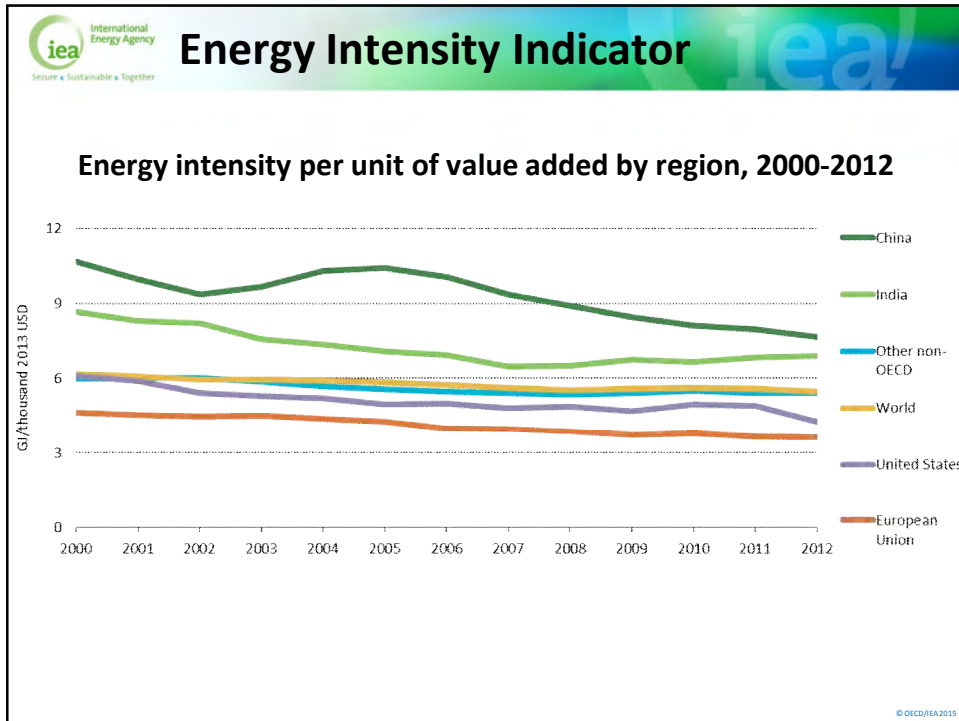
 International Energy Agency  
Secure • Sustainable • Together

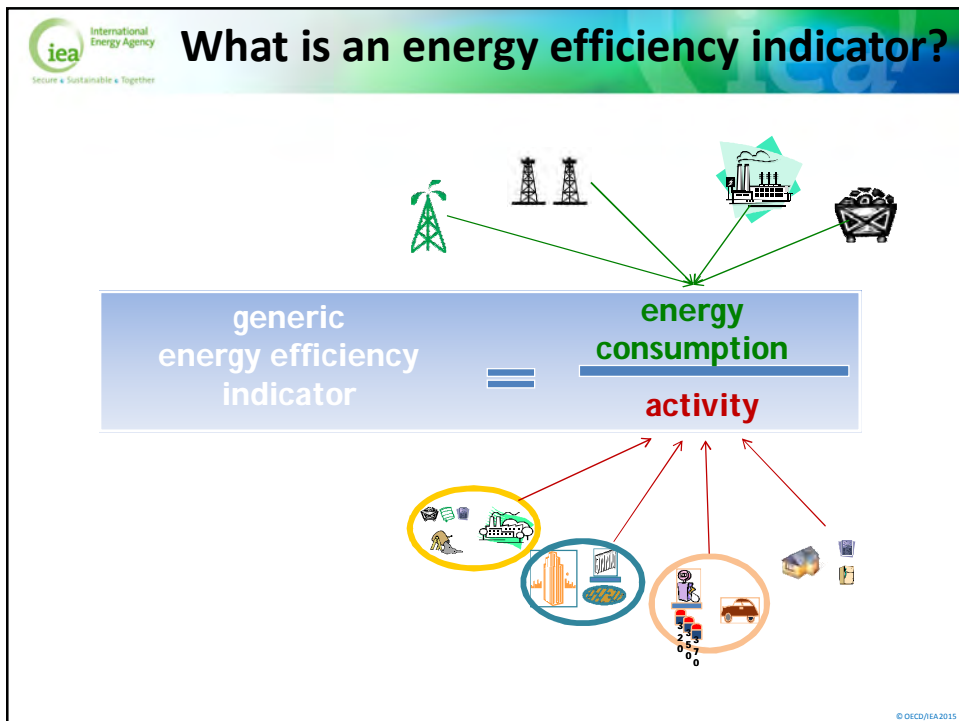
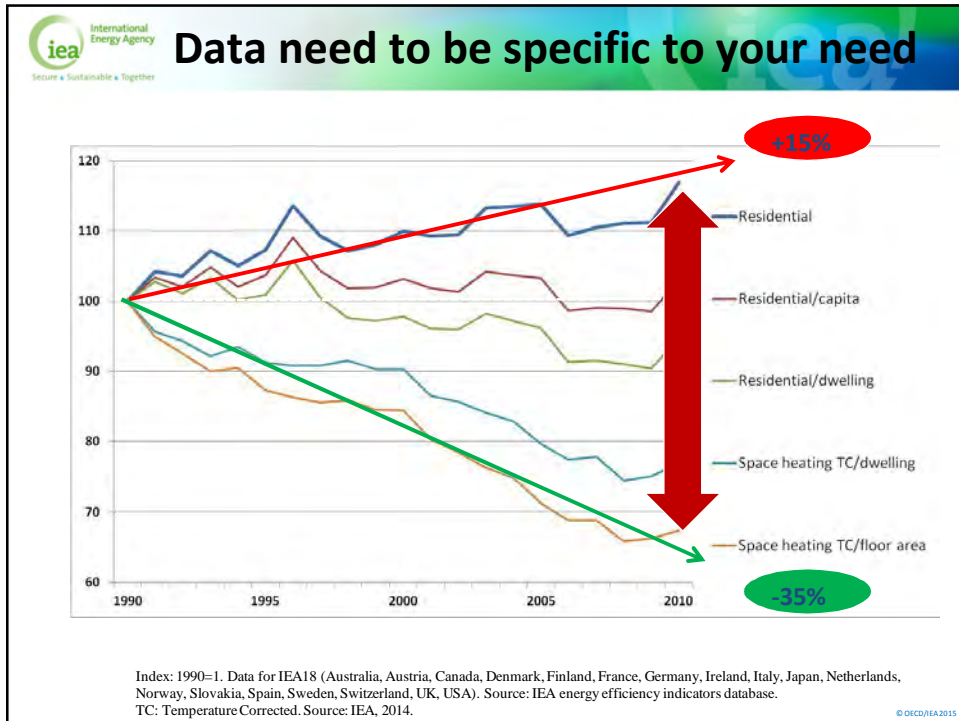
## What do we use indicators for?

