

# 05 – Rational use of energy

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MECA H417 / MECA H530 – Sustainable energy

A. General overview

<http://atm.ulb.ac.be>



MECAH530 "Sustainable energy" Part 1 : General Overview – Michel HUART – [mhuart-at-ulb.ac.be](mailto:mhuart-at-ulb.ac.be)  
05 – RUE – 23/10/2015 – Edition 22/10/2015

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## Lesson plan

### Content

- Glossary and definitions
- Efficiency, conservation, saving, rebound effect, sobriety, sufficiency, intensity
- Trias energetica, negaWatt
- Behaviour science
- Rational use of energy

### General learning outcome

You are able :

- To describe and apply a methodology of rational use of energy;

### Specific learning outcomes

- To describe the presented concept (ie look at the content)



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# Bibliography extract

EVERETT

HERMANS

MACKAY

## Other material

- IEA : Energy Efficiency Indicators: Fundamentals on Statistics, 2014. Extract p. 17-19  
“Definition of Energy efficiency”; 189-190 (HDD)

[https://www.iea.org/publications/freepublications/publication/IEA\\_EnergyEfficiencyIndicatorsFundamentalsonStatistics.pdf](https://www.iea.org/publications/freepublications/publication/IEA_EnergyEfficiencyIndicatorsFundamentalsonStatistics.pdf)

- TED Talk: Alex LASKEY - How behavioral science can lower your energy bill

[https://www.ted.com/talks/alex\\_laskey\\_how\\_behavioral\\_science\\_can\\_lower\\_your\\_energy\\_bill](https://www.ted.com/talks/alex_laskey_how_behavioral_science_can_lower_your_energy_bill)



## Glossary in RUE

**Energy efficiency** is using less energy to provide the same service with the same ease.  
(Note: at every stage of the energy chain)

**Energy conservation or Energy saving** reduces energy losses (or energy waste) in the stage of use

(Note: It concerns generally behaviour)

**Rebound effect** (or take-back effect) is the reduction in expected gains (energy savings) from new technologies (efficiency), because of behavioral or other systemic responses.

Direct: More efficiency in conversion, but increase the use or the service.

Indirect: Lower cost of use creates incomes (energy savings reduce energy bill) and creates new purchase possibilities (purchase more intensive energy products or service).

**Energy sobriety or energy sufficiency** is energy conservation by behavioral actions. Generally to reduce the need and the amount of services. Slow down lifestyle.

**Energy intensity** : Amount of delivered energy used per unit of output.

**Demand side management** (DSM) is the modification of consumer demand for energy through various methods.

**Rational use of energy (RUE)**: While providing sufficient access to energy services, RUE chooses individual and collective solutions which induce the smallest energy consumption by efficiency, savings and conservation.

RUE combines smart behaviour and energy efficient equipment.

RUE has to consider how to tackle rebound effect.

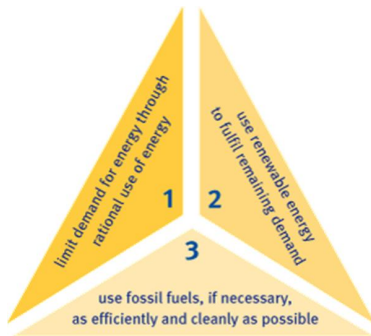


# Trias Energetica concept

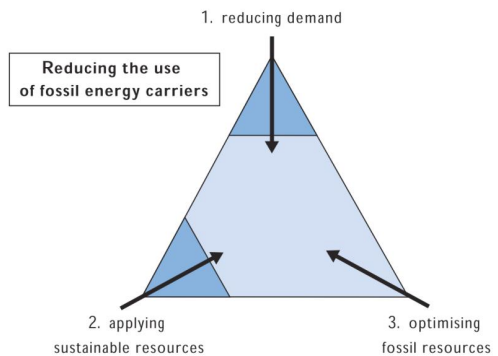
Trias Energetica is a model developed by the Delft University of Technology– acts as a guide when pursuing energy sustainability.

It's a three steps method:

1. Limit demand for energy through rational use of energy
2. Use renewable energy to fulfill remaining demand
3. Use fossil fuel energy, if necessary, as efficiently and cleanly as possible.



