METHODOLOGIES FOR IMPACT ASSESSMENT OF IMPLEMENT RESPONSE MEASURES

BONN CLIMATE CHANGE CONFERENCE

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ORGANIZED BY:

MITIGATION, DATA AND ANALYSIS PROGRAM

UNFCCC

PRESENTED BY:

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MEGA ZING SOLUTION PVT. LTD. ,INDIA

Presented on-05/16/2017

Time- 13:15 to 14:45 hours

Venue: Room Berlin 112 of WCCB, Bonn, Germany

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DIFFERENT CLIMATE MITIGATION POLICIES

a. Carbon taxes;
b. Subsidies, including those granted for the production and consumption of low-carbon technologies or goods, and removal of existing subsidies to greenhouse gas intensive technologies or goods;
c. Standards and labelling requirements;
d. Energy policy reforms and green public investments;
e. Cap-and-trade schemes and international offsets;
f. Trade-related measures, including trade tariffs and border carbon adjustment (BCA);
g. Technology cooperation;

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STANDARDS AND LABELLING POLICY

- Energy-efficiency labels are informative labels affixed to manufactured products to describe the product's energy performance; these labels give consumers the data necessary to make informed purchases. Energy efficiency can be classified into two types:
  - Endorsement labels
  - Comparative labels
- Energy-efficiency standards are procedures and regulations that prescribe the energy performance of manufactured products, sometimes prohibiting the sale of products that are less efficient than a minimum level. Energy-efficiency standards can be classified into three types:
  - prescriptive standards
  - minimum energy performance standards (MEPS)
  - class-average standards

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IMPORTANT CONSIDERATIONS WHILE CREATING STANDARDS AND LABELING PROGRAMS

- Determining whether a labeling or standards-setting program is right for their countries and, if it is, determining what combinations of programs and products are appropriate
- Designing, developing, implementing, and maintaining labels and standards
- Understanding the data; facilities; and cultural, political, and human resources necessary to reach their goals
- Learning about existing field experience with energy-efficiency labeling and standards (through case examples and references)

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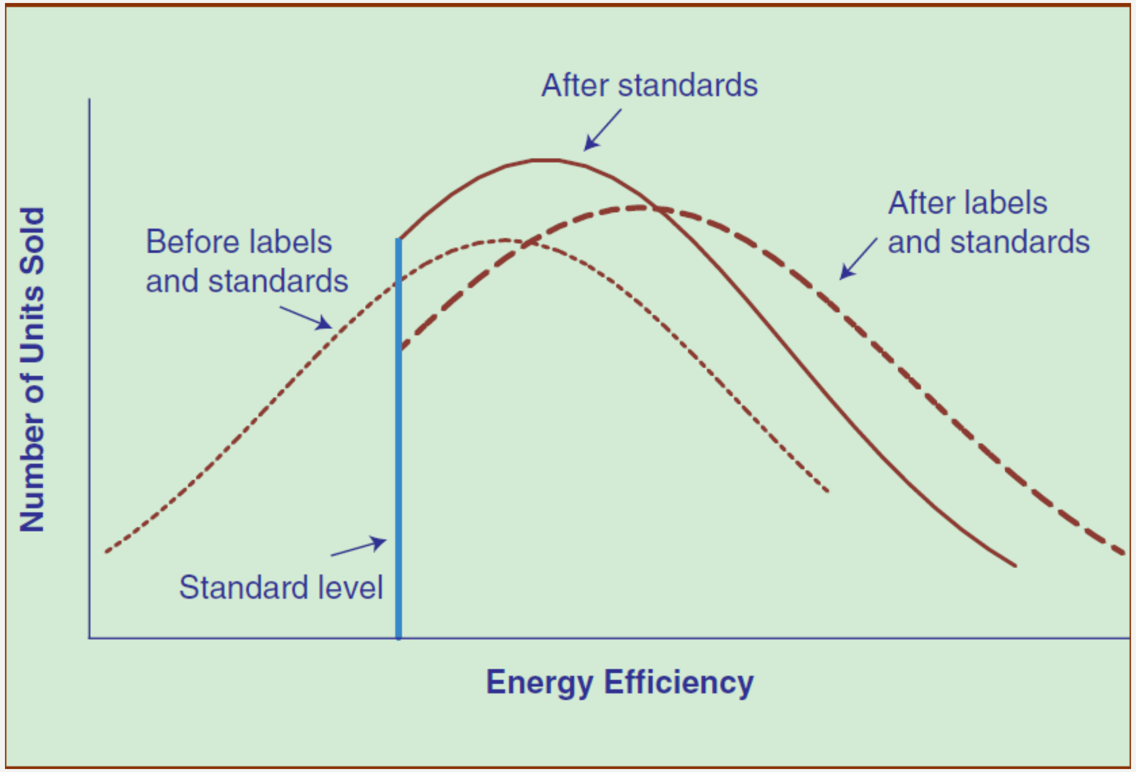
NEED FOR ENERGY LABELING

