POLITECNICO MILANO 1863

United Nations Educational, Scientific and Cultural Organization

UNESCO Chair in Energy for Sustainable Development

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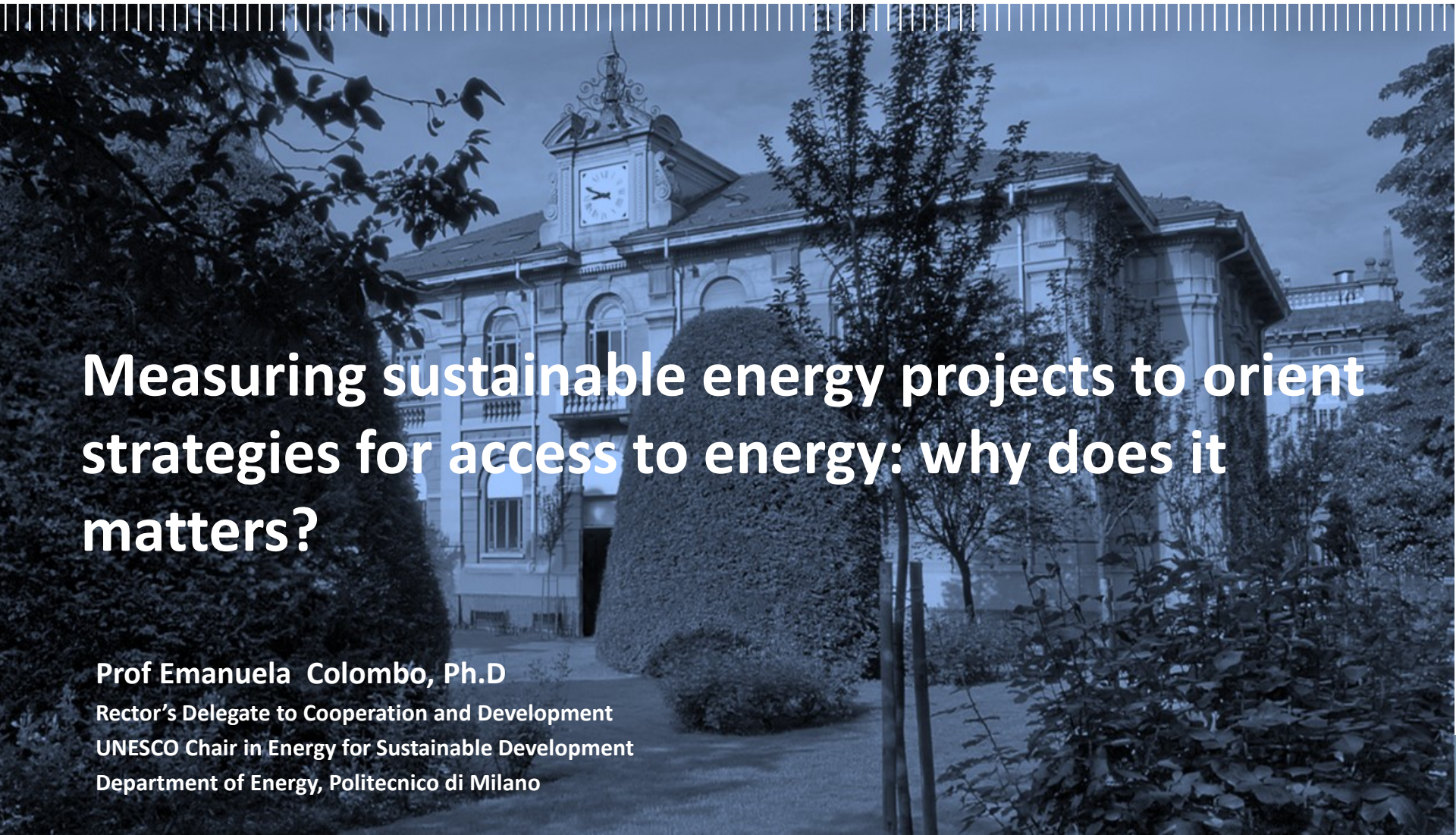
Foundation



Measuring sustainable energy projects to orient strategies for access to energy: why does it matters?