Trias Energetica



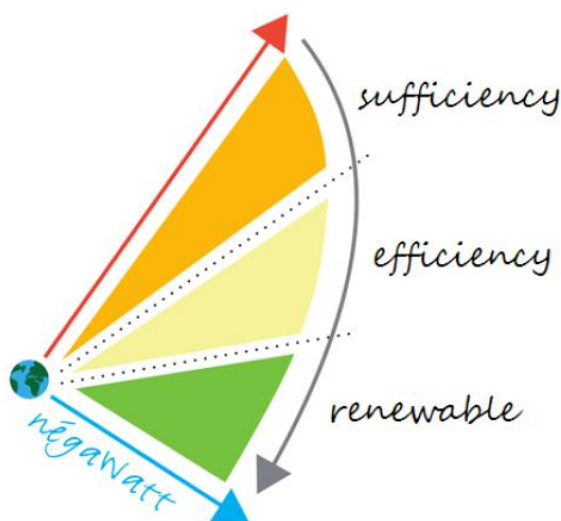
## negawatt

<http://www.negawatt.org>

**Energy sufficiency** (favoring low energy services and lifestyles)

**Energy efficiency** (ensuring that energy is used in the most productive way)

**Renewables** (developing first the greenest forms of energy for our supply)



- **Sufficiency**, consisting in an assessment of our needs and finding individual and collective ways at prioritising the most valuable, restricting the most extravagant, and cutting the most detrimental energy usages.

- **Efficiency**, meaning efforts to reduce the unitary amount of energy to satisfy a certain need, mostly through technological choice all along the chain.

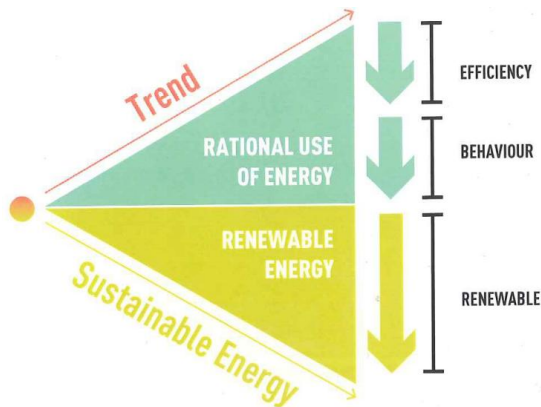
- **Renewable sources**, to ensure that the least polluting and most sustainable energies are favoured.

As an illustration, carefully sizing a lighting installation and using highly efficient luminaires and lamps can already cut the electricity need by a factor five or more. It will then be much easier to supply it through renewable energy. This simple example can be extrapolated to all our forms of energy use, from the most insignificant to the most substantial.

# Sustainable energy

Fossil fuels are unsustainable.

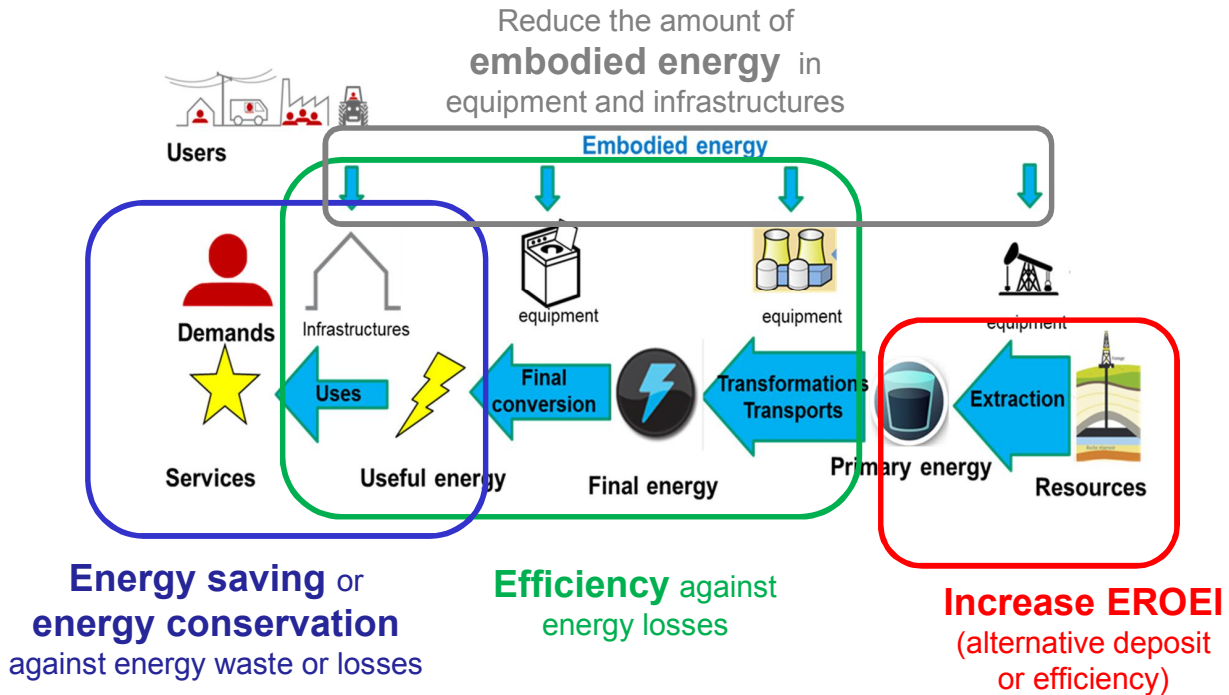
Sustainable energy balances energy supply based on renewable energy sources and a energy demand controlled by rational use of energy (smart behavior and efficient equipment)