Energy-labeling programs help consumers understand which products are most efficient and what the benefits of this efficiency are. Labels not only influence consumers to choose more efficient products but also create competition among manufacturers to produce and market the most energy-efficient models, which engages retailers in promoting efficiency.



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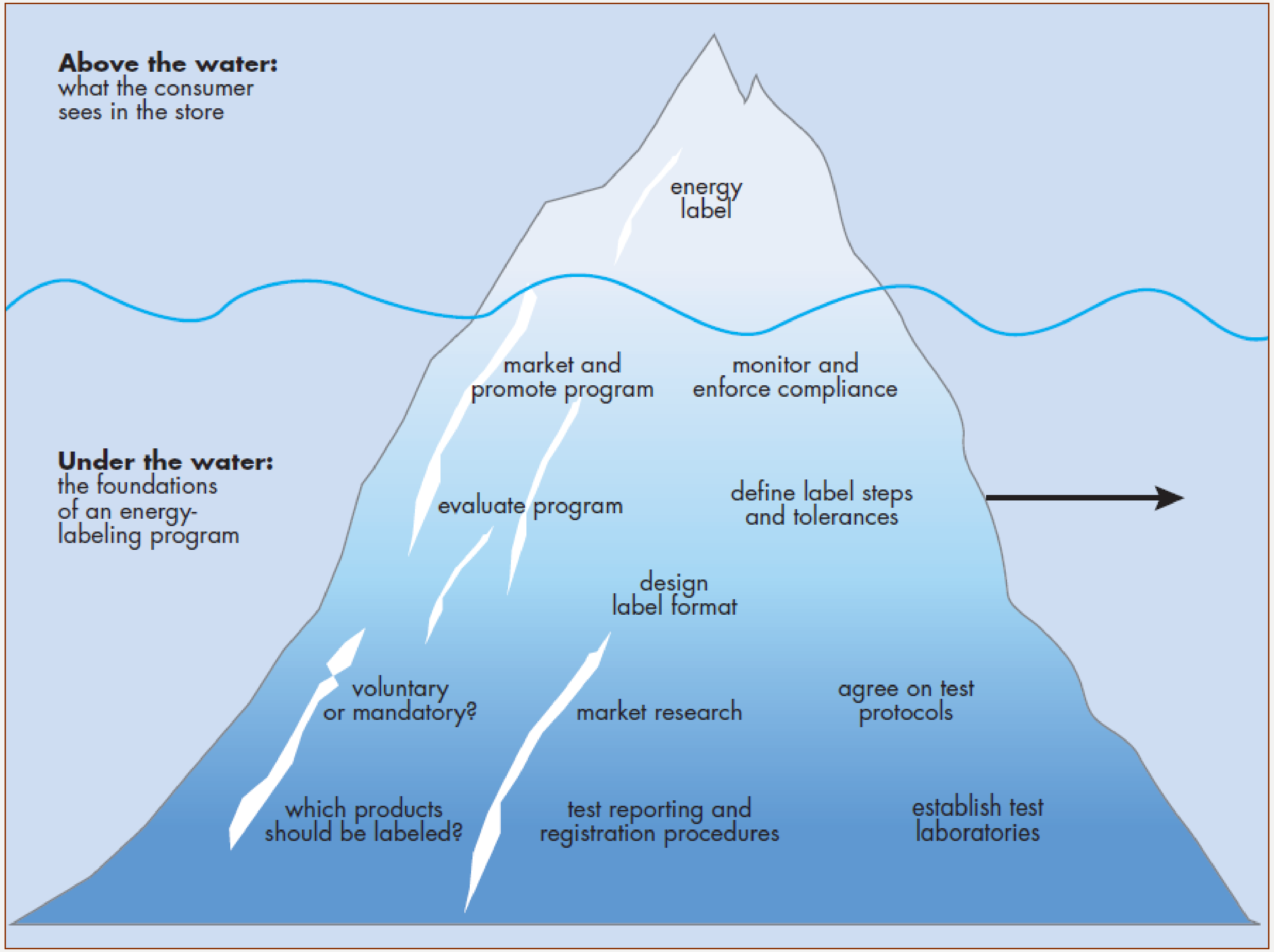
ENERGY LABELLING PROGRAM