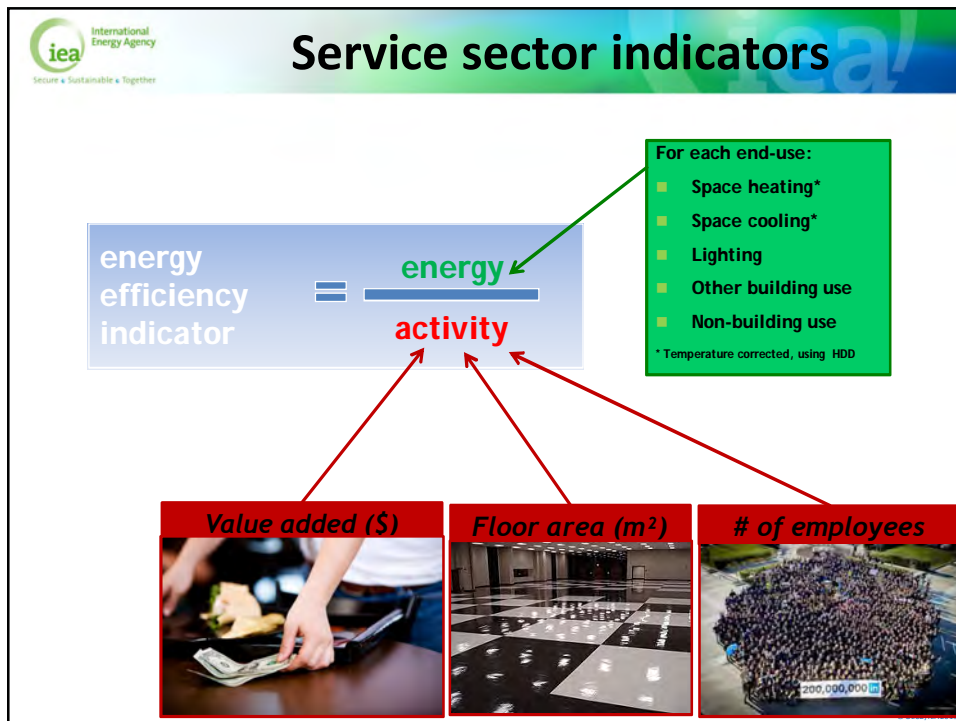
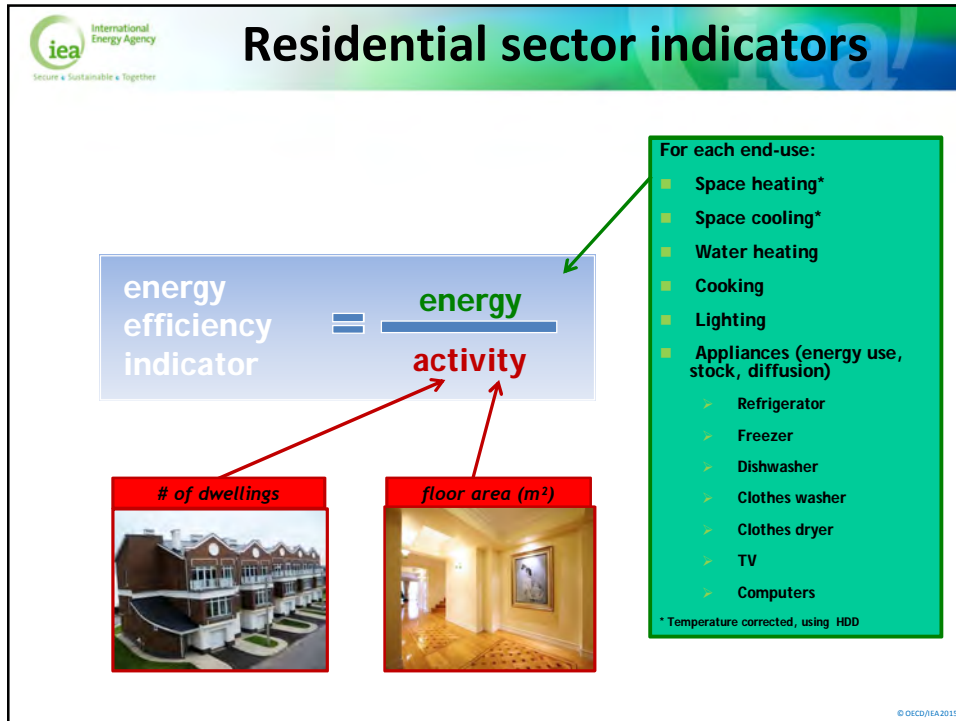
- We use indicators along with evaluation to design better policies
- We use indicators along with evaluation to track progress against targets