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Rector's Delegate to Cooperation and Development
UNESCO Chair in Energy for Sustainable Development
Department of Energy, Politecnico di Milano

Energy & Sustainable Development

Multiple interconnections among energy, environment and society

Interlinkages on

- Socio-Economic **Development**
- **Quality of life** for the people
- Global **Security** (raw materials, food, water)
- **Environmental** protection

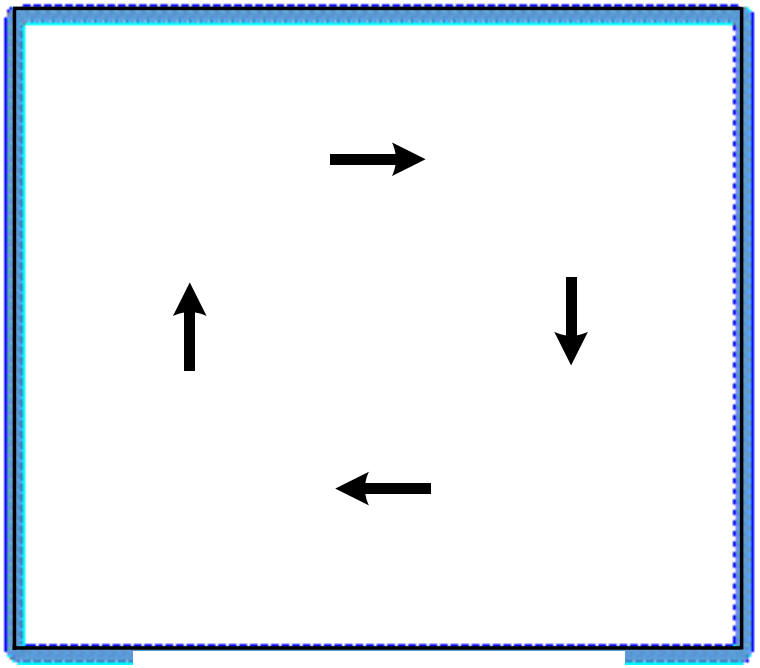
GOAL 7 **COP21 & COP22** **SE4ALL**

Energy → **Services** → **Development**

Energy & Sustainable Development

Concern about over-exploitation of resources

Human and economic activity goes along with **the capacity of using natural resources**



The concern about **overexploitation of natural resources** has come to be **global**:

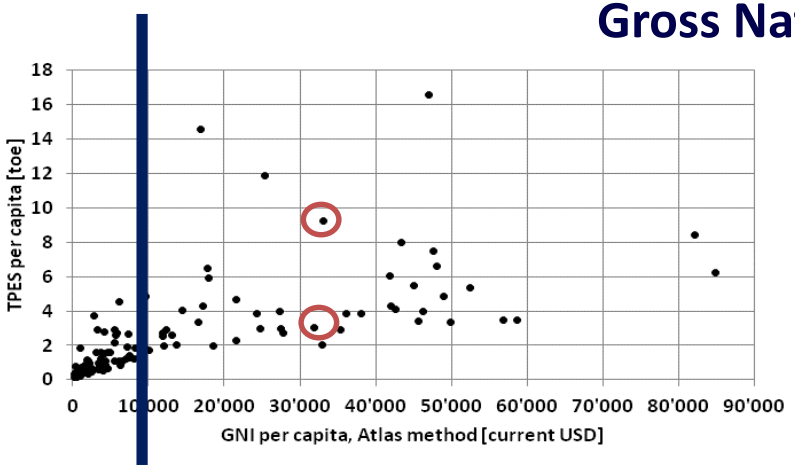
- **are limited**
- **their misuse** affects the environment
- The **non-equitable distribution** affects international security