Source: [http://www.abh-ace.be/en/binaries/20140825\\_ace\\_energysolutions\\_BD%20%28%29\\_tcm450-254638.pdf](http://www.abh-ace.be/en/binaries/20140825_ace_energysolutions_BD%20%28%29_tcm450-254638.pdf)

# Rational use of energy (RUE) through the chain

Goal of RUE : to reduce the energy consumption, for the same work or service.



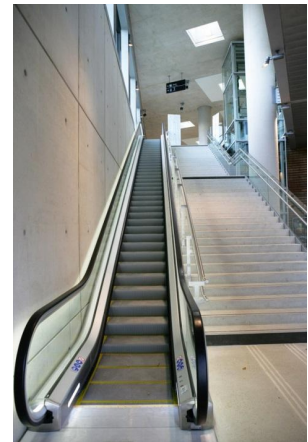
## Efficiency and its impact on the ease of the service

Definition: Energy efficiency is using less energy to provide the same service with the same ease.

For example

What solution is more energy efficient to go upstairs ?

- a. High efficient lift
- b. High efficient escalator
- c. Take the stairs



- These three solutions provide the same work.
- To take the stairs reduces the energy consumption of electricity, but it's a less easier solution for person (You need to work by your own foot!). It's not exactly the same service. It's classified as an energy saving (or energy conservation) solution.
- To improve energy efficiency means to implement a system which reduces the energy consumption without reducing significantly the ease to users.
- In this case, efficiency means implementing an energy efficient technology (mechanical transmission with less frictions and high efficiency electrical engine).





# Energy saving

Energy saving or energy conservation reduces energy losses (or energy waste) in the stage of use ie

- To avoid losses by behaviour
- To take the stairs instead of the lift
- To switch off the light in unoccupied room
- To lighten your car load (remove unnecessary transported weight)
- ...
- To improve things and infrastructures energy efficiency
- To lighten vehicle (ie. Replace steel with carbon fibres)
- To control air ventilation in building
- To build or to refit high efficiency building (insulation, air tightness, ...)
- ...

Burn Calories, Not Electricity

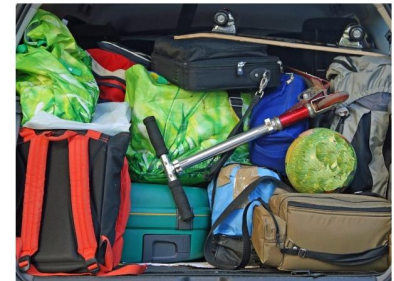


Take the Stairs!



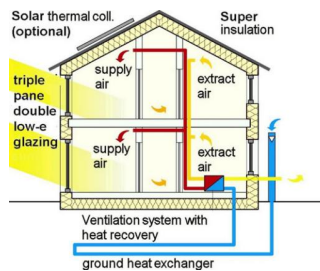
## LIGHTEN YOUR CAR LOAD

It is unfortunate that the big vehicles, the typical SUVs, which are known for terrible fuel efficiencies, are the same ones that have big luggage spaces. This is unfortunate because these big spaces encourage motorists to carry unnecessary luggage in their cars. The more things you store in your car, the more fuel your car burns in order to move forward. Suppose you buy a car with a bike rack, but you don't have a bike, why keep the rack on the car? Things like gym equipment, unused buckets in the back, tools you don't use all the time and such like things should not be left in the car. Think about this: for every 45 kilograms you add to your car, you are liable lose about 2% in your fuel efficiency.



