Training on Energy Efficiency in Buildings of stakeholders in urban planning, construction and building

Organised by ECREEE

PRAIA, CABO VERDE, 9th-10th June 2014

SERA Sustainable Energy & Resources Availability

SUSANNE GEISSLER _ CÉSAR FREITAS

How to deal with large buildings: Key elements of a framework on energy efficient buildings

SUSANNE GEISSLER + CÉSAR FREITAS

Energy efficient buildings

Large buildings | key elements of an energy efficiency framework

> Table of contents

Introduction

Objectives | energy efficiency policy

> It is the objective to develop / to implement an energy efficiency policy resulting in an actual increase in building energy efficiency

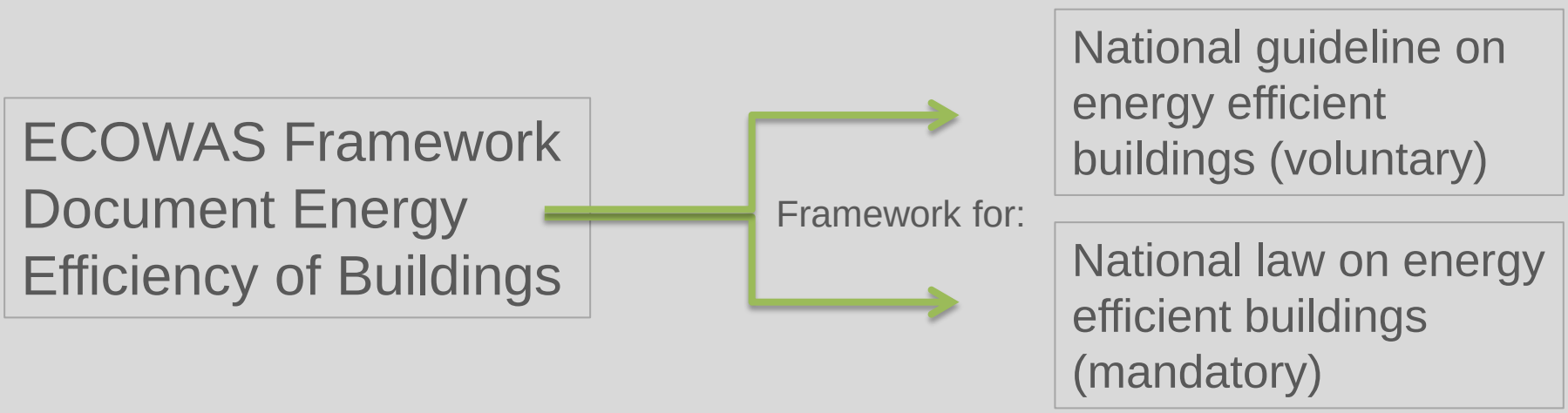
> Basic elements:

> Energy minimum requirements for buildings

> Indicators for energy efficiency:

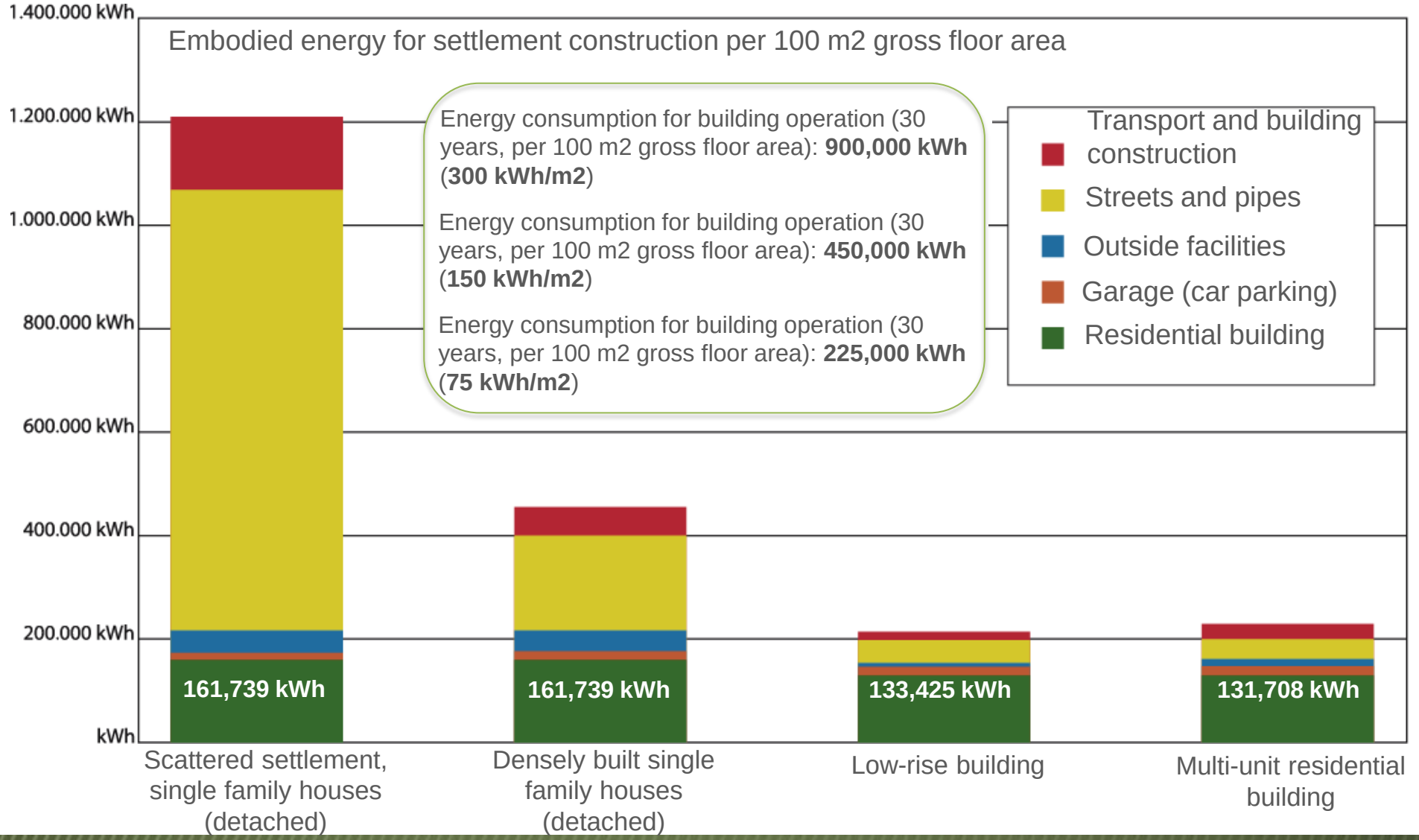
Building operation: kWh per m2 and year

Building construction: kWh per m2 and year (embodied energy of building materials; to be considered later, when energy consumption during building operation has been reduced already)



LCA of buildings in different urban layouts

Energy consumption for constructing buildings and infrastructure



Introduction

Integrated building optimisation | stepwise approach

> Actual building energy consumption can be minimised based on:

> Correct way of building arrangement

> Climate and site responsive building form / design

> High quality building construction

> Up-to-date building management during operation

> Urban design (zoning plan) has a big impact on the potential of energy efficiency at the building level

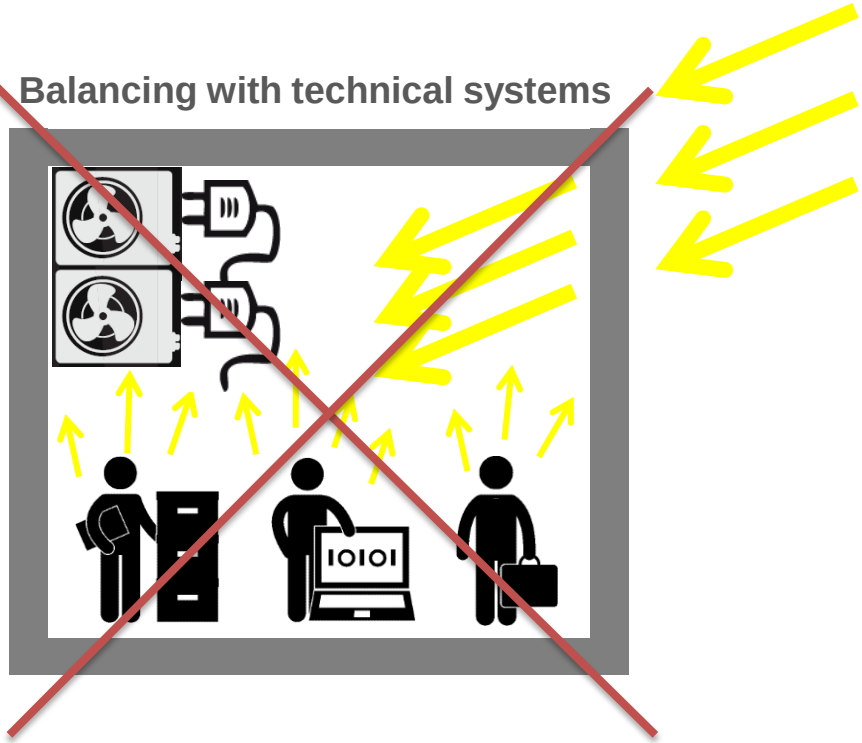
Step 1: Building arrangement	**Step 2**: Building form / design	**Step 3**: Building construction	**Step 4**: Building operation
*) Building orientation; making use of wind and vegetation *) Avoid formation of urban heat islands	*) Basic principles: Compactness, Share of window area, shading *) Climate and site responsive design	*) Construct as planned *) Commissioning during construction (quality control)	*) Use of building as planned *) Energy management (accounting and control)