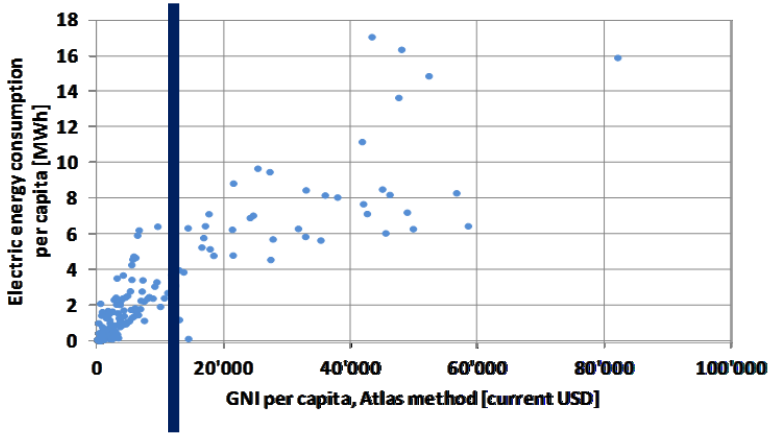
Energy & Sustainable Development

Energy, Economics and beyond

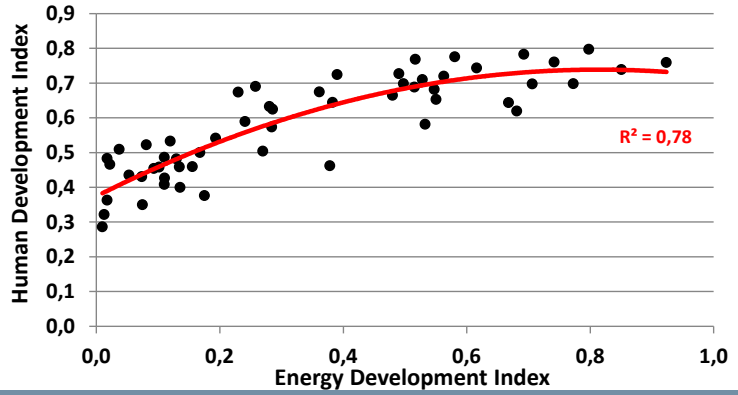
Total Primary Energy Supply *Versus* Electric energy Consumption

Gross National Income





Human development index *Versus* Energy Development index



Energy & Sustainable Development

Energy and Rights

Some Philosophical achievements

- Energy does not determine **human dignity.**
- With zero/poor access, **fundamental rights** may not be guarantee

Energy comes to be an **instrumental right**

UNITED NATIONS
HUMAN RIGHTS
OFFICE OF THE HIGH COMMISSIONER

Energy Access beyond a binary metrics

QUANTITY access to energy

QUALITY affordable, reliable, safe & clean…

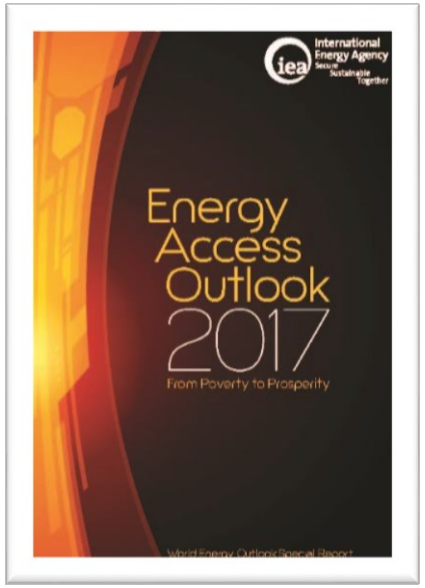
Low income countries

1.1 billions No **access to electricity**

2.5 billions use **traditional biomass**

Middle Income Country

1 billion, no **reliable** access



High Income Country

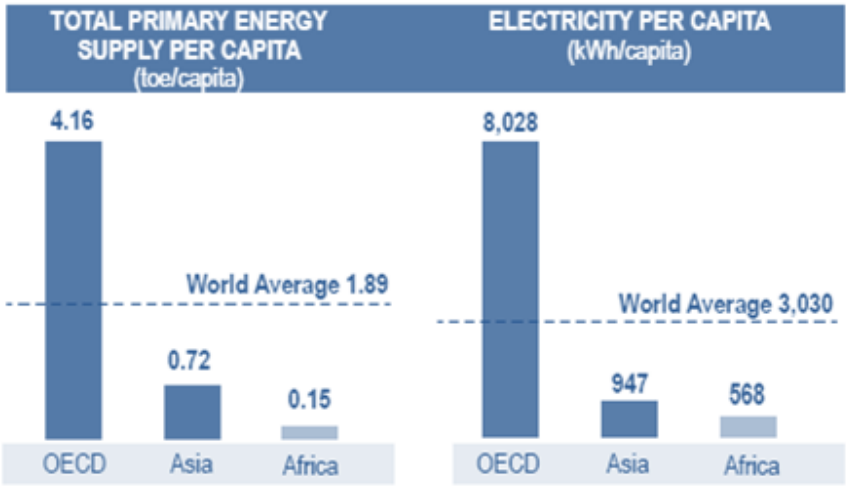
50-75 millions in EU affected by **“fuel poverty”**

