



# Results of the workshop on Sustainability Performance of the Energy Systems

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72nd Semi-Annual ETSAP workshop  
11<sup>th</sup> - 12<sup>th</sup> December 2017  
Zurich, Switzerland



# Workshop on Sustainability Performance of the Energy Systems

- CIEMAT, Madrid
- 29th-30th May 2017
- Organised by CIEMAT and IFE
- Financial support by IEA ETSAP
- Researchers from 13 organisations
- 14 presentations

<https://iea-etsap.org/index.php/etsap-project/workshop-on-sustainability-performance-of-the-energy-systems>

# Workshop on Sustainability Performance of the Energy Systems

## Sessions:

1. Assessment of the energy systems sustainability
2. Energy Systems Modelling and Life Cycle Assessment
3. Input-Output assessment
4. Impacts of energy policies

And a lot of discussion and exchange of ideas

# Assessment of the energy systems sustainability

## **RENEWABLE ELECTRICITY INVESTMENT: COMBINING TOP-DOWN AND BOTTOM-UP MODELLING APPROACHES**

Patrícia Fortes

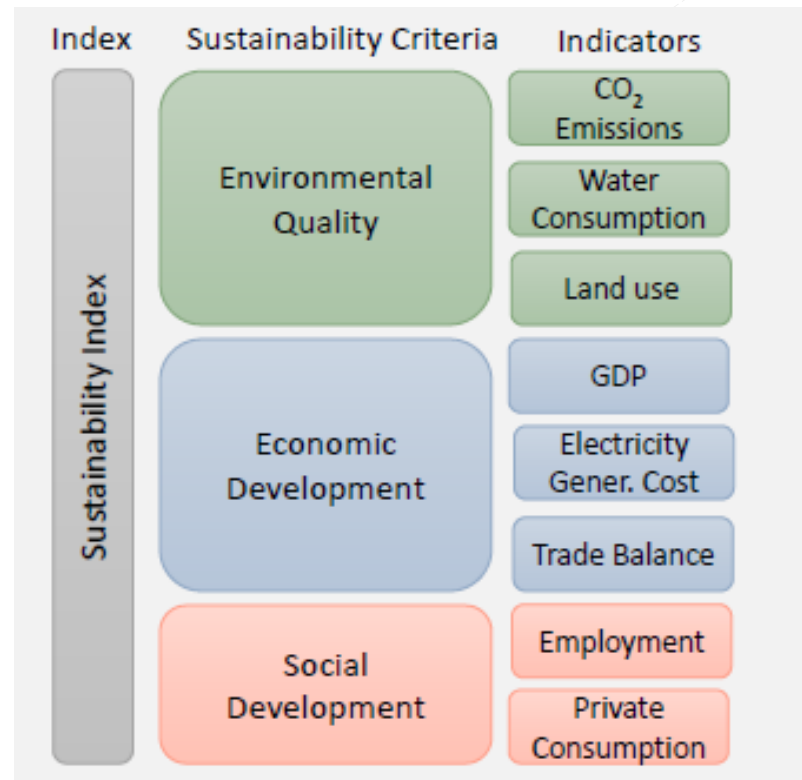
### **Objective:**

Improve the connection between the bottom-up TIMES and top-down CGE model

### **Methodology:**

- POWER SECTOR DETAIL IN GEM-E3\_PT
- INVESTMENT MATRIX
- SCENARIOS
- SUSTAINABILITY INDEX

## Sustainability index



### **Results showed:**

- Scenarios with best environmental quality may have the worst economic and social sustainability index

# Assessment of the energy systems sustainability

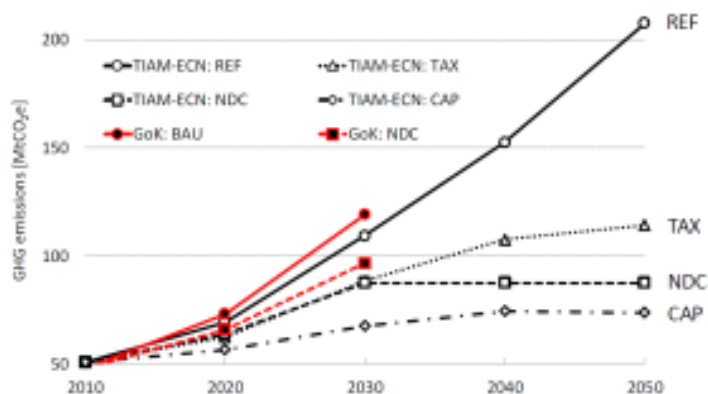
Kenya NDC and renewables:  
TIAM-ECN model results