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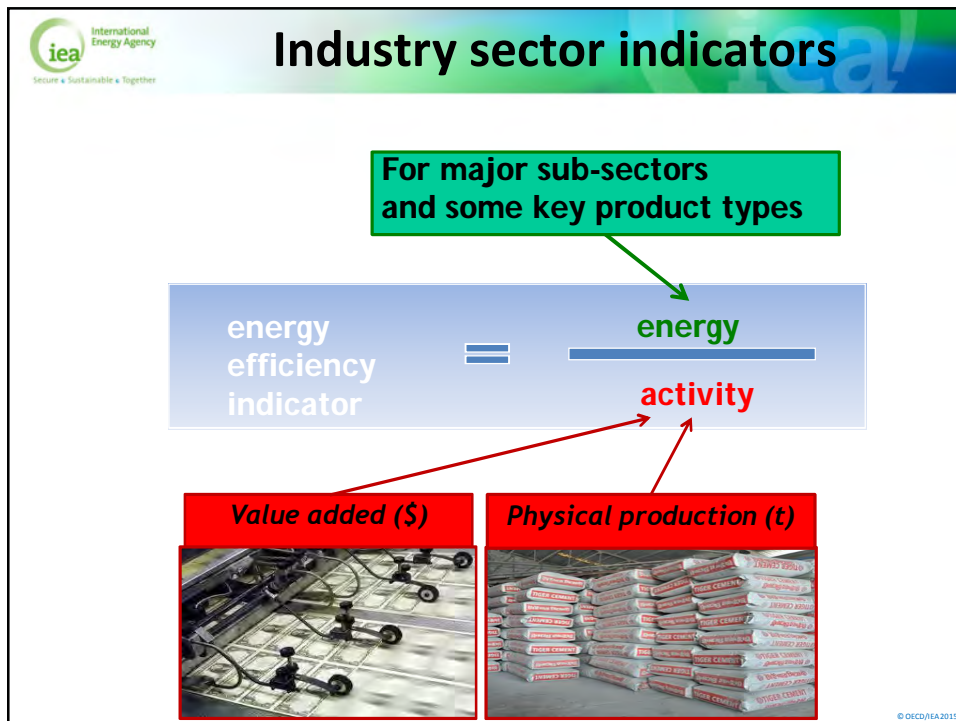
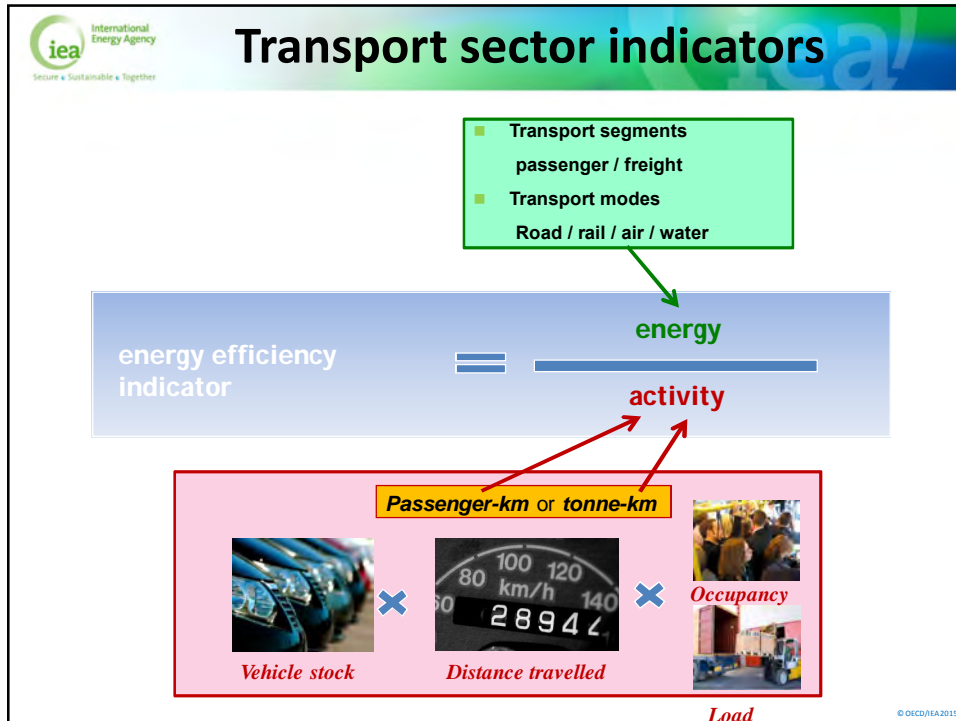