EOLAB: AN ULTRA LIGHT BODY

THE RIGHT MATERIAL IN THE RIGHT PLACE



TED Talk: Alex LASKEY - How **behavioral science** can lower your energy bill

[https://www.ted.com/talks/alex\\_laskey\\_how\\_behavioral\\_science\\_can\\_lower\\_your\\_energy\\_bill](https://www.ted.com/talks/alex_laskey_how_behavioral_science_can_lower_your_energy_bill)



# Rational use of energy in ..... How?

## Sector of activity

1. Agriculture/Forestry/Fishing
2. Building [residential, commerce, services (public and private), army, school, ...]
3. Industry
4. Energy sector
5. Transport

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B	WW	LS	Maint



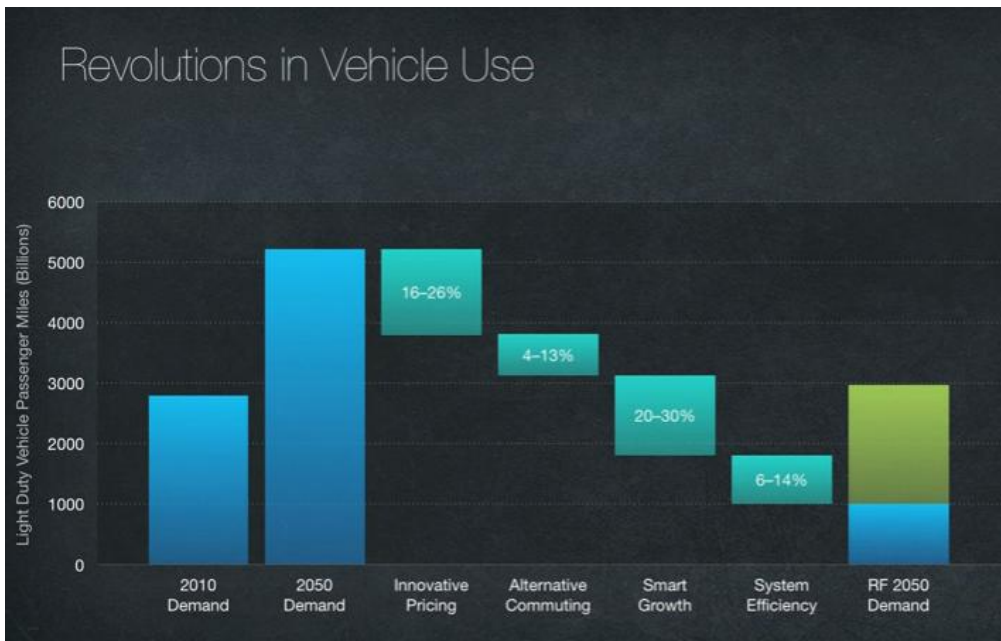
## Rational use of Energy (RUE) - Definition

While providing sufficient access to energy services, RUE chooses individual and collective solutions which induce the smallest energy consumption by efficiency, savings and conservation. RUE combines smart behaviour and energy efficient equipment. To tackle rebound effect, RUE takes into account ALL the following levels:

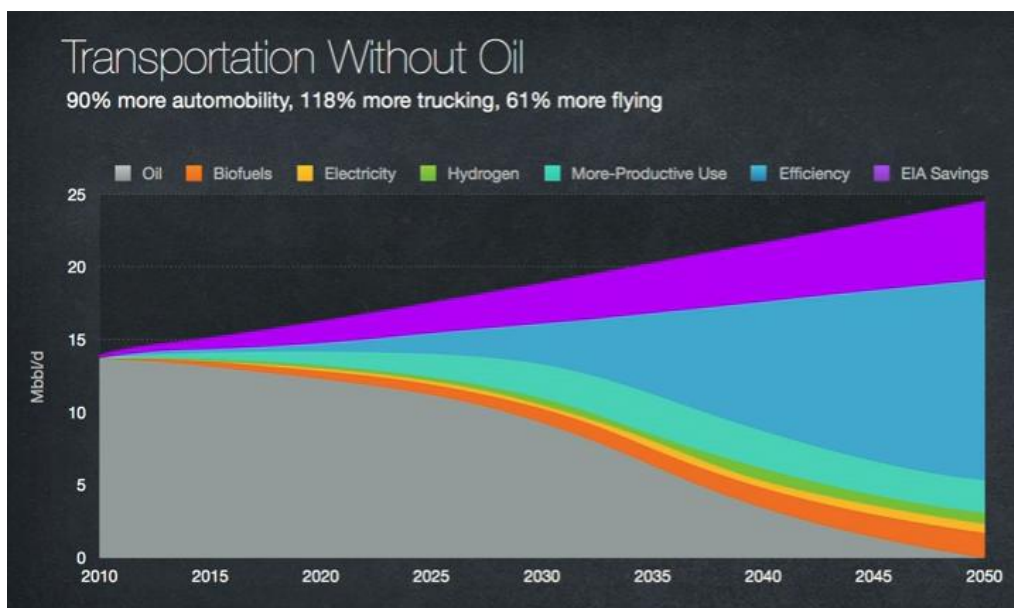
- Behaviour**
1. To hold energy waste watch  
*ie Switching off light when there is nobody (refrain useless consumption)  
Refraining from useless shopping*
  2. To adapt lifestyle and activities  
*ie Sharing or pooling equipment (car sharing, car pooling, ...)  
Sobriety (slow down lifestyle)  
Consuming at the best period (availability of energy flow, degree of useful)*
  3. To maintain equipment