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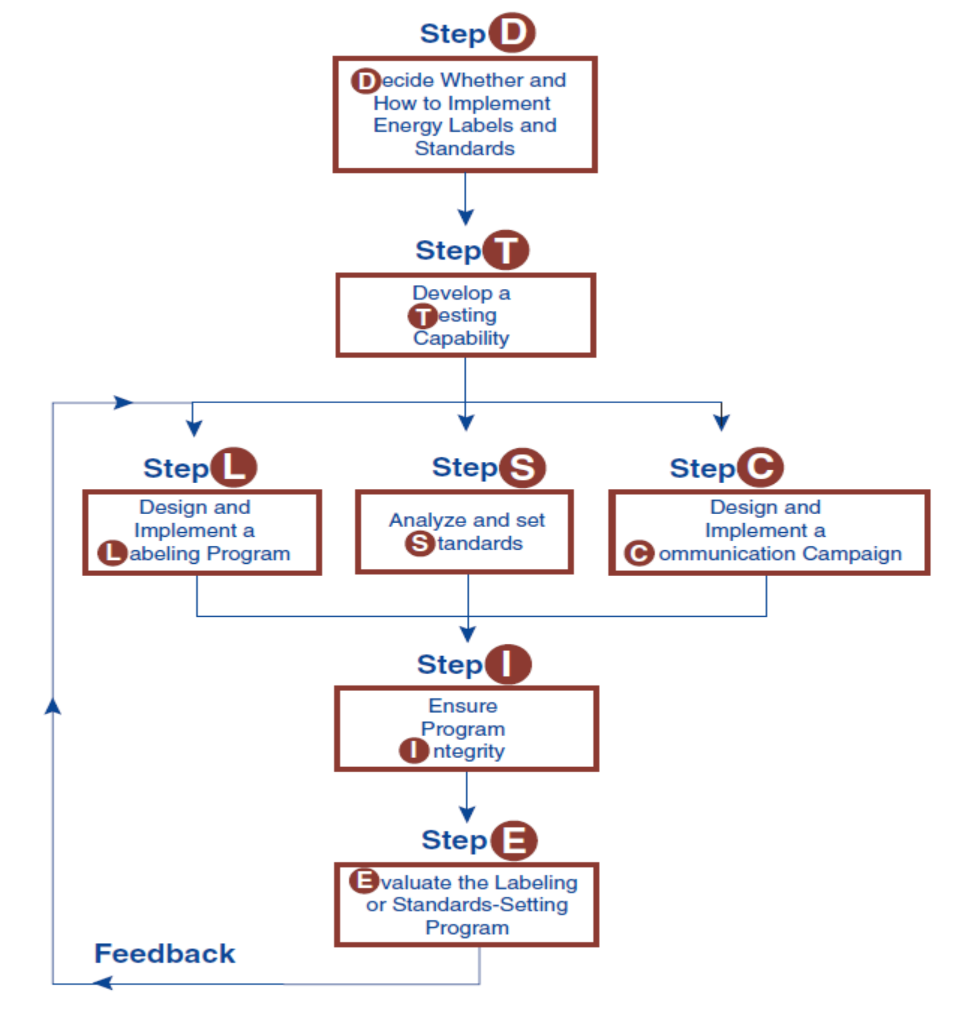