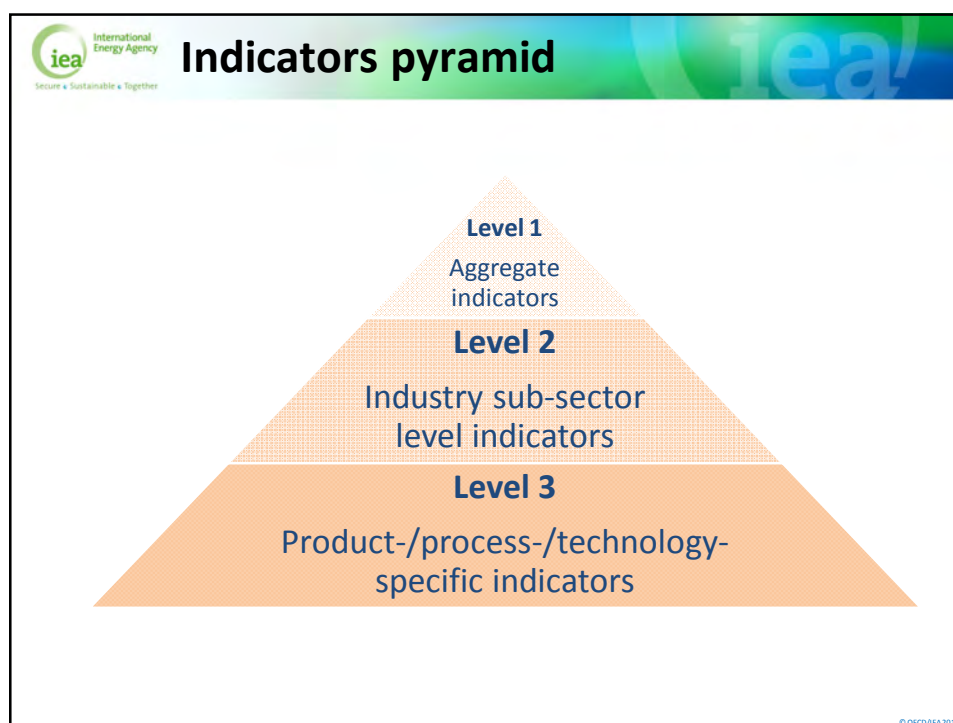













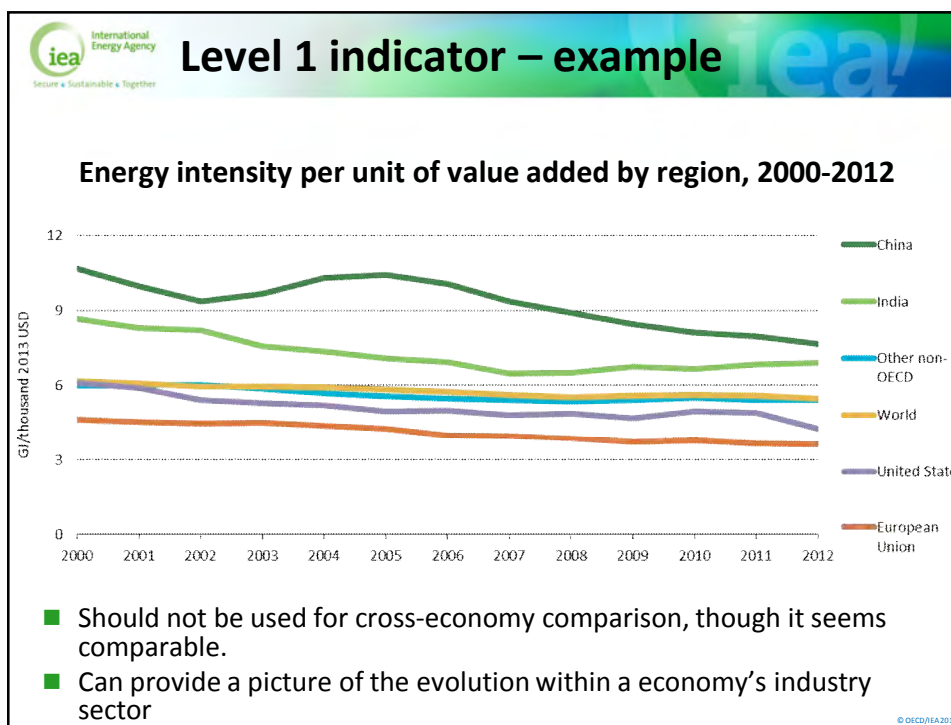
**Level 1 – Aggregate indicators**

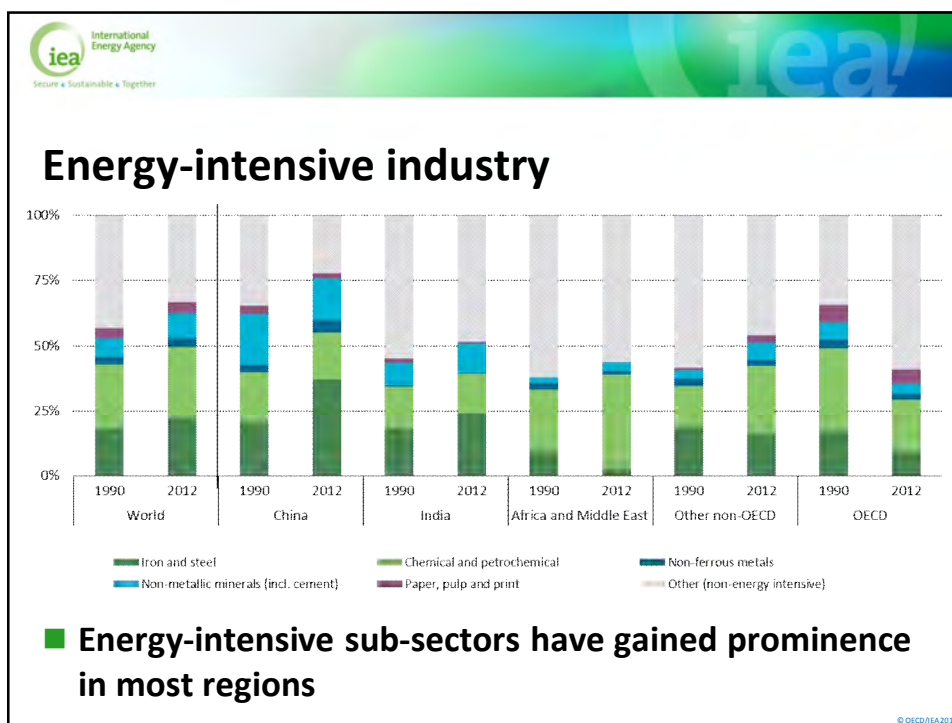
- **Industry sector-level energy intensity**
- **Measures the amount of energy needed to produce one unit of economic output**
- **Energy intensity for industry can provide a general trend of the relationship between energy and economic output**
  - Should not be used for cross-economy comparison
  - Affected by other factors, such as structure of the industry sector (i.e. share of production/energy use in energy-intensive sub-sectors), quality of resources, and even weather conditions
  - Could indicate general trend of energy efficiency only if other factors have not significantly changed

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 <b>Description of Level 1 indicators</b>			
Indicator	Data required	Purpose	Limitations
Total energy consumption by unit of industrial value-added	<ul style="list-style-type: none"> <li>“ Total industrial energy consumption</li> <li>“ Total industrial value-added (in constant currency)</li> </ul>	<ul style="list-style-type: none"> <li>“ Reflects trends in overall energy consumption relative to value-added</li> </ul>	<ul style="list-style-type: none"> <li>“ <b>Does not DIRECTLY measure energy efficiency developments</b></li> <li>“ Changes over time can be influenced by factors not necessarily related to energy efficiency</li> <li>“ Cannot be used for cross-economy comparison</li> </ul>