Francesco Dalla Longa  
Bob van der Zwaan

[TRANSrisk-project.eu](http://TRANSrisk-project.eu)

## Emission Trajectories: All Scenarios



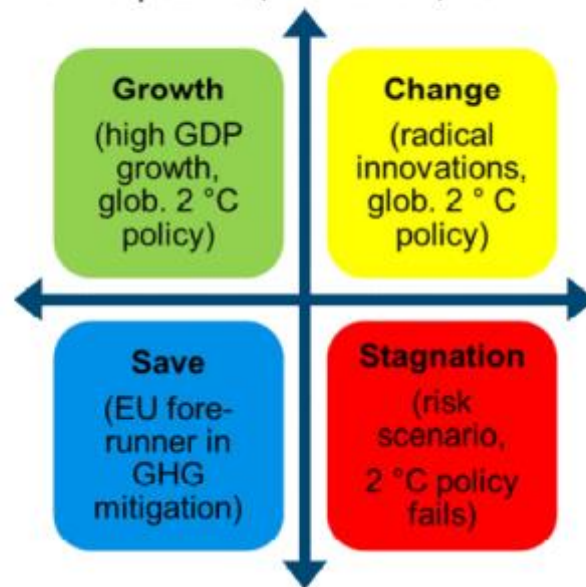
### Analysis:

Kenya's NDC target is achievable with a timely deployment of RE

SUPPORTING ENERGY POLICY



Different assumptions on norms, acceptance, behavior, etc.



Due to new national policies, acceptance, etc. all the scenarios will fail (too much nuclear, too little RES)

# Assessment of the energy systems sustainability

## LOCAL SUSTAINABLE ENERGY SYSTEMS - THE ROLE OF TIMES MODEL

Luis Pereira Dias<sup>1</sup>, Sofia Simões, João Pedro Gouveia, Júlia Seixas

<sup>1</sup>lpdias@fct.unl.pt

Workshop on Sustainability Performance of the Energy Systems  
29th and 30th May, 2017



**SURECITY**  
SUSTAINABLE AND RESOURCE EFFICIENT CITIES

## Modelling Sustainable and Resource Efficient Cities

Workshop on Sustainability Performance of the Energy Systems, 29<sup>th</sup> and 30<sup>th</sup> May, 2017

Anna Krook Riekkola, Erik Sandberg and Jonas Forsberg  
Luleå University of Technology



### The project:

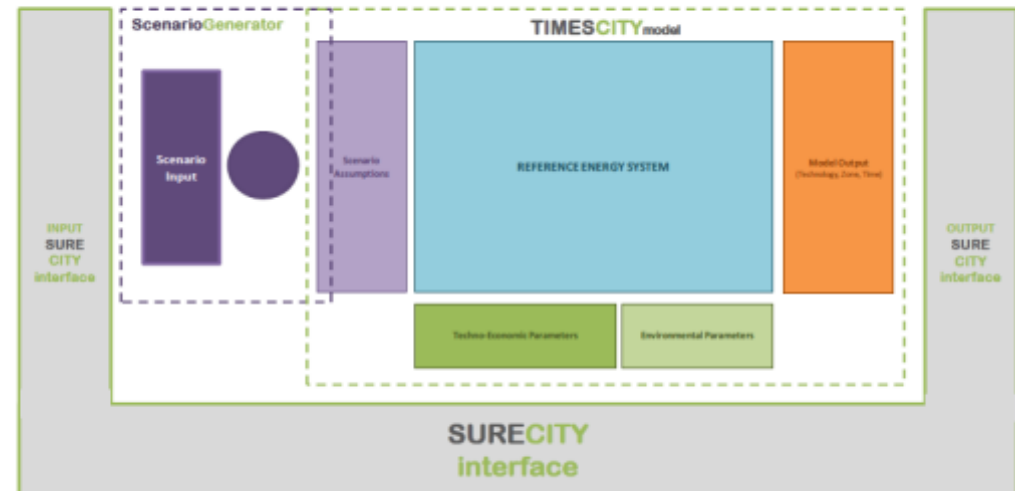
- Local scale TIMES model for four different cities
- Different methods and tools have been used to support the municipalities in the development Sustainable Energy Action Plan: **GIS energy database, Door-to-door surveys, Smart meters**
- Develop a planning tool to identify optimum mix of short, medium and long-term measures