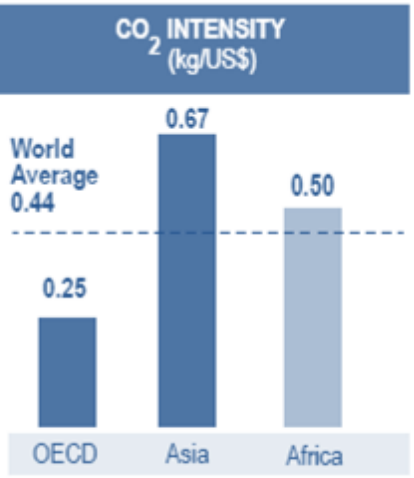
Energy access in Africa

Lack of Energy access

690 millions people no electricity

780 millions no clean cooking



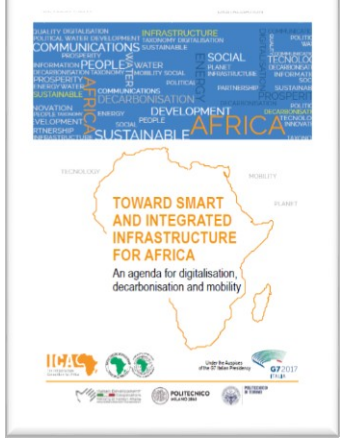


Access ~50%	Electricity use ~1/5 world av.	Intensities >2 times OECD	~ 150 GW uneven share

Underinvestment is still an issue

Energy access in Africa

Toward Smart and Integrated Infrastructure for Africa, ICA Background Paper 2017

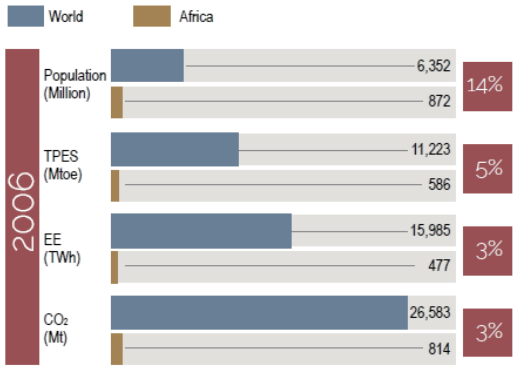


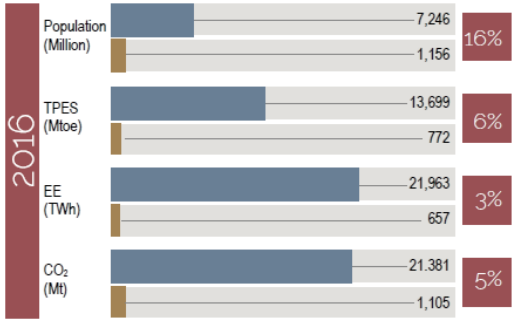
Lack of Energy access

LAST TEN YEARS: Africa Energy System could **not keep pace** with population growth

LOOKING FORWARD: Africa is expected to become more **energy demanding** due to its growing population and economy

FIGURE 13. EXTENSIVE ENERGY INDICATORS: AFRICA AND WORLD AVERAGE





Broadband <5%

Internet <30%

Passengers ~5%

Goods ~3%

Rails ~15%

Lack of access to other services

Further **'leapfrogging' opportunities may be enabled by inter-sectorial synergies** among energy, transport and ICT

Energy access in Africa

The Energy Paradox

16% **of population** => **6%** **TPES,** **3%** **EE,** **5%** **C02**
30% of global **O&G discoveries** and top potential for REs

Few Energy

Technical losses in the power sector are **twice** the average
Sales lost for SMEs are huge (**5-15 %** of the total sales)

Not Reliable

Electricity tariffs are among the highest in the world
No domestic market: **2/3** **investment** are for export

Not affordable

67% **population** rely on biomass (fuelwood/ charcoal)
40% **rise in bioenergy => forestry stocks + health**