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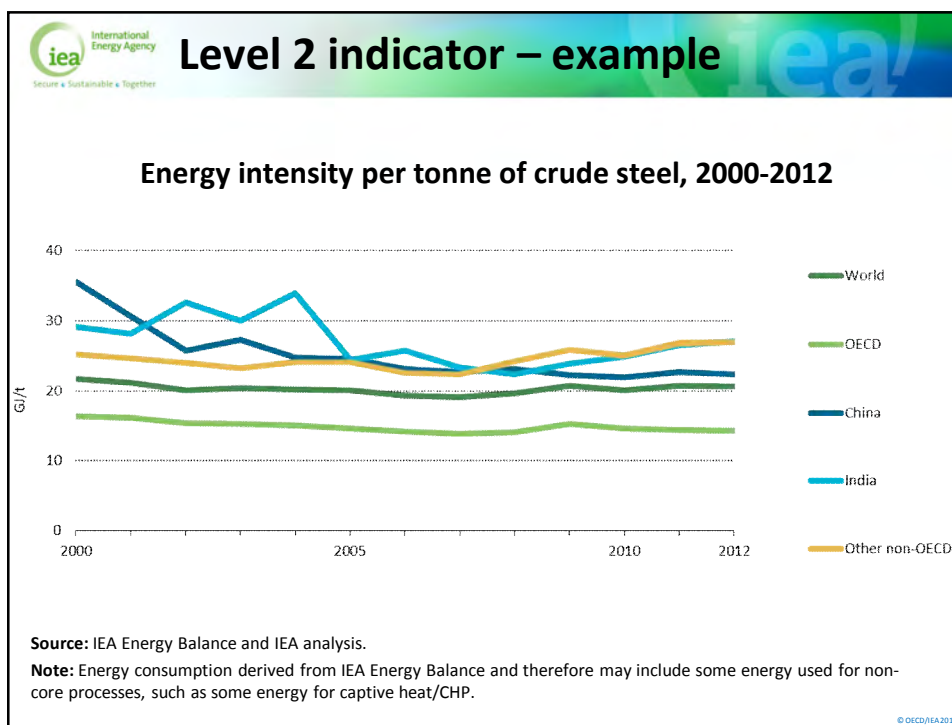
## Level 2 – Sub-sector level indicators


- **Specific indicators depend on data available.** Include indicators at the sub-sector level that measure energy use per unit of production (either in value-added or physical terms)
- **Energy intensity for industry can provide a trend of the relationship between energy and economic output within a sub-sector**
  - Can be influenced by structural shifts within a sub-sector (i.e. changing shares of products/process routes)
  - Can be influenced by pricing effects
  - Cannot be used to compare intensity across sub-sectors

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 <b>Description of Level 2 indicators</b>			
Indicator	Data required	Purpose	Limitations
Sub-sector energy consumption by unit of value-added	<ul style="list-style-type: none"> <li>~ Energy consumption by sub-sector</li> <li>~ Corresponding value-added (in constant currency)</li> </ul>	<ul style="list-style-type: none"> <li>~ Indicates the relationship of energy consumption to economic output in a particular sub-sector</li> </ul>	<ul style="list-style-type: none"> <li>~ May hide important structural shifts in a sub-sector</li> <li>~ Value-added is influenced by a range of pricing effects unrelated to physical production or energy efficiency</li> </ul>
Sub-sector energy consumption by unit of physical production (specific or unit energy consumption)	<ul style="list-style-type: none"> <li>~ Energy consumption by sub-sector</li> <li>~ Corresponding physical production</li> </ul>	<ul style="list-style-type: none"> <li>~ Indicates the relationship of energy consumption to physical production</li> </ul>	<ul style="list-style-type: none"> <li>~ Not possible to compare across sub-sectors because of differences in process and units</li> <li>~ Cannot provide an aggregate picture of efficiency in industry</li> <li>~ May hide important structural shifts in a sub-sector</li> <li>~ Difficult to apply for industrial sectors where a wide range of products exist and energy consumption cannot be allocated to a specific product</li> </ul>

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## Level 3 – Product- or process-level

- **Specific indicators depend on data available.**
  - Indicators at the product or process-route level that measure energy use per unit of production for a particular product, technology, or process-route
  - Can also include indicators for a particular fuel or set of fuels
- **Can provide a trend of the relationship between energy and production for a particular process or product**
  - Cannot be used to compare intensity across sub-sectors