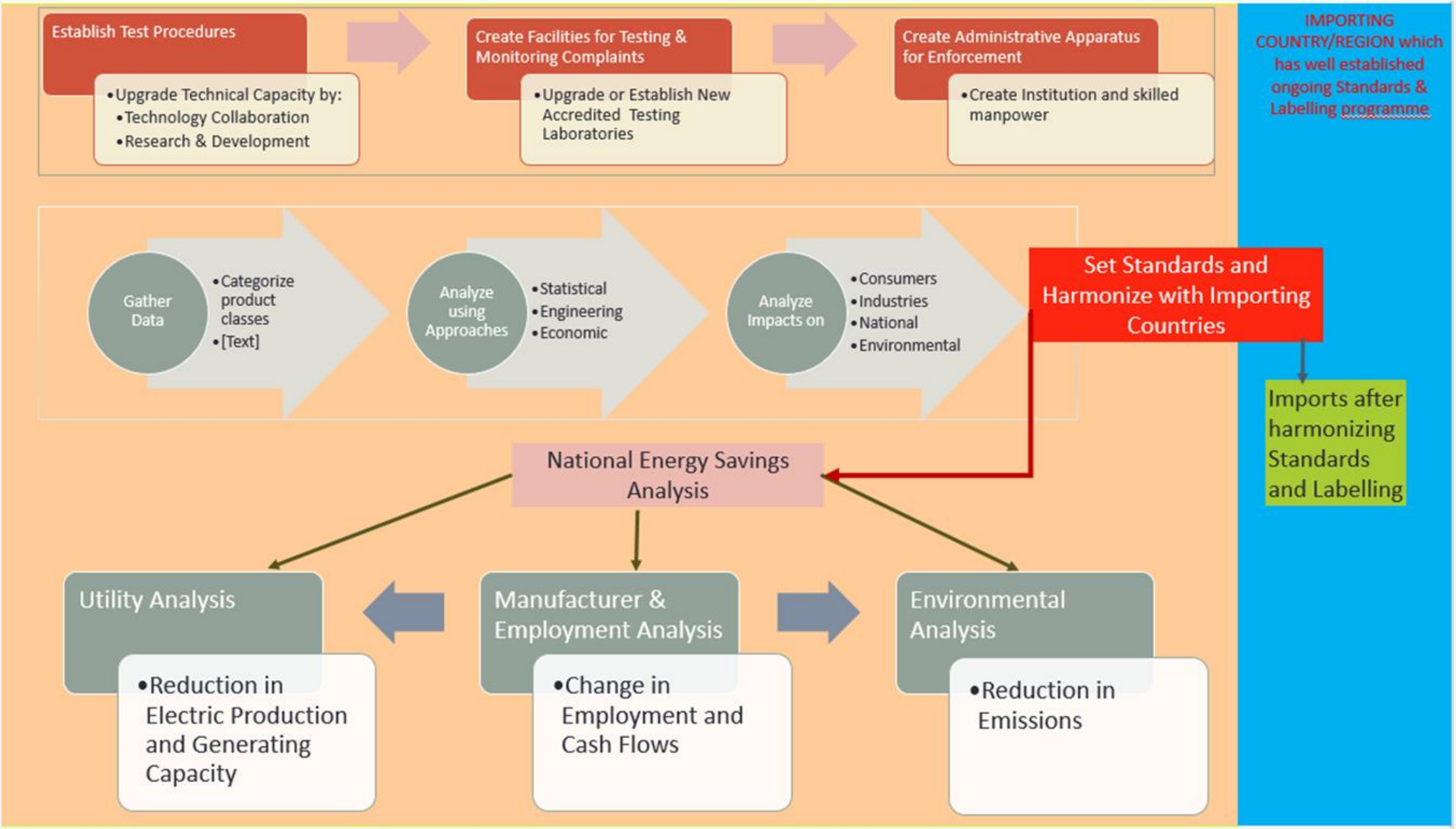
STEPS IN DEVELOPING STANDARDS AND LABELING PROGRAMS