Important aspects

Scope – system boundaries | building related aspects

Energy efficient building design

Balancing with technical systems



How to get rid of heat:

(1) Avoid intake through building design and landscaping

(2) Dispose of the heat generated inside by occupants and electronic devices

Important aspects

Vegetation and landscaping | cooling effects

> Cooling is achieved by:

> Blocking the radiation

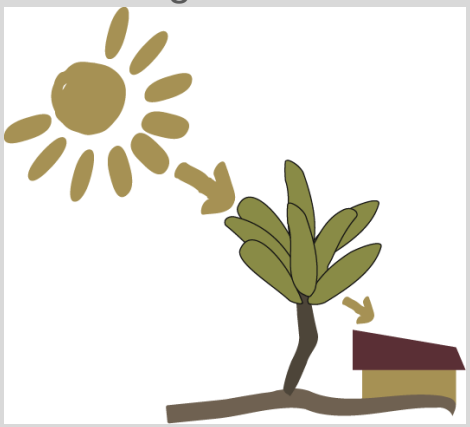
> Evapotranspiration

> Landscaping to channel cooling breezes

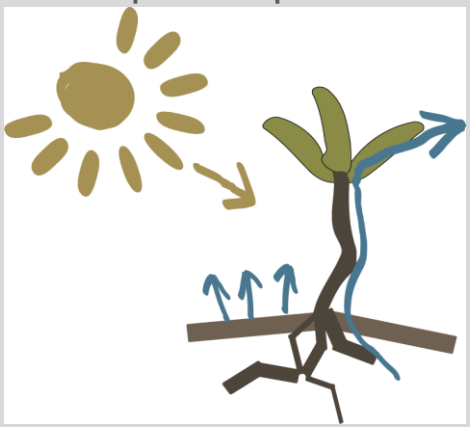
> The beneficial effect of transpiration is limited if the climate is humid during warm weather.

http://www.epa.gov/heatisland/resources/pdf/TreesandVegCompendium.pdf
http://www.energybooks.com/pdf/961964.pdf