Not clean nor safe

0,6-0,8 **billion still** affected by **poor energy access in 2040**

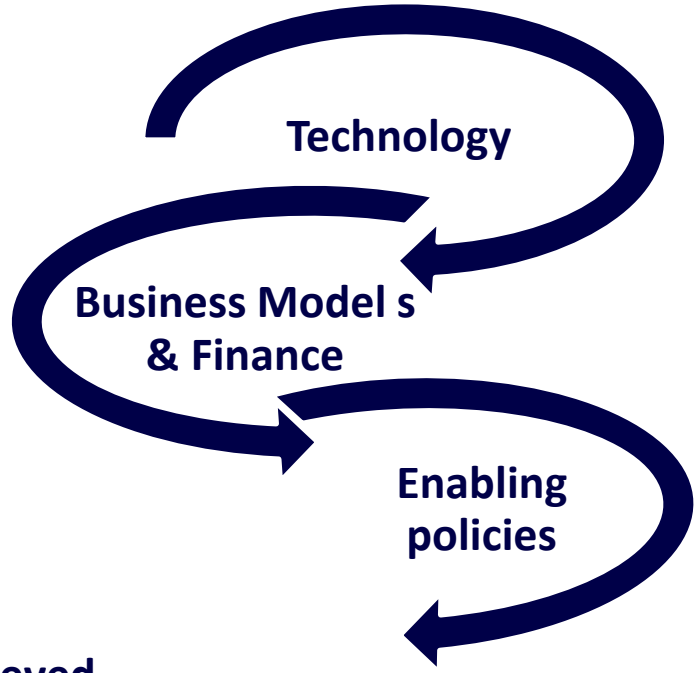
Not improving fast!

What is missing?

From the Energy Paradox into the Energy Power for Africa

Energy Debate for Africa

2012
INTERNATIONAL YEAR OF
SUSTAINABLE
ENERGY FOR ALL



7 AFFORDABLE AND CLEAN ENERGY

\+

- **Progresses has been achieved**

\-

- the goal of **SE4All** is still far
- **GOAL 7** will not be straightforward

What is missing? *Measuring Impact*

Measuring the impact of our Actions

Learning from the past

"Whoever wishes to foresee the future must consult the past." Niccolò Macchiavelli

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ESMAP
Energy Sector Management Assistance Program

enel Foundation

Evaluation metric to address the complexity and interconnections of current energy challenges

Accountability
Assess project performance

Strategic Planning
To guide future interventions

Performance and Impact Assessment Framework

Measuring the impact of our Actions

Learning from the past

Accountability
Assess project performance

Strategic Planning
To guide future interventions

Metrics for IMPACT has to take into account

(i) The induced change on the community
(ii) The relation between effects & costs or needs

TAKING PROFIT FROM …

- LFM, **Livelihood approach**, **Results Chain**
- DAC-OECD 5 Criteria

Common tools exist

MITIGATING …

Lack of harmonization

- few structured and **quantitative assessments**

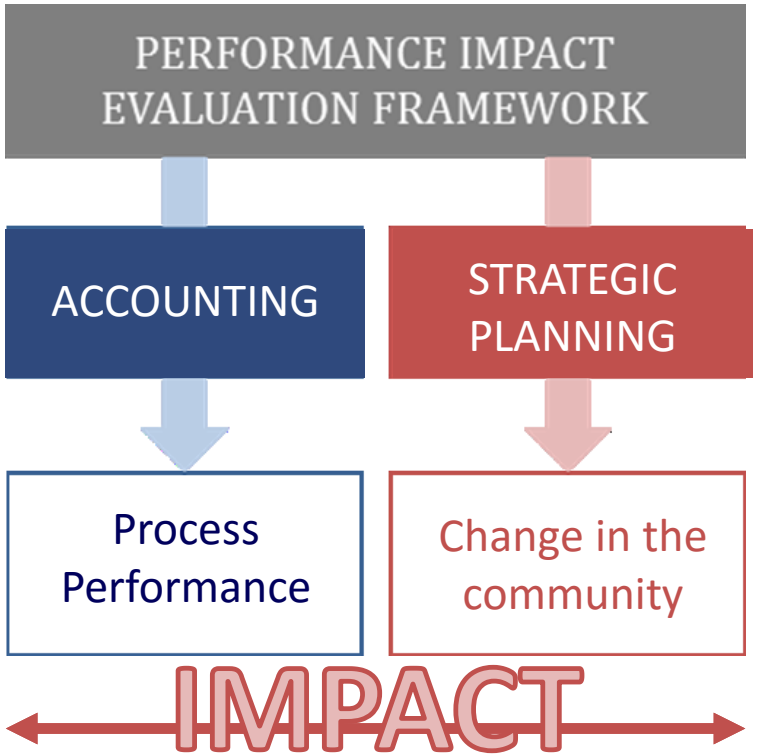
Performance and Impact Assessment Framework

Measuring impact beyond energy access project!