CROSS BORDER IMPACTS OF STANDARDS AND LABELLING PROGRAMS



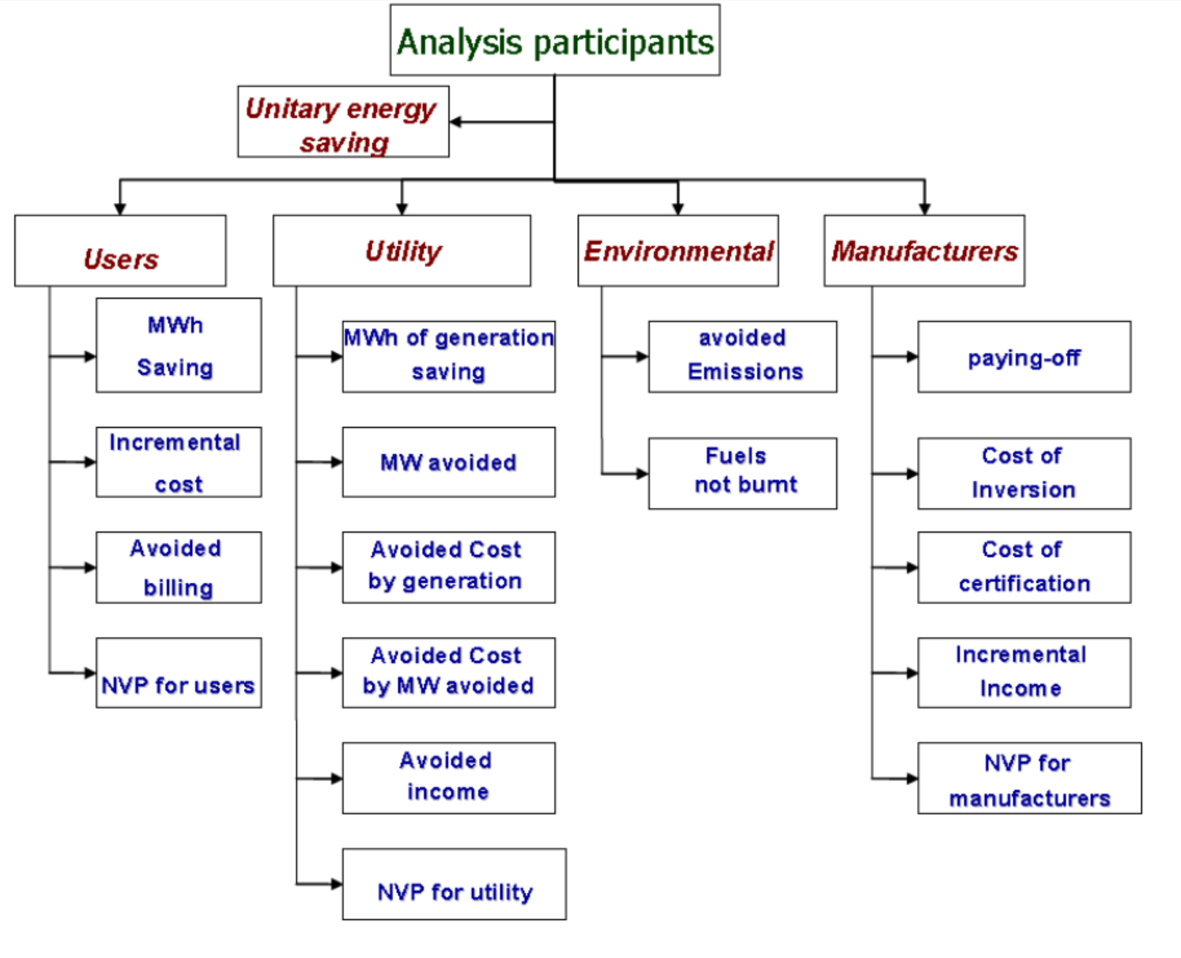
CASE STUDY: ASSESSMENT OF THE IMPACTS OF STANDARDS AND LABELING PROGRAMS IN MEXICO

- This study analyzes impacts from energy efficiency standards and labeling in Mexico from 1994 through 2005 for four major products: household refrigerators, room air conditioners, three-phase (squirrel cage) induction motors, and clothes washers.
- It is a retrospective analysis, seeking to assess verified impacts on product efficiency in the Mexican market in the first ten years after standards were implemented.