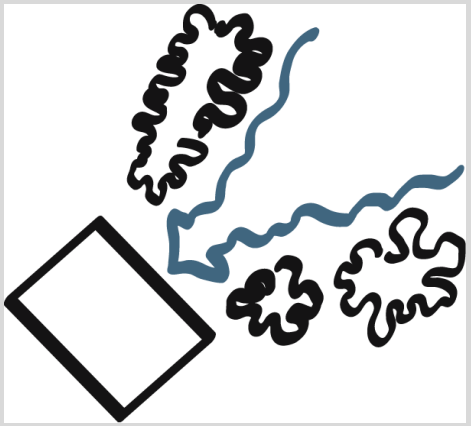
Blocking the radiation



Evapotranspiration



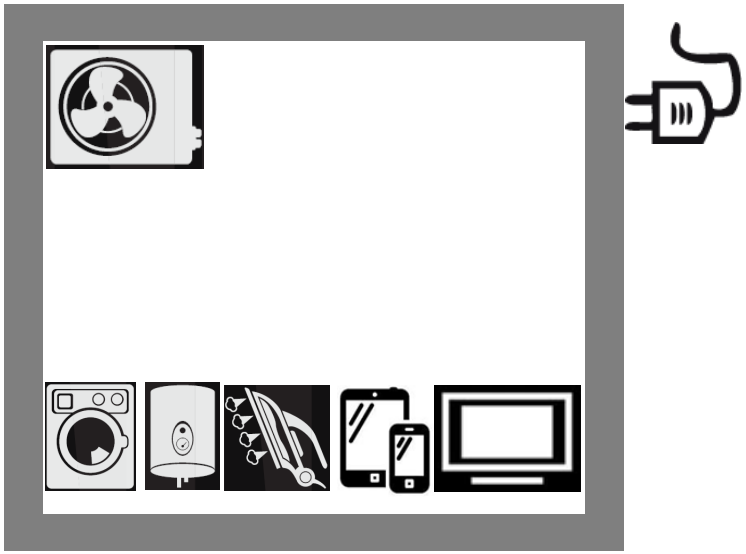
Channel cooling breeze



Important aspects

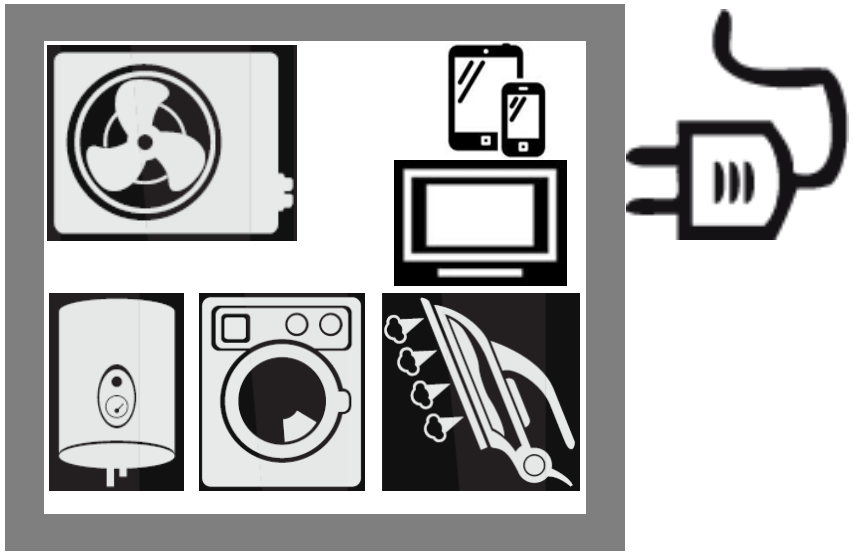
Scope – system boundaries | equipment and user behaviour

Standard user behaviour and standard equipment



Electricity demand is projected based on the building performance (calculated cooling need) and based on a standard equipment (electric appliances) and a standard user profile (how many hours are the appliances in use)

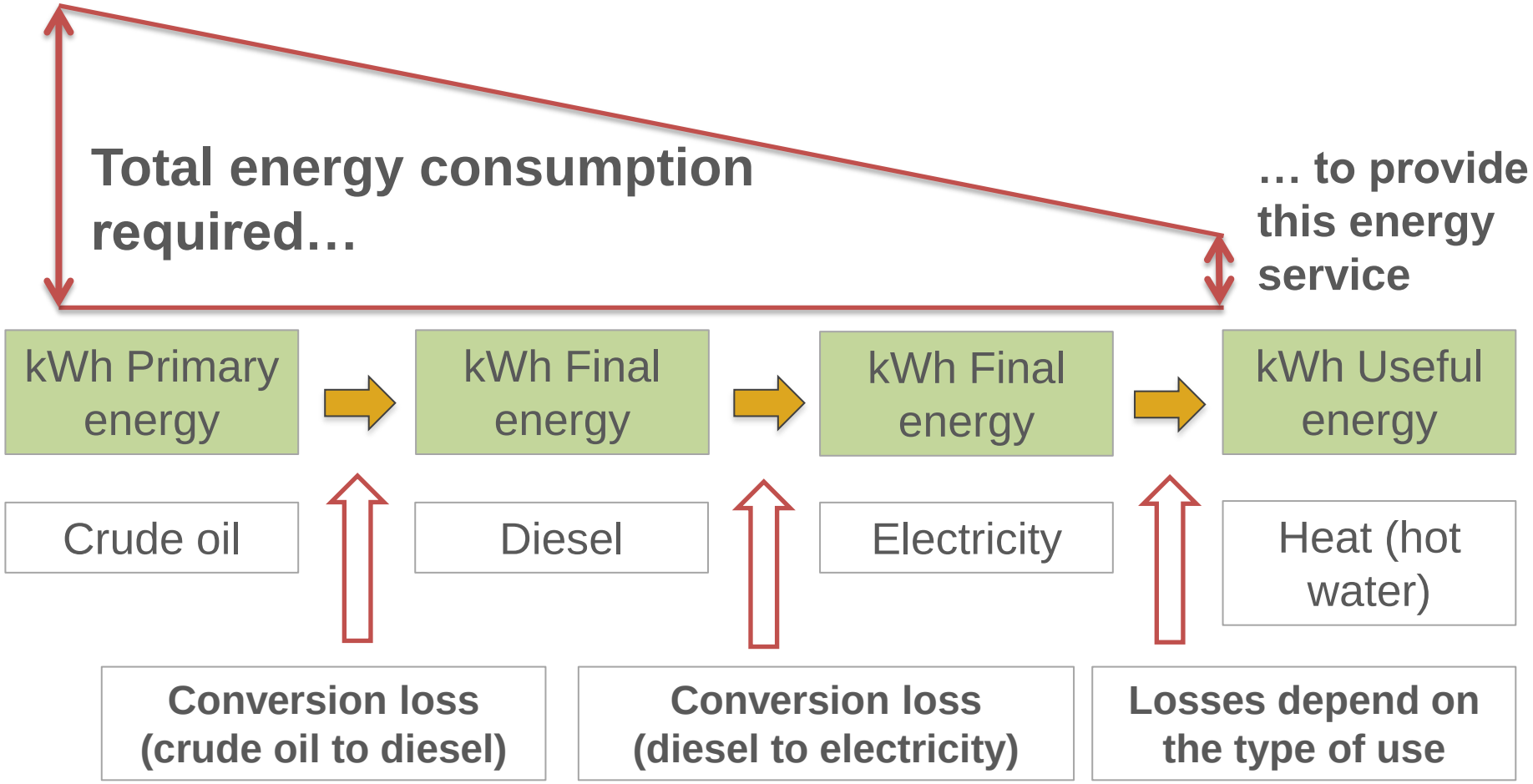
Real user behaviour and real equipment (electric appliances)