Accountability ….. Measuring the process's performance

Inputs → Activities → Outputs → Outcomes → Impact

Strategic Planning…measuring the change



ACCOUNTING: measuring process performance

MODEL BASED APPROACH

FLOWS OF INPUT

- Materials
- Energy
- Other goods & services
- Externalities

RESOURCE CONSUMPTION

Overall estimation of
- resources consumption
- waste production

INTENSIVE INDEXES

- Efficiency
- Effectiveness
- Relevance
- Sustainability

Needs • *Local Assessment* **Resources**

Quantitative models from Energy System Analysis

- Exergy Based Accounting methods
- Life Cycle Approach
- Macroeconomic Input/output

… to calculate multidimensional reference metrics

Effects

- *Energy produced*
- *Income or Value added*
- *Employment creation*

Costs

- *Monetary input*
- *Embodied energy, Virtual Water*
- *Carbon Footprints….*

Process performance is accounted

- Intensive measure of **DAC-OECD criteria**

Efficiency, Effectiveness, Relevance ,Sustainability

STRATEGIC PLANNING: measuring impact on community

EVALUATION HIERARCHY

Induced change on community capitals

Based on the Sustainable Livelihood Framework

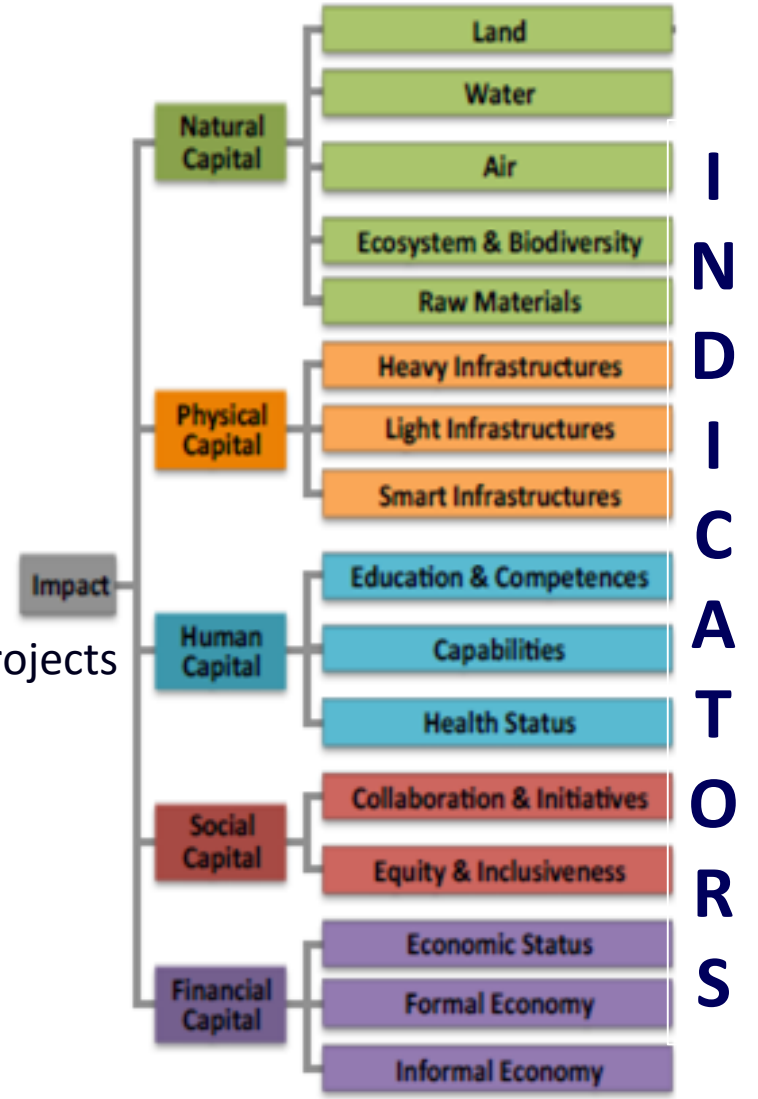
- Capitals are recognized
  - Natural
  - Physical
  - Human
  - Social
  - Financial
- Dimensions within capitals are identified 4 energy projects