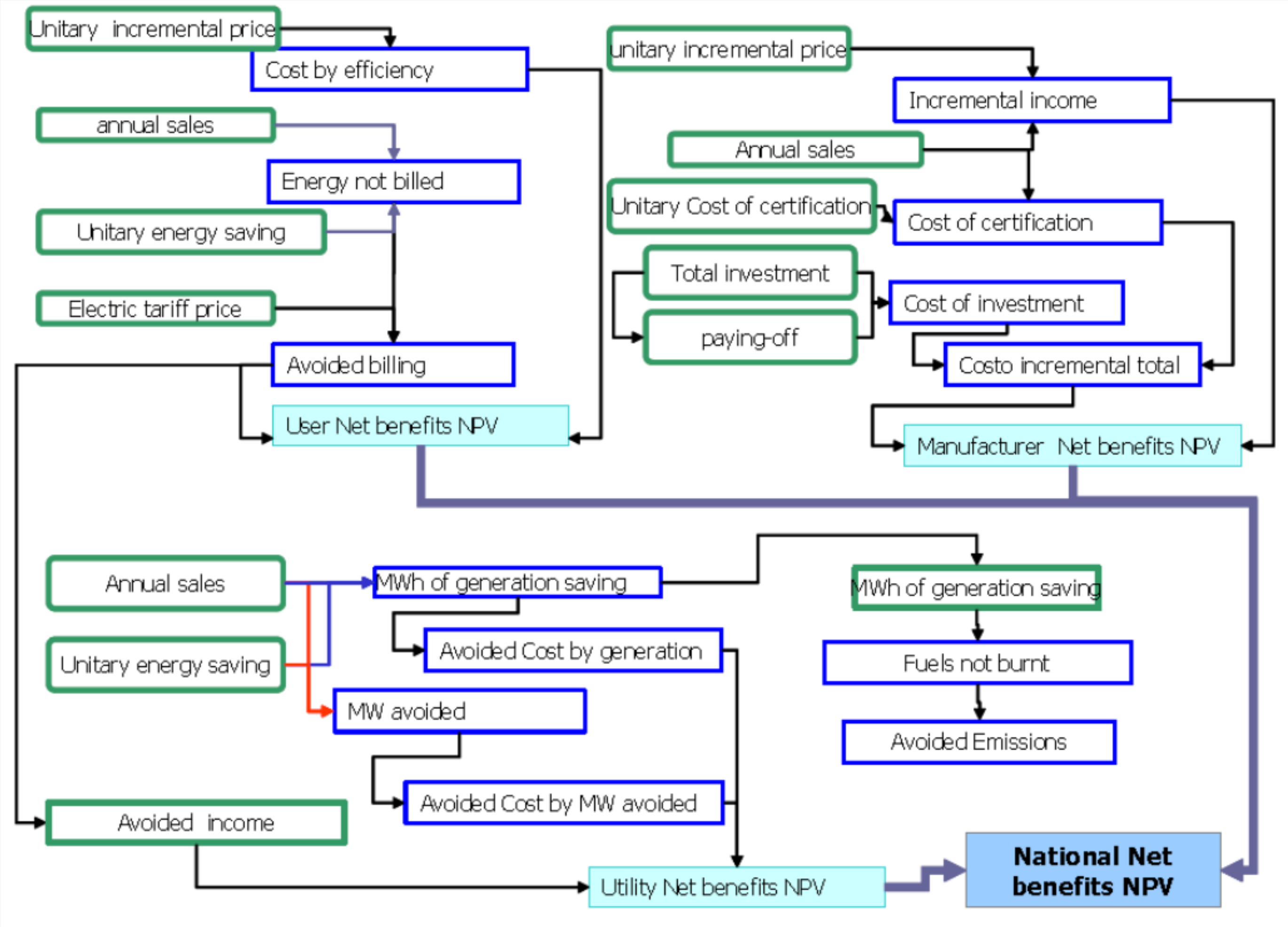
METHODOLOGY

- CONAE (Comisión Nacional para el Ahorro de Energía) obtained the support of United States Agency for International Development (USAID) for financing the first part of the project, which consisted of validating the model.
- In this first phase, PA Consulting Group was assigned as USAID's administrative representative, and Lawrence Berkeley National Laboratory (LBNL) and the IEE were involved in the technical aspects of the effort.
- The second phase of this project included using computer models to update the data in order to project the potential impact of implementing the proposed energy efficiency standards for the four products mentioned above. The result of this phase was a revised, validated model.
- For the development of the second phase of this project, the input data required to run the evaluation model was updated in order to obtain the energy and economic impacts.