Real user behaviour can multiply projected electricity consumption → metered electricity consumption during building operation must complement projection of energy needs during building design

Important aspects

Energy indicators I different types of kWh to be considered

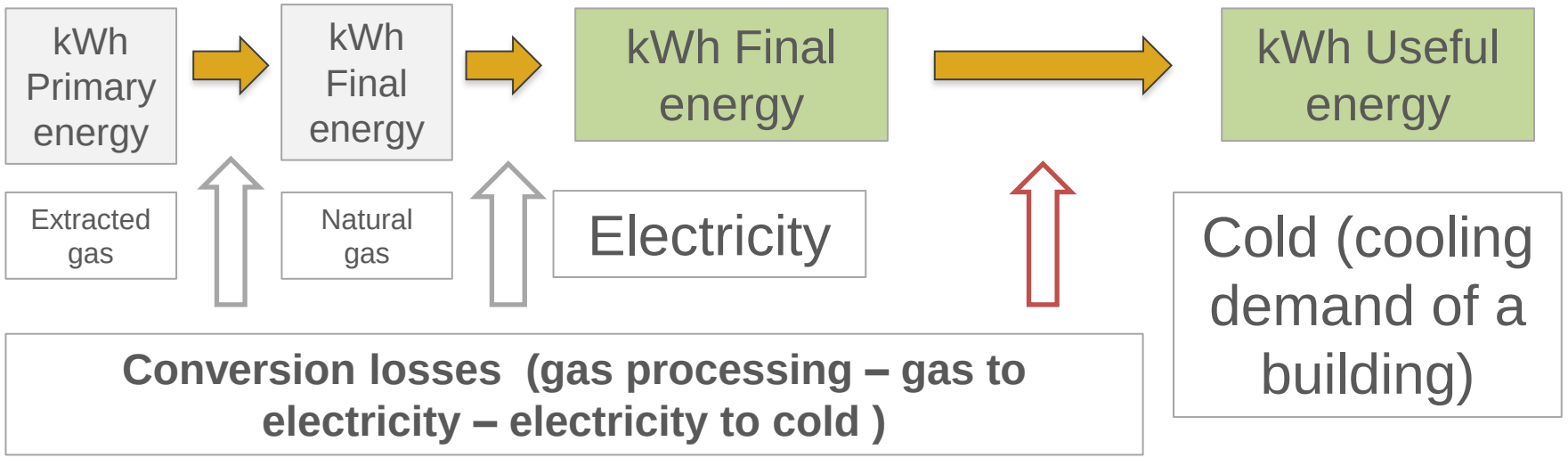


Important aspects

Energy indicators I different types of kWh - example cooling

Calculated value: how much energy is needed to maintain a **comfortable indoor climate (which temperature?);** determined by quality of the building envelope and occupancy

Metered value: includes the efficiency of the cooling system (useful energy plus conversion losses)



Key elements of an energy efficiency framework

Defintions of terms I ensuring comparability

> Definition of climate zones type

> Hot and humid, hot and dry; days with need for cooling and dehumidification; which indoor temperature and humidity level should be achieved

> Definition of type of kWh

> Energy demand (kWh) → calculated value

> Energy consumption (kWh) → metered value

> **Definitions of m2:** gross floor area, net floor area, useful area, etc.

> Definition of building types

> Residential buildings, office buildings, educational buildings, hotels, hospitals

> Definition of exemptions

> Small buildings below e.g. 150 m2 (gross floor area) until e.g. 2020, then all buildings included

> Monuments; historic and protected buildings

> Definition of major renovation

> New roof, new windows and / or new technical systems

Key elements of an energy efficiency framework

Minimum requirements | indicators

Minimum requirements for the use of renewable energy sources (e.g. solar hot water for hotels)

Example of indicator:

> Minimum 30% of hot water demand must be provided by SWH (performance indicator)

> Minimum 1 m2 collector area per single family house (prescriptive indicator)

Minimum requirements for the energy performance of buildings:

> Different options of setting minimum requirements

> Differentiate: New buildings (focus first) and existing buildings subject to major renovation and requiring planning approval (later on)

Key elements of an energy efficiency framework

Setting minimum requirements | options

> Prescriptive. This method sets separate energy efficiency requirements for each building part and for each part of the equipment. Individual components must achieve compliance with their specific targets.