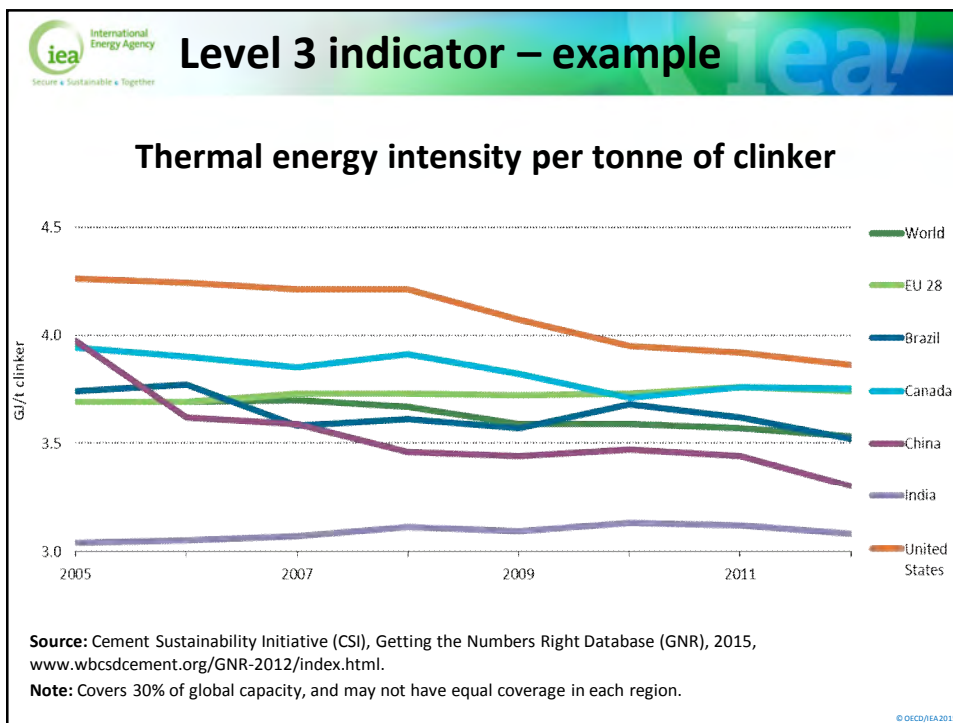
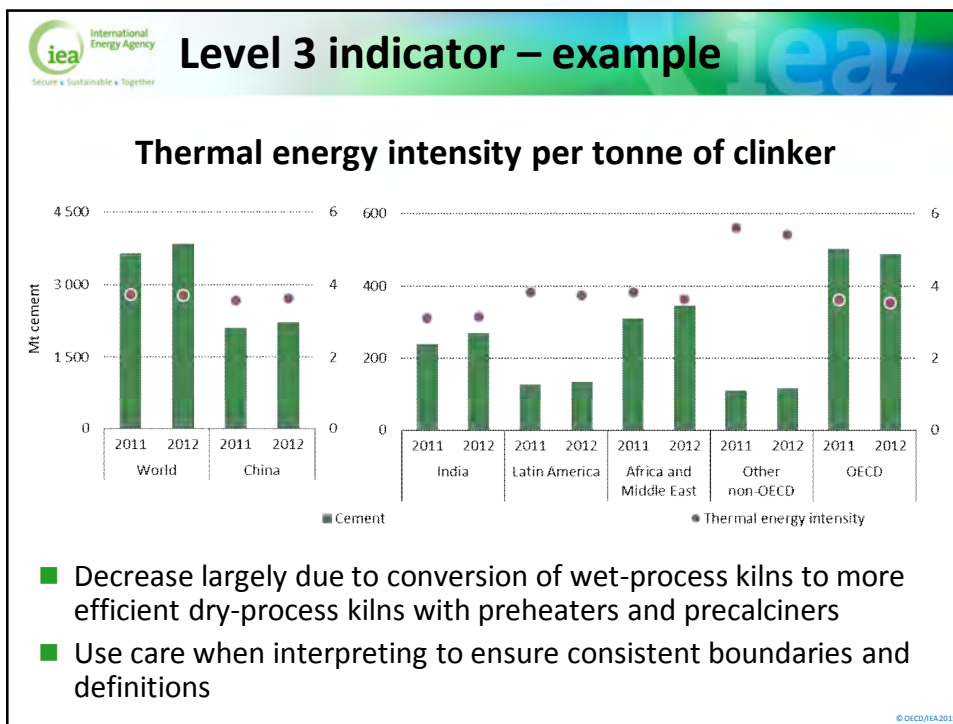
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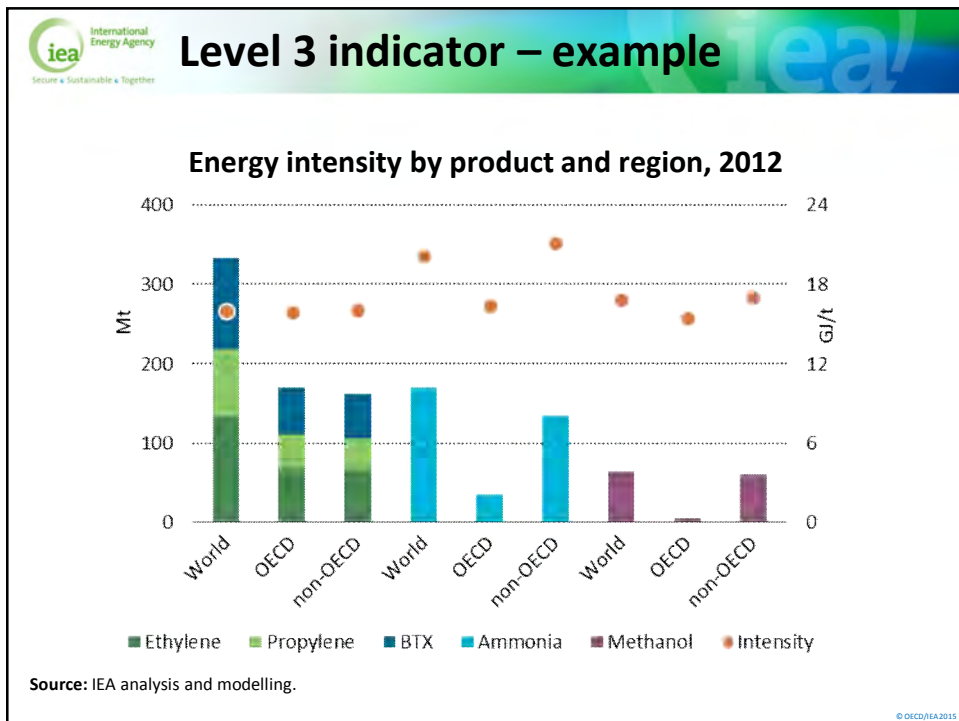
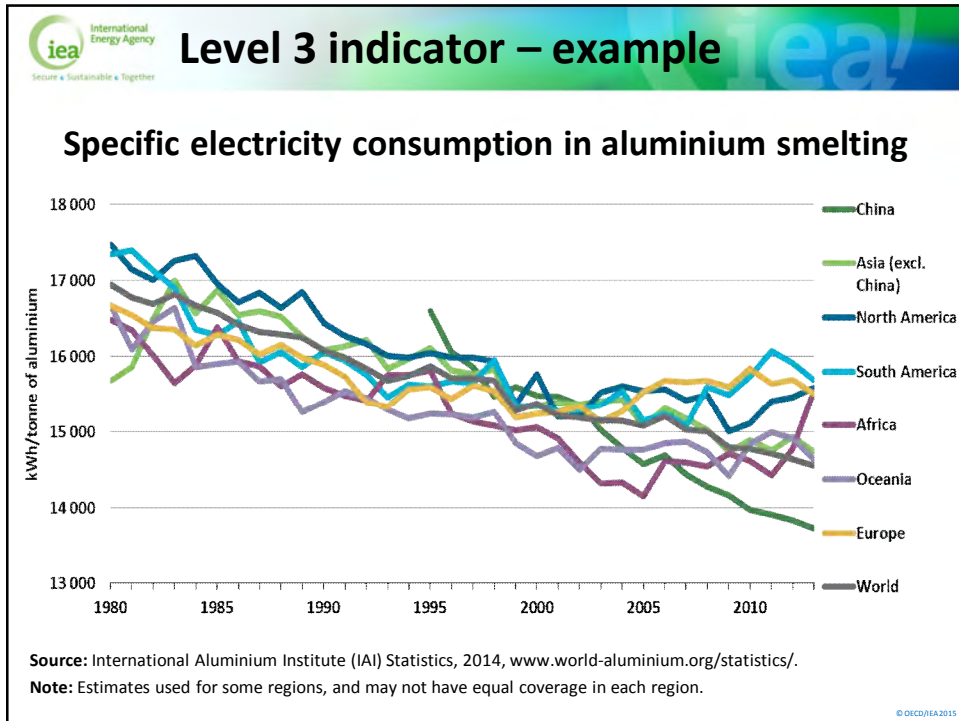