SUSTAINABLE CITY

### The SureCity modelling framework

- Three cities
- Identification of cost-effective strategies and measures to reduce CO<sub>2</sub>-emissions without decreasing

**SURECITY**



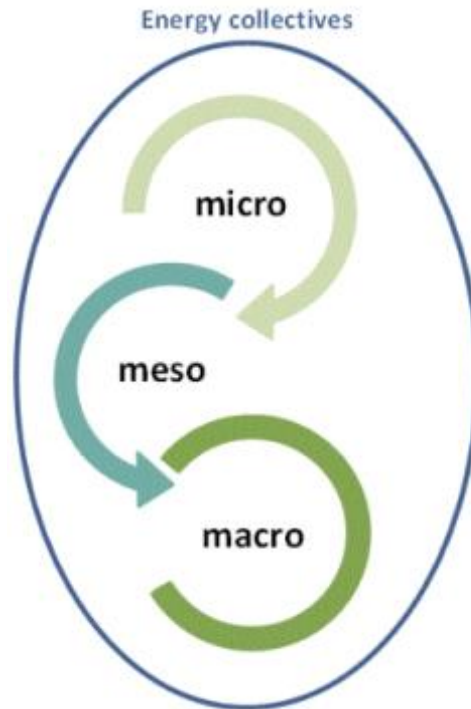
# Assessment of the energy systems sustainability



Social change in energy system transition – who cares about modelling of human behaviour?

Workshop on Sustainability Performance of the Energy Systems  
29th and 30th May, 2017  
Tiina Koljonen, Lassi Similä & Antti Lehtilä

The overarching objective of ECHOES is to unlock the policy potential of an integrated social science perspective on energy behaviour



CHALMERS

## A broad sustainability assessment of utilization of industrial **excess** heat based on **MARKAL** modelling

Erik O. Ahlgren, Akram Fakhri Sandvall, Tomas Ekvall\*

Dept of Space, Earth and Environmental Sciences,  
Chalmers Univ of Technology

\*IVL Swedish Environmental Research Institute

### Questions:

- Is it economically sustainable?
- What are the CO<sub>2</sub>-emission impacts?
- Are there other important sustainability impacts?

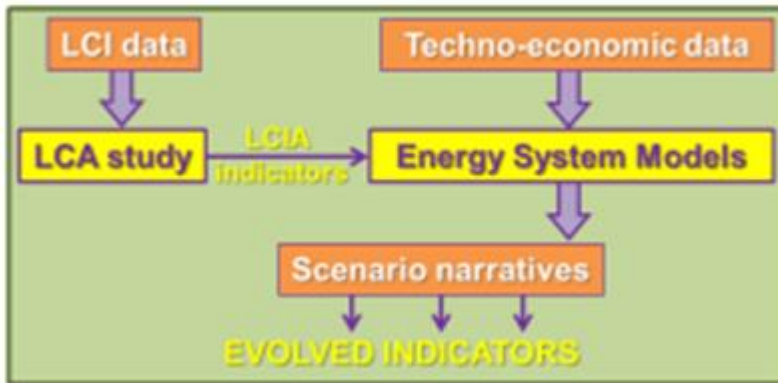
### Methodology:

- Case study
- Scales
  - Local
  - Regional
  - National

# Energy Systems Modelling and Life Cycle Assessment

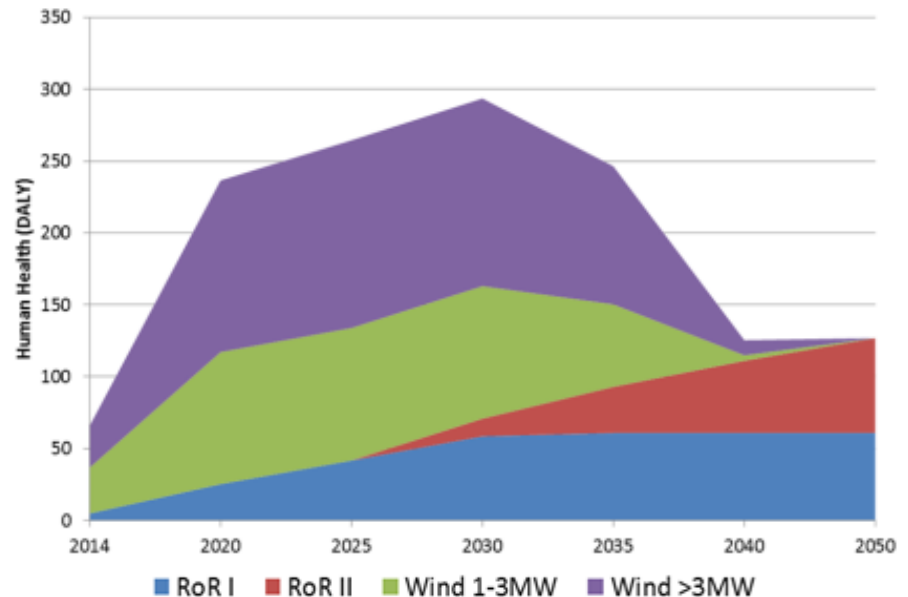


Methodological framework:



A new indicator to measure energy security based on electricity demand satisfaction and national renewability factor was introduced

LCA indicators Climate Change, Ecosystems Quality, Human Health, and Resources was added to TIMES-Norway as emission factors.





# Input-Output assessment

## An input-output model for Irish economy- a preliminary study of stepwise substituting imported fossil-fuel electricity with renewable electricity

Mitra Kamidelivand ([mitra.kamidelivand@ucc.ie](mailto:mitra.kamidelivand@ucc.ie))

Caitian Cahill, Maria Llop, Fionn Rogan, Brian O'Gallachoir



### Environmental and socio-economic impact from decarbonising the economy- an IO perspective



Difficulty: Energy sectors are aggregated and environmental do not match the economic sectors



Approach: Irish I-O table is split so are sector's GHG emissions and employment numbers



Analysis: Partial input-output substitutions of imported fossil fuels used for electricity with renewables

### Concluding remarks



- IO-based analysis:
- Portrays all the economic activities of the system ☹
- Coefficients and multipliers rely on strong assumptions ☹
- Implicit assumptions in expanding renewable electricity ☹
  - There is (excess) capacity in all sectors and factors , e.g. (un)employed factors of production
- ... **Future work** →
- **IO to CGE model linked with energy systems**
  - ✓ Analysing e.g.:
    - Impacts of **price changes and changing elasticities?**
    - Coal and gas substitution with renewables?
    - Overall environmental and socio-economic outputs of low carbon energy scenarios?
    - ...?



### Evaluating the Mexican National Strategy of Climate Change- Integration of energy models and Multiregional Input-Output Analysis