Indicators definition

- Project based
- Scientific Literature
- Standards from Grey literature

Field-Base Survey (community perspective)

- Indicators measure



STRATEGIC PLANNING: measuring the impact on community

EVALUATION HIERARCHY

FIVE-STEP PROCEDURE

COSTUMIZATION

- Indicators selection

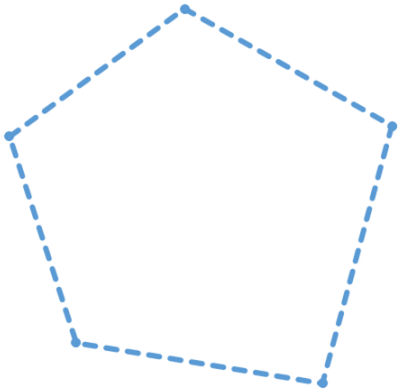
DEVELOPMENT

- Data input and normalization
- Weights assignment
- Multi-criteria aggregation

RESULTS ANALYSIS

- Impact

- **Evaluation of change in the community Ex-Ante/Ex-Post**



- **Possibility to compare project results with national averages to assess improvements**

Performance and Impact Assessment Framework

Feedback from framework application

Lessons learnt

When applied to large number of projects it may allow comparisons
Offering a set of information either Ex-Ante or Ex-Post to different stakeholders

Policy Makers
Local, national, regional

⇒ **Feedback for local development strategies**

Investors
Private, public

=> Feedback on investment complement bankability indexes

Science Community
Research Center , Academia

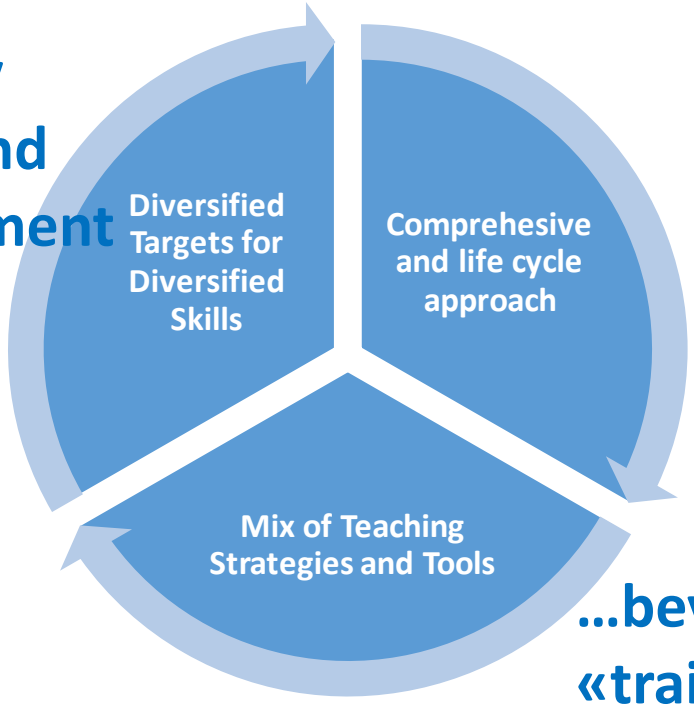
=> Feedback on effective strategies and research direction

What is missing? *Human capital*

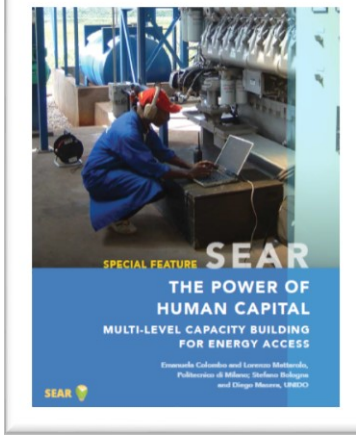
"The greatest invention in the world is the mind of a child." - *Thomas Edison*

Universal access requires «PEOPLE» at the center of the design

... capacity building and empowerment



«Appropriate energy solutions…must respond to the needs, capacities, and aspirations of people and be absorbed within the local culture…"