## Description of Level 3 indicators

Indicator	Data required	Purpose	Limitations
Product or process level energy consumption by unit of physical production (specific or unit energy consumption)	<ul style="list-style-type: none"> <li>~ Energy consumption by product or process</li> <li>~ Corresponding physical production</li> </ul>	<ul style="list-style-type: none"> <li>~ Indicates the relationship of energy consumption to physical production</li> <li>~ Indicates energy efficiency improvements within a process or product</li> </ul>	<ul style="list-style-type: none"> <li>~ Not possible to compare across sub-sectors because of differences in process and in units</li> <li>~ Cannot provide an aggregate picture of efficiency in industry</li> <li>~ Use care when interpreting to ensure consistent boundaries and definitions</li> <li>~ Can be influenced by changes in process technology</li> </ul>

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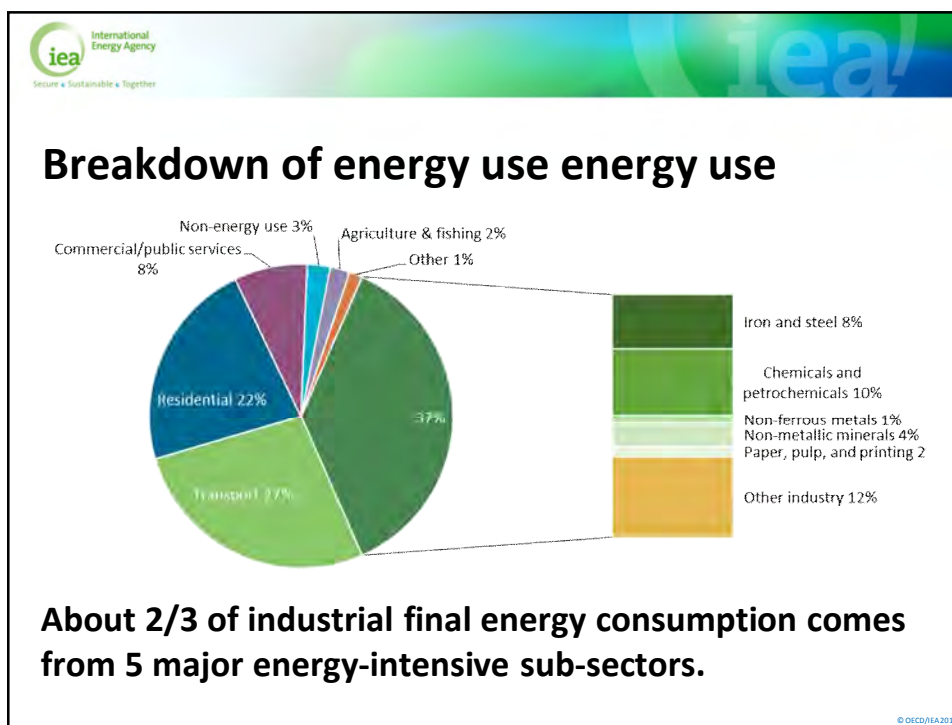


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## Where do I start?

- **Prioritising the sectors important to your economy**

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## IEA Energy Efficiency Indicators Manuals

Energy Efficiency Indicators:  
Fundamentals on Statistics

Energy Efficiency Indicators:  
Essentials for Policy Making

**Policy, analysis and monitoring:  
together to ensure successful implementation**

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## Presenting a set of indicators for each end use

**Residential**

**Appliance indicators** . . . . .

The pyramid averages all the appliances into the first row showing total energy use for appliances either in absolute value or in relative terms compared to total energy consumption of the residential sector (A1a) and the second row, as in the case of cooling and lighting, showing the same indicator but just for electricity since electricity is almost the only energy source used for appliances

**Figure 11 • Pyramid of residential appliances indicators**

**A1a** Total appliances energy consumption (absolute or as a share of residential consumption)

**A1b** Total appliances electricity consumption (absolute or as a share of residential electricity consumption)


**A2a** Appliances consumption per dwelling (and per dwelling with electricity)

**A3a** For each appliance type: energy consumption per appliance unit ☺

For each indicator of levels 2 and 3, the table gives the name, its coverage (overall or by specific type), the energy data and the activity data to be used. The column before the last gives the code number for the indicator and, when it applies, the last column highlights if the indicator is considered as the preferred indicator for a particular end-use.