METHODOLOGY: ANALYSIS MODULES FOR THE EVALUATION OF ENERGY EFFICIENCY STANDARD PROGRAM



METHODOLOGY: INTERRELATION OF ANALYSIS INPUT AND OUTPUTS



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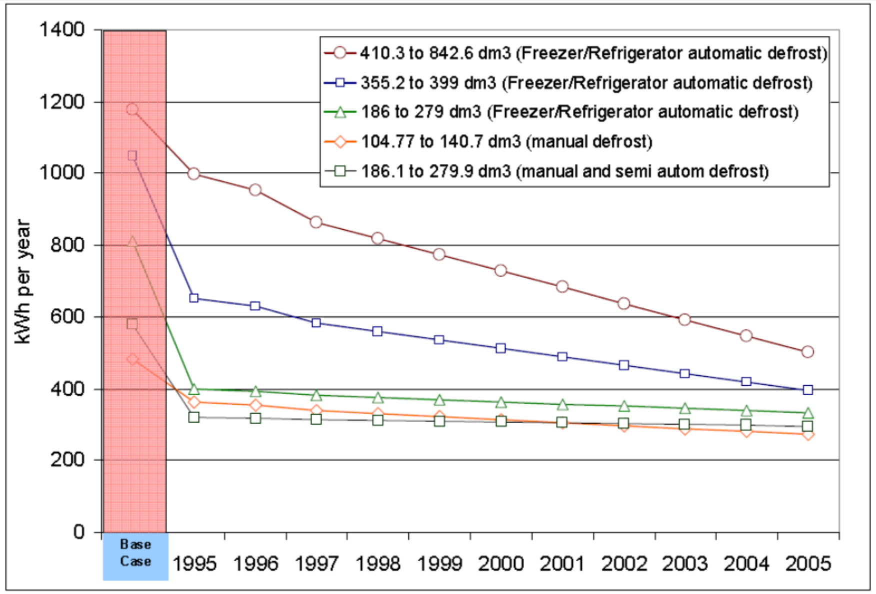
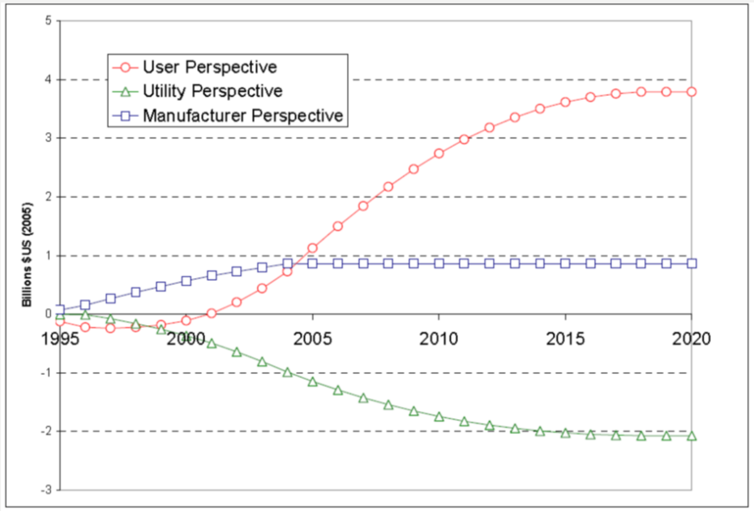
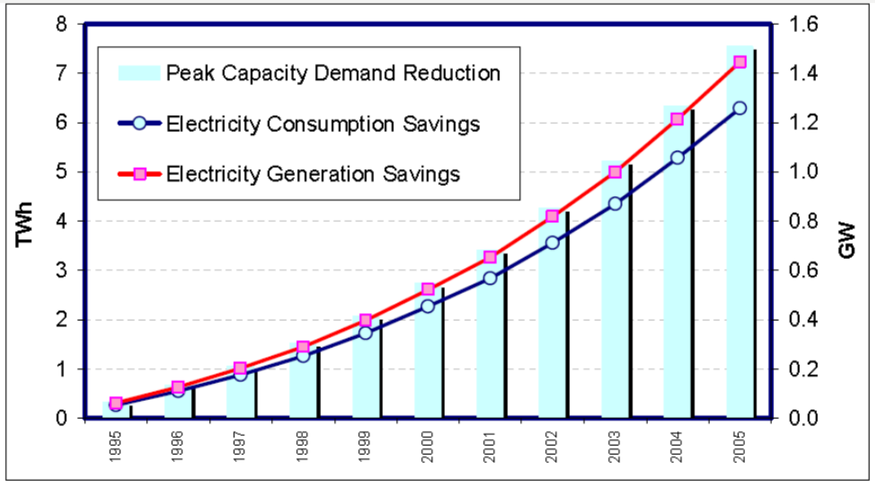
IMPACTS ON HOUSEHOLDS REFRIGERATOR