> Trade-off. Values are set for each part of the building, but a trade-off can be made so some values are better and some are worse than the requirements.

> Model building. Values are set as in the trade-off, and a model building with the same shape is calculated with those values. A calculation has to demonstrate that the actual building will be as good as the model building.

> Energy frame. An overall framework establishes the standard for a building's maximum energy loss. A calculation of the building has to show that this maximum is respected.

> Performance. Energy performance requirements are based on a building's overall consumption of energy or fossil fuel or the building's implied emissions of greenhouse gas.

Source: Energy Efficiency Requirements In Building Codes, Energy Efficiency Policies For New Buildings. IEA 2008

Key elements of an energy efficiency framework

Calculation methods | tools

Method / tools for the calculation of energy performance of buildings (to proof whether minimum requirements are met):

Most important is the balance between the accuracy and level of detail, on one hand, and the simplicity and availability of input data, on the other.

Example of input data:

Cooling system	Average cooling season energy efficiency ratio					
1 (e.g., central) *2 (e.g., SPLIT)* ...						
Local renewable energy systems	Active area of solar collector m^2	Maximum capacity of solar panels kW	Nominal capacity of wind turbine kW			
Internal heat gains	People W/m^2	Appliances W/m^2	Lighting W/m^2	Usage ratio %	Use days per week d	Use hours per day h

Key elements of an energy efficiency framework

Calculation methods | tools

Method / tools for the calculation of energy performance of buildings (to proof whether minimum requirements are met):

Technical bodies and activities

The horizontal coordination of the work under M/480 has been allocated to:

› CEN/TC 371 - Project Committee - Energy Performance of Building project group

Five CEN technical committees have been assigned the task of developing the required standards:

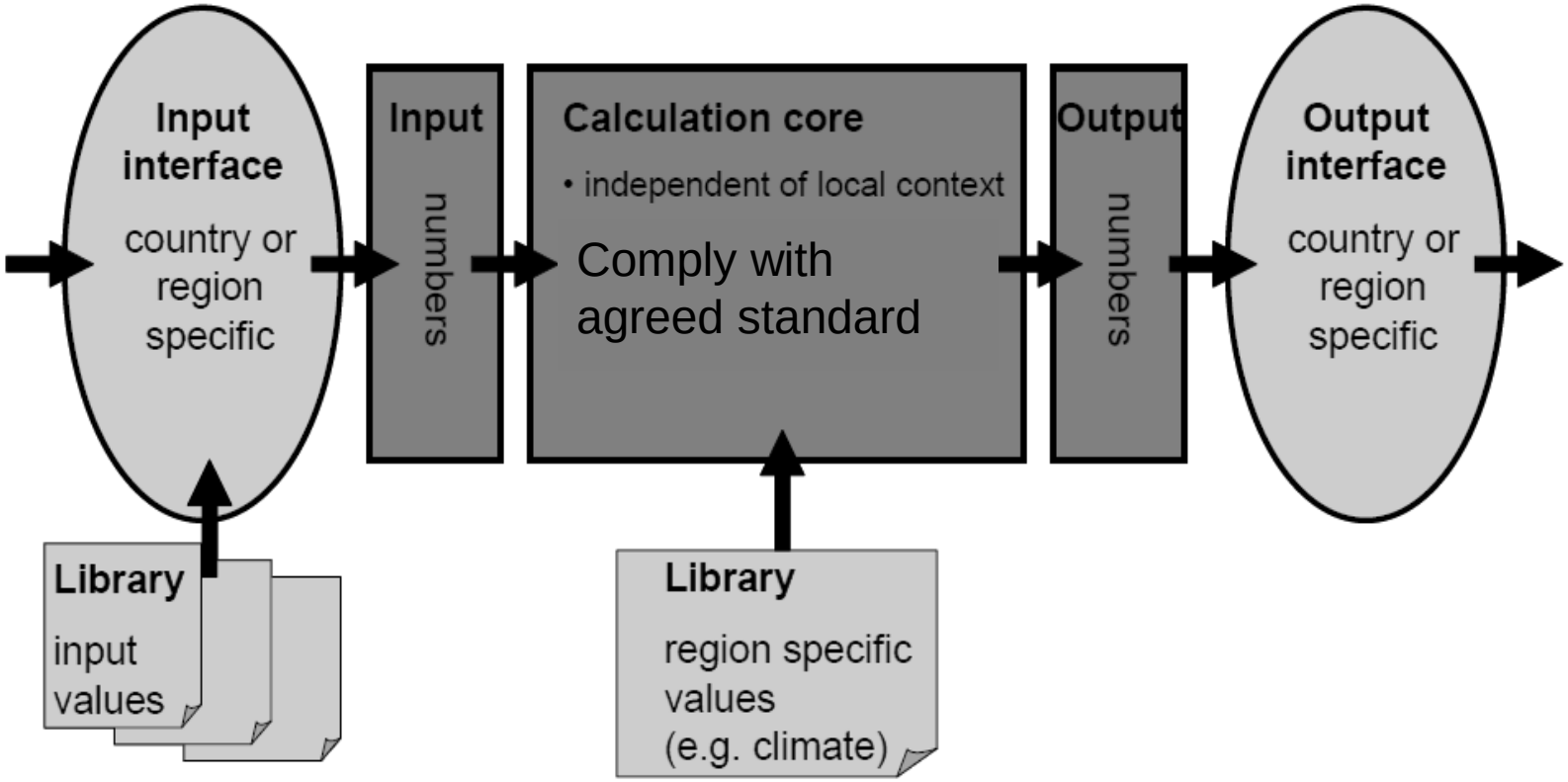
› CEN/TC 89 - Thermal performance of buildings and building components
› CEN/TC 156 - Ventilation for buildings
› CEN/TC 169 - Light and lighting
› CEN/TC 228 - Heating systems in buildings
› CEN/TC 247 - Building automation, controls and building management