- Equipment**
1. Technology – Reduce the energy conversion losses  
*ie High efficiency process (fuel -> service)  
Saving energy lamp (electricity -> lighting)  
Household electrical appliances A++ (electricity -> service household)*
  2. Stuff and infrastructure- Reduce the energy consumption of using  
*ie reducing the weight of vehicle (Reduce the amount of work)  
Building insulation (Reduce heat losses maintaining heat comfort)  
Centralisation of housing zone and mixity of activities (Dispersed habitat increases transport need of inhabitants)*
  3. Goods and services – Reduce the embodied energy  
*ie Short circuit sale (less transport)  
Natural insulation (less embodied energy than synthetic ones)  
Season products (less embodied energy)  
Reparable items and not throw-away (longer lifespan)*



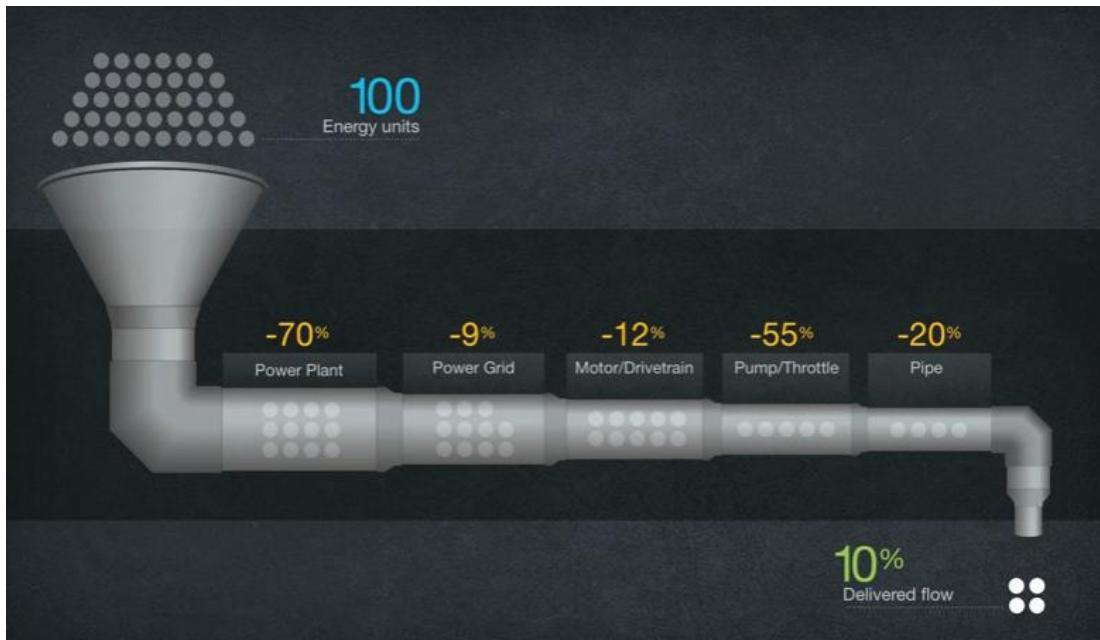


A Lovins 10 min



A Lovins 11.2 min





## In limited resource, energy demand must be managed

To prioritize uses is essential.

Examples : (1) Polar Station **Princess Elisabeth Antarctica**



Vital function - Comfort space  
Research Activities Recreational activities



[http://www.antarcticstation.org/station/smart\\_grid/](http://www.antarcticstation.org/station/smart_grid/)  
[http://www.antarcticstation.org/multimedia/video/energy\\_management\\_at\\_the\\_princess\\_elisabeth\\_station](http://www.antarcticstation.org/multimedia/video/energy_management_at_the_princess_elisabeth_station)

### (2) Order of priority based on the priority of the need

Vital – Essential – Necessary - Helpful

Accessory – Useless – Extravagant – Unacceptable - Harmful