20

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## Describing possible sources for data

**Table 7.3 • Summary of the main data needed for transport indicators and examples of possible sources and methodologies**



Data	Source	Methodology
<b>Energy data</b>		
Total transport consumption	National energy balance National energy statistics	Administrative sources Modelling
Consumption by sub-sector	National energy balance National energy statistics	Administrative sources Mobility surveys Modelling
Consumption by segment		Mobility surveys Modelling
Consumption by vehicle type		Mobility surveys Modelling
<b>Activity data</b>		
GDP, population	National statistics offices	Administrative sources
Vehicle-km (vkm)	Vehicle registers/ Roadworthiness testing services/ Inspecting organisations  Municipalities/Transport authorities  National and international databases Transport ministries	Measurements: odometer readings  Measurements: road traffic count  Administrative sources Mobility surveys Modelling
Passenger-km (pkm)	National and international databases Transport ministries	Administrative sources Mobility surveys
Tonne-km (tkm)	National and international databases Transport ministries	Administrative sources Mobility surveys, freight surveys


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## Methods used to collect data for indicators

- **Administrative sources**
- **Surveys**
- **Metering and measuring**
- **Modelling**





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## Sharing expertise from countries

160 economy practices presented by sector and by methodology

Country	Austria		R/Su/OI
Organization	Statistics Austria		
Name of the survey	Household energy consumption survey		
Survey purpose	<ul style="list-style-type: none"> <li>• To determine total household energy consumption</li> <li>• To determine household appliances energy consumption</li> <li>• To collect household energy expenditure</li> <li>• To collect dwelling physical characteristics</li> <li>• To collect household occupant characteristics</li> </ul>		
Sample design	Stratified random sampling approach		
Sample sources	List of addresses, list of telephone numbers, labor force survey		
Collection methods	<ul style="list-style-type: none"> <li>• Computer assisted personal interview (CAPI)</li> <li>• Computer assisted telephone interview (CATI)</li> </ul>		
Sample/Population size	14 000 / 3 429 720	Response rate	55%
Frequency	Every two years	Last time surveyed	2010
Time to complete survey	10 minutes	Mandatory	No
Incentive	None		
Survey respondents	Households		
Elements collected	Dwelling type, dwelling floor area, building age, household occupancy, energy-related renovations, household energy consumption and related expenditures		
End-uses collected	Space cooling, space heating, domestic hot water, other: cooking		
Main challenges	<ul style="list-style-type: none"> <li>• Inconsistent responses</li> <li>• Response quality</li> </ul>		
Possible improvements			
Key best practice	<p>A new approach to data control compared with previous surveys was taken for the first time in 2004 and continued in the follow-up survey runs. Up to and including the 2009 survey, only the individual energy sources themselves were checked for plausibility, any missing data were calculated (quantity-value pairs) and substitutions were made if necessary. Such routines of course continue to be used, with the additional step that the total of the reported energy consumption is then related to a calculated (fictional) overall consumption. This fictitious overall consumption by the household is calculated from the data for that household, on the one hand (floor space, number of people in household) and pre-set parameters for the individual types of use (space heating, water heating, cooking, other purposes), on the other hand. Calculating the total reported energy consumption per household in this way involves some quite complicated plausibility routines, because one or more alternative quantities have to be calculated if the quantity-value pairs do not match and these alternative quantities then, when variably applied, lead to a number of different calculated overall energy consumption figures. The fictitious standard value is then used to select the quantity-value pairs that appear most probable.</p>		
Other documentation	Available: Surveying Methodology and Questionnaire		

Background:


Institution  
Purpose ...

Technical information:

Sample  
Frequency  
Data collected...

Comments:


Challenges  
Tips  
Documents  
Links...  
(e.version)



## How are countries collecting data?

A platform to share expertise worldwide in a searchable database

Русский 中文简体



Working together to ensure reliable, affordable and clean energy

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[International Energy Agency > EE Indicators Manual](#)

### Energy Efficiency Indicators Statistics: Country Practices Database

A supplement to the publication [Energy Efficiency Indicators: Fundamentals and Statistics](#), this database presents practices on collection of data for developing efficiency in from a variety of OECD and non-OECD countries.

Practices are searchable by country, sector, methodology and type of available documentation. By sharing these experiences, we hope to help countries and organisations to their own energy efficiency indicators programmes.

**Countries**

- Austria
- Italy
- Japan
- Kazakhstan
- Korea, Republic of
- Mexico
- Netherlands
- New Zealand
- Norway
- Portugal
- Slovenia

**Sector**

- Industry
- Residential
- Services
- Transport

**Methodology**

- Administrative sources
- Measuring
- Modelling
- Surveying

**Available content**

- methodology
- project web site
- questionnaire
- report
- results

**Search by keywords**



## A few concluding remarks

- Indicators are an important tool for improving the effectiveness of energy efficiency policy and tracking progress
- Varying levels of detail are needed across sectors depending on economy-specific priorities, policy needs, data availability, etc
- A global community of experts and a database of practices used across countries in support of developing programmes is available at:  
[www.iea.org/statistics/topics/energyefficiency](http://www.iea.org/statistics/topics/energyefficiency)

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## Appendix 3

### List of Workshop Participants

No.	Economy		Name
1	China	Dr	Pengcheng Li
2	China	Mr	Wei Ren(Steven)
3	China	Ms	Li Zhu
4	Japan	Dr	Gyuyoung Yoon
5	Korea	Mr	Inchul Hwang
6	Malaysia	Mr	Zulkiflee UMAR
7	Philippines	Mr	Antonio Nabong
8	Thailand	Mr	Warote Chaintarawong
9	Thailand	Mr	Wisaruth Maethasith
10	US	Mr	Cary Bloyd
11	Thailand	Mr	Wongkot Wongsapai
12	China	Mr	Jianlin Wu
13	China	Ms	Huai Li
14	China	Ms	Yanjie Lyu
15	China	Mr	Shicong Zhang
16	China	Ms	Jiali Kang
17	Hong Kong, China	Mr	Ming Sum CHOI
18	US	Dr	Cary Bloyd
19	Japan	Dr	Kazutomo Irie
20	Indonesia	Ms	Gita Lestari
21	Chinese Taipei	Mr	Henry Lo
22	Chinese Taipei	Mr	Tony Chang
23	Mexico	Mr	Eduardo Ramos Huerta
24	Malaysia	Mrs	Noor Afifah ABDUL RAZAK
25	Malaysia	Ms	Ida Syahrina Haji Shukor
26	New Zealand	Mr	Eddie Thompson
27	APERC	Ms	Cecilia Tam
28	APERC	Mr	Martin Brown-Santirso
29	CLASP	Mr	Hans Alarcon
30	UK (consultant)	Mr	Charles Michaelis
31	ICA	Mr	Mayur Karmarkar
32	IEA	Ms	Melanie Slade