SEAR Special Report, 2017: The Power of human Capital, the World Bank

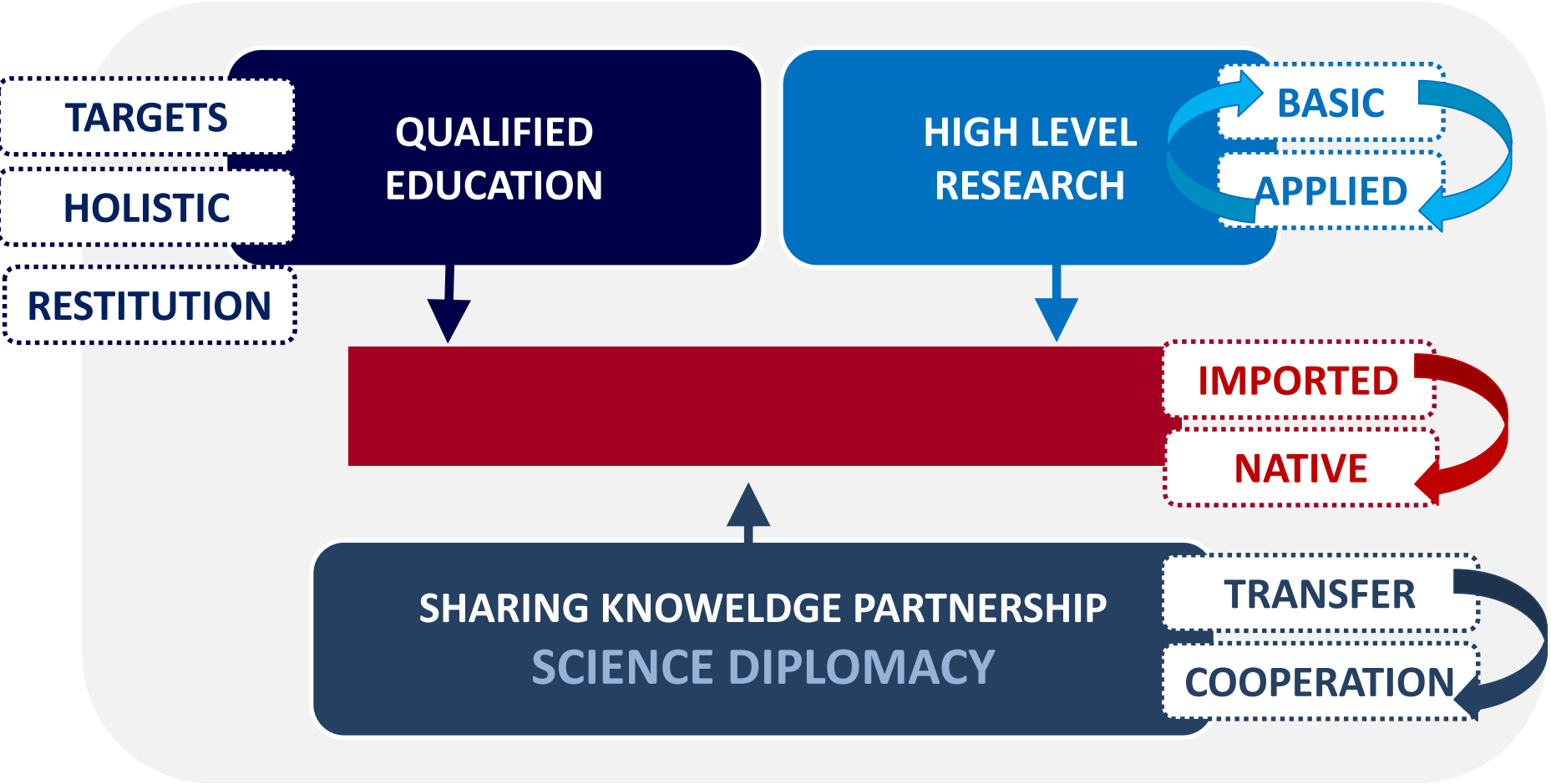
…beyond delivering «training hours»

Win-Win strategy for local communities and private investors
And an essential element for long term sustainability

What is missing? *Science as Un-usual*

"We don't know who discovered water, but we're certain it wasn't a fish." - *John Culkin*

Beyond traditional mission, while preserving science independence!



Thank you for your kind attention!

"The only way to discover the limits of the possible is to go beyond them, entering the impossible"- B.Pascal

Sustainable Energy Solutions **FOR** **People** **BY** **WITH**