http://www.cen.eu/work/areas/construction/buildingsenergyperf/Pages/default.aspx

Key elements of an energy efficiency framework

Calculation methods | tools

Tools: Software to perform the necessary calculations, type of software required depending on the complexity of the respective building,



Key elements of an energy efficiency framework

Inspection of technical sytems | air conditioning systems

Inspection of technical systems (e.g. air conditioning systems) results in an **inspection report**.

The inspection report provides information to the client about:

> the current efficiency of the equipment;

> suggestions for improving the efficiency of the equipment;

> any faults and suggested actions;

> how to reduce the air conditioning use.

Following the recommendations will not only save energy but also money which is shown in the inspection report.

https://www.gov.uk/get-your-air-conditioning-system-inspected

https://www.gov.uk/get-your-air-conditioning-system-inspected

Get your air conditioning system inspected

Your air conditioning system must be inspected every 5 years by an energy assessor to make sure it's energy efficient.

Find an accredited energy assessor

Only an accredited energy assessor can inspect your air conditioning system.

Energy inspection

If you don't get your air-conditioning inspected every 5 years, you will be fined £300.

Your energy inspection will include:

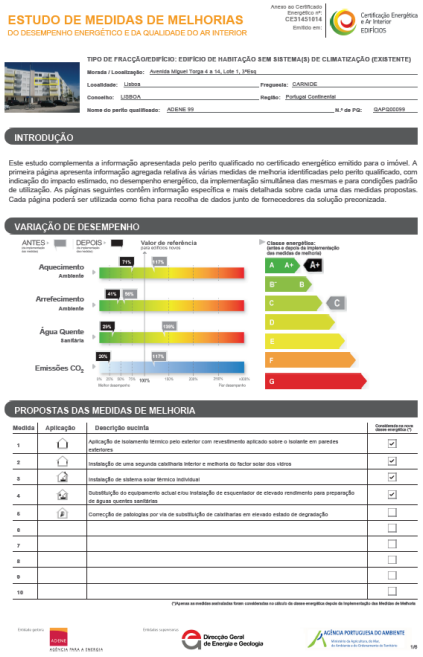
- a visual assessment of your air conditioning system
- an examination of your air conditioning equipment and controls

Key elements of an energy efficiency framework

Energy Performance Certificate | information & awareness raising

Energy certification of buildings (asset rating or operational rating): **energy calculation results in the Energy Performance Certificate (EPC)** displaying the energy indicator and technical information about the building, including recommendations for energy efficiency improvement; a standard defines the content and the layout of the EPC.

Information and awareness raising (to raise demand for energy efficient buildings): **Exemplary role of public buildings** (to develop the market and establish trust).