Centro de la Paz  
Teléfono: 52561 6100  
Habrana Calid



Antonio Rodríguez Martínez

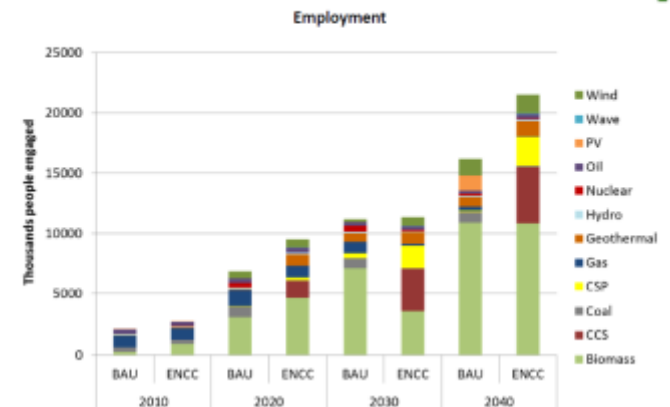
### Objective



- Based on this policies, the socioeconomic and environmental impacts associated to two scenarios have been estimated.
- The study has been conducted in two phases:
  1. Through an energy model, the evolution of the Mexican electricity systems in the long term has been analyzed
  2. Based on the energy model results, and using a Multiregional Input-Output Analysis, the socioeconomic and environmental impacts have been estimated for both scenarios.

EUROfusion  
Times Model

### RESULTS



# Impacts of energy policies

## The Italian Energy Strategy: energy and macroeconomic impacts

Workshop on Sustainability Performance of the Energy Systems - Madrid  
 29<sup>th</sup> and 30<sup>th</sup> May 2017

M. Gaeta / M. Rao / M. R. Virdis

### Methodological approach

- 1) Reference energy scenario
- 2) Policy scenario with decarbonisation goals without any measures or government influence (only optimization results).
- 3) Impact analysis in different fields (emissions, business competitiveness, electrical system, etc.)
- 4) Weakness and strengths
- 5) Economic and environmental feedback
- 6) Introduction in energy scenario of policies/measures and sectoral goals set by the government

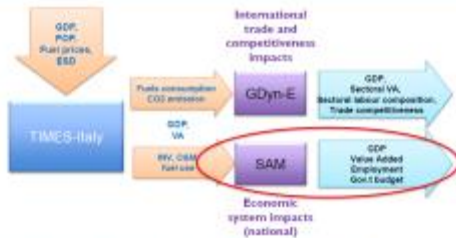
Work in Progress

The impact assessment is not yet complete and Air quality impacts and macroeconomic analysis with Gdyn-E are postponed to the elaboration phase of the National Integrated Energy and Climate Plan

Presentation focus: energy analysis and macroeconomics impacts with SAM

ENEA The Italian Energy Strategy: energy and macroeconomic impacts - 29<sup>th</sup> and 30<sup>th</sup> May 2017

### Workflow for integrated analyses by ENEA



- Focus on economic impacts with Social Accounting Matrix

## "Up in the Air"

Co-impacts of energy sector decarbonisation on outdoor air pollution in the UK



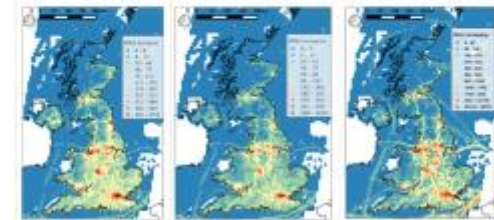
Melissa C. Lott, Steve Pye, Birgit Fais and Paul Dodds

Presented by Isabela Butnar

## Adding Air Pollution to UKTM-UCL

- Added an air pollution emissions database for
  - Particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>)
  - Nitrogen oxides (NO, as NO<sub>2</sub>)
  - Sulfur dioxide (SO<sub>2</sub>)
  - Ammonia (NH<sub>3</sub>)
  - Non-methane volatile organic compounds (NMVOCs)
- Included both emissions factors and damage cost values
- For emission factors (EFs), we used
  - Fuel-based EFs for the agriculture, industry, process, residential, services, and electricity sectors
  - Activity-based EFs for the transport sector, which allowed us to capture non-tailpipe emissions of particulate matter

## Soft-linking UKTM to CMAQ for spatial representation of pollution



Air quality modeling with a Community Multiscale Air Quality Model (CMAQ) in partnership with Kings College London

# Impacts of energy policies

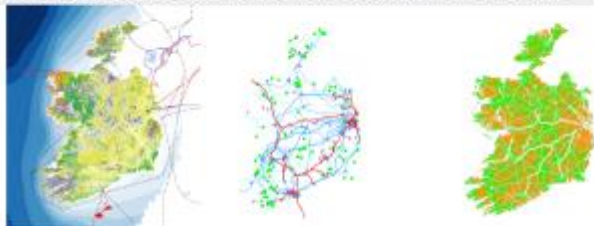
Energy security assessment methods - quantifying the security co-benefits of decarbonising the Irish Energy System

James Glynn | @james\_glynn | james.glynn@ucc.ie

Alessandro Chiodi, Brian Ó Gallachóir.