Awareness creation with EPC indicators in real estate advertisements

Key elements of an energy efficiency framework

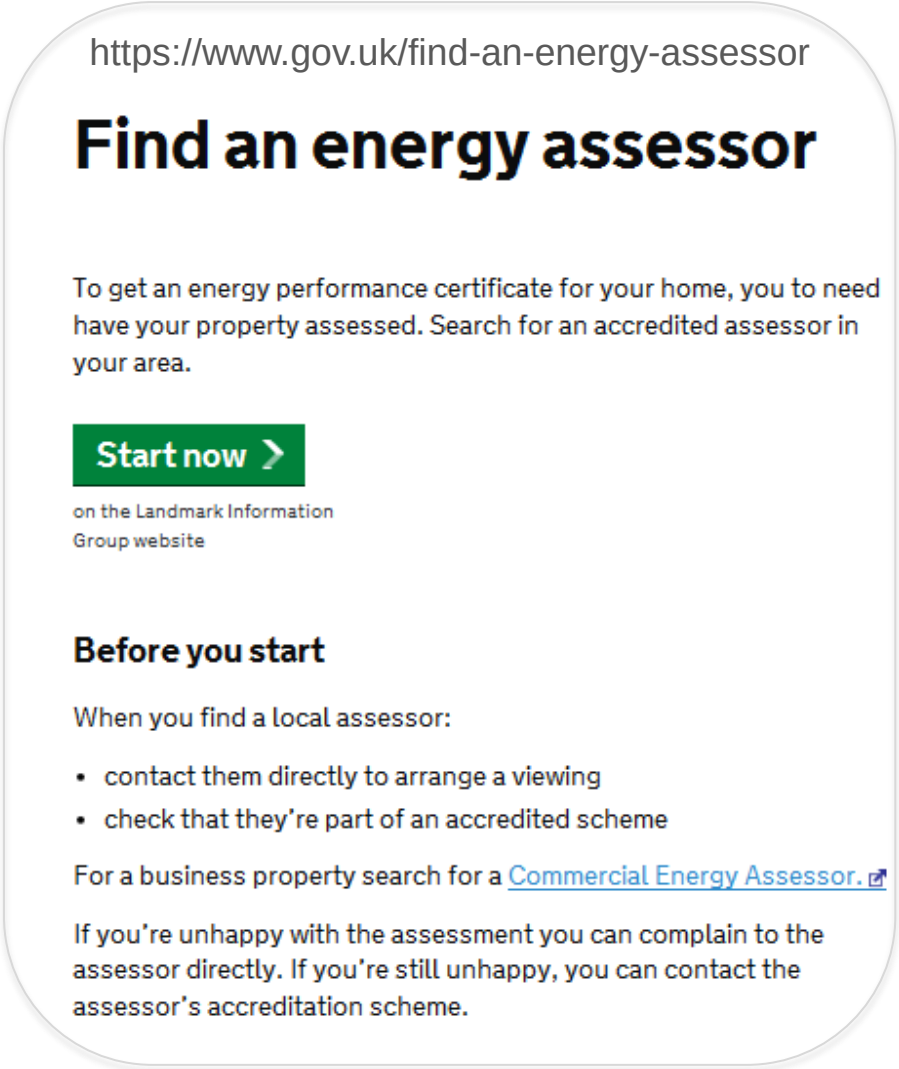
Training and qualification of experts | features

Training and qualification of experts; it has to be determined:

> who is entitled to do the energy performance calculation resulting in the Energy Performance Certificate which is the supporting document required by the energy building code;

> who is entitled to provide advice on how to improve the energy performance of buildings;

> who is entitled to the inspection of technical systems (air-conditioning systems) during building operation.



Key elements of an energy efficiency framework

Need for training | structured by phases of building life cycle

Building design	Building construction	Building operation	Building refurbishment
Qualified personnel calculates and issues **design energy certificate**	**Qualified personnel** calculates and issues **completion energy certificate**	**Qualified personnel: Inspection of air conditioning systems** resulting in an inspection report	Major renovation: See: Building design and Building Construction
Qualification is defined by education (architecture, engineering) and additional courses in energy efficiency	**Qualified workers** Qualification is defined by training; for new building materials and for the installation of technical systems	**Qualification is defined** by education (engineering) and additional courses in energy efficiency	
Qualified personnel is listed in the **official public registry**; lists all experts allowed to calculate and issue an energy certificate	**Quality control:** Commissioning during construction and before handing over	Qualified personnel is listed in the **official public registry**; lists all experts allowed to do inspections	

Key elements of an energy efficiency framework

Enforcement and incentive systems | monitoring and verification

Enforcement and incentive systems: Link the energy performance certificate (EPC) values (kWh or rating result, such as A, B etc.) to:
> Approval of building permit
> Permission to occupy the building
> Connection to the grid
> Insurance terms
> Credit terms
> Allocation of subsidies

Precondition: EPC must be correct and reliable!
Quality assurance and sanctioning framework must be in place.

Monitoring and verification of energy efficiency in buildings: e.g. done by measuring the savings generated from the energy efficiency policy. EPCs are collected and the amount of energy saved is compared with the policy plans. This serves to refine policies and adjust targets.

Thank you for your attention!

office@sustain.at
geral@cesarfreitas.com

PRAIA, CABO VERDE, 9th-10th June 2014

SERA Sustainable Energy & Resources Availability

SUSANNE GEISSLER _ CÉSAR FREITAS