Not just affordably supply, - Sovereign, robust, resilient markets & infrastructure



### Primary energy

- Domestic Fuels
- Fossil Fuel Imports
- Renewable Resource Potentials

### Conversion & Transport

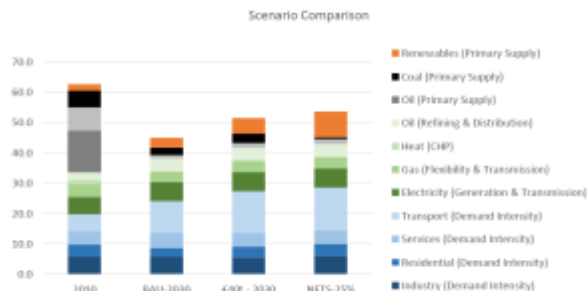
- Diesel
- Petrol
- Natural Gas
- Electricity

### Energy (Service) Demands

- Passenger Transport
- Freight Transport
- Heat
- Light



## 2030 security in lower carbon scenarios



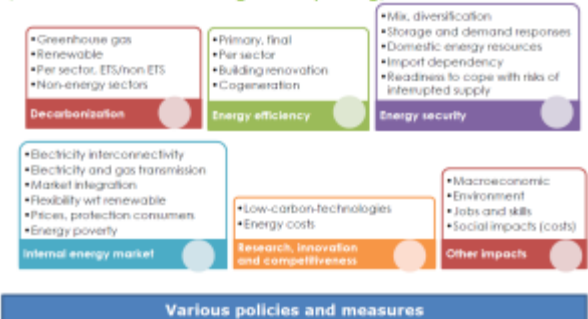
And to finish...

## Some thoughts

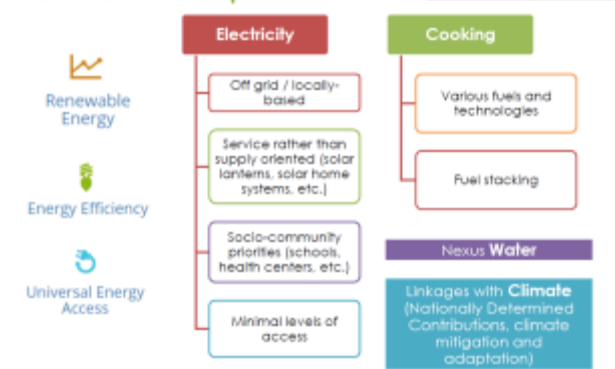
Maryse Labriet



### European Commission: Integrated National Energy and Climate Plans (Mechanism for Monitoring and Reporting)



## Sustainable Development Goal 7



# Some conclusions

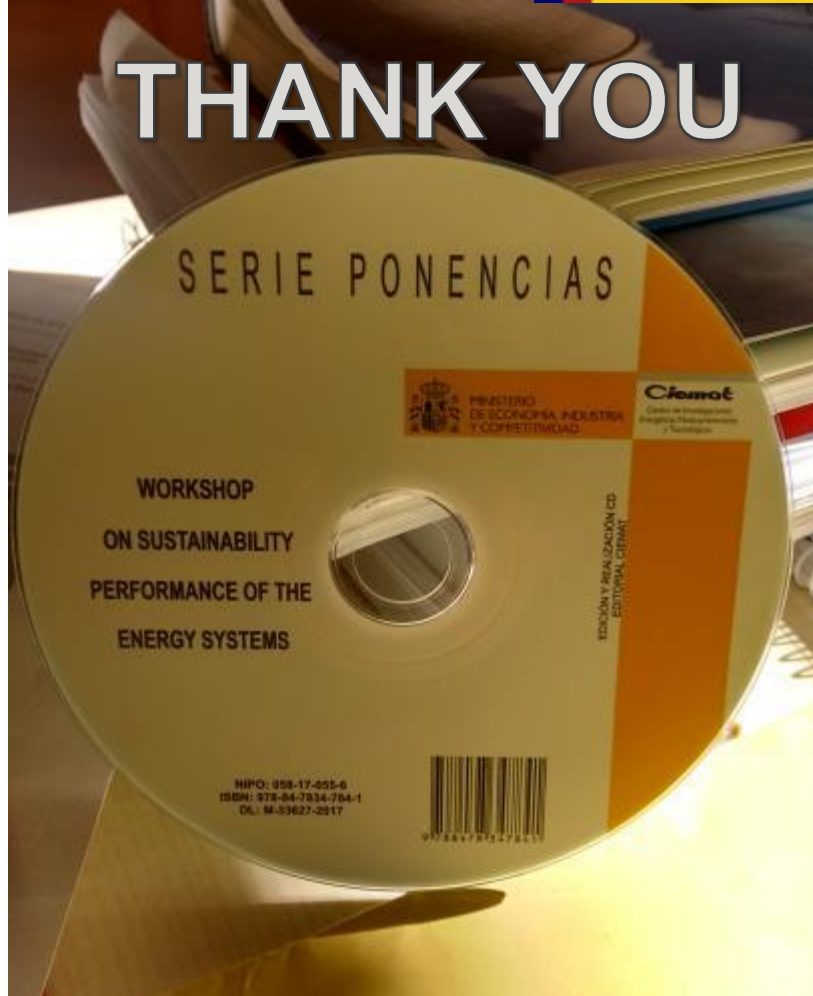
- ✓ Including **behaviour** into the models
- ✓ **Transparency** with the implementation of technologies, with special mention to renewable
- ✓ Characterisation of **critical materials** like silver, copper, etc. considering costs but also competition with other uses
- ✓ **EC categories factors** should be kept in mind when analyzing climate and energy scenarios (descarbonization, energy efficiency, energy security, internal energy market, research, innovation and competitiveness, and other impacts)
- ✓ Technology and energy explicitness, the **representation of the consumers** regarding preferences and behaviour (microeconomic robustness and non-market preferences), the **trade** as interdependence between countries in the EU and from outside, macroeconomic feedback, and the **uncertainty analysis**
- ✓ Models can also play a good role analysing the **Nexus Water-Energy-Land (Food)**
- ✓ Holding **Stakeholders consultations** as well as the **involvement of the general public**
- ✓ Dealing with **energy efficiency**
- ✓ Other issues discussed: **car sharing**, relevant in local models; **air pollution and dispersion models** to move from pollutants dispersion to concentrations; **agricultural sector** as supplier of the cities and sectors; **demand based on ecosystem services** instead of socioeconomic drivers; **external costs of biodiversity**

# General conclusions

- ✓ Contribution to improve the analysis of the interaction between the energy system and the economy and society incorporating environmental, social and socioeconomic aspects
- ✓ Thanks to the participation of ETSAP members and TIMES users
- ✓ Productive, interesting and stimulating



**THANK YOU**



# Backup slides

# Objective

- To hold a workshop on ***Sustainability performance of the energy systems***

## Motivation

- Sustainability indicators are a measure of sustainability performance of the energy systems and can deal with different aspects of sustainability: economic, social and environmental
- While environmental sustainability indicators have been broadly investigated and applied to energy systems, the research on the applications of socioeconomic and social indicators are still lagged behind in their incorporation
- To take a step forward in the incorporation of new indicators to our analyses

## Benefits for ETSAP

- This project contributes to improve the analysis of the interaction between the energy system and the economy and society incorporating environmental, social and socioeconomic aspects
- Collaboration between ETSAP teams



# Deliverables

- D1. Two-day workshop to be held in spring 2017
- D2. Workshop proceedings
- D3. Document with main results from discussion



# Time schedule

January-December 2017

Tentative date for the workshop: April  
CIEMAT, Madrid