Official Mexican standards: “Eficiencia energética de refrigeradores y congeladores electrodomésticos” (Energy Efficiency of Household Refrigerators and Freezers).		
Name	**Publication in DOF**	**Effective date**
Original NOM-072-SCFI-1994	September 8 , 1994	January 1, 1995
Update NOM-015-ENER-1997	July 11, 1997	August 1, 1997
Update NOM-015-ENER-2002	January 13, 2003	After 120 days (March 14, 2003)







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IMPACTS SUMMARY ON HOUSEHOLD REFRIGERATORS

	TOTAL THROUGH		
	2000	2005	2015
Energy and Power savings			
Cumulative Avoided Consumption (TWh)	6.96	29.29	85.25
Cumulative Avoided Production (TWh)	8.00	33.67	98.01
Reduced Demand (MW)	544	1,507	
Economic benefits (Millions $2005 US)			
Cumulative NPV - Users	-0.11	1.20	4.22
Cumulative NPV - Utilities	-0.37	-1.18	-2.24
Cumulative NPV - Manufacturers	0.57	0.86	0.86
Cumulative NPV - Net	0.09	0.88	2.84
Environmental Savings - Avoided Emissions (kton)			
Cumulative SO_x Avoided	59	250	796
Cumulative NO_x Avoided	15	65	207
Cumulative CO_2 Avoided	4,819	20,279	64,645
Cumulative CO Avoided	1	4	12
Cumulative Suspended Particles Avoided	34	144	460
Cumulative Hydrocarbons Avoided	1	4	13

SUMMARY OF IMPACTS ON ALL MEXICAN MEPS

Energy and Power savings through 2005					
	Refrigerators	Air Conditioners	Motors	Washing Machines	**Total**
Cumulative Avoided Consumption (TWh)	29	15	13	1.8	59
Cumulative Avoided Production (TWh)	34	18	15	2	68
Reduced Demand (MW)	1,507	868	1,066	0	3,440
Economic benefits through 2015 (Millions $2005 US)					
Cumulative NPV – Users	4.2	2.6	1.6	0.2	8.5
Cumulative NPV – Utilities	-2.2	-1.0	-0.2	-0.2	-3.6
Cumulative NPV – Manufacturers	0.9	0.3	0.1	0.2	1.4
Cumulative NPV – Net	2.8	1.9	1.5	0.2	6.3
Environmental Savings - Avoided Emissions (kton) through 2005					
Cumulative SO_x Avoided	250	131	109	15	504
Cumulative NO_x Avoided	65	34	28	4	131
Cumulative CO_2 Avoided	20,279	10,606	8,842	1,257	40,984
Cumulative CO Avoided	4	2	2	0.2	8
Cumulative Suspended Particles Avoided	144	75	63	9	292
Cumulative Hydrocarbons Avoided	4	2	2	0.2	8

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CONCLUSION

- Revision of standards has led to higher energy efficiency
- Harmonization of Testing Standards with technical and intergovernmental MRA (Mutual Recognition Agreement)
- Standards for these products accounted to a 9.6% reduction in demand in 2005. In terms of capacity, standards reduced the need for total generating capacity of 3440 MW, or 6.4% of capacity installed by 2004 of 53561 MW.
- Efficiency improvements of the four products studied generally exceeded the requirements of minimum efficiency standards. A possible explanation for this effect is the desire of manufacturers to market their products in the U.S. and Canada, and to avoid maintaining separate lines of production for these foreign markets and the Mexican domestic market.

ENERGY POLICY REFORMS AND GREEN PUBLIC INVESTMENTS- CASE STUDY USING GEM-E3MODEL

ASSESSING THE EMPLOYMENT AND SOCIAL IMPACT OF ENERGY EFFICIENCY

ENERGY POLICY – POST PARIS AGREEMENT & GREEN PUBLIC INVESTMENTS

- The energy policy reforms are driven by the Paris Agreement with the primary objective to develop a sustainable transition to a low-GHG economies.
- A comprehensive green policy must considers the inter-relationships between economic sectors, social welfare and environmental integrity as well as address market failures and barriers, create the enabling policy framework for large-scale private sector investment.
- To achieve an energy transformation – large scale adoption of energy efficiency, CCS, deployment of renewable energy, switching to low carbon fuels, etc. required
- Governments have an important role to play to foster innovation and support the scaling up of deployment of new technologies in the energy sector.

HOW DO PUBLIC INVESTMENTS HELP?

- Public investment by federal, state, and local governments help:
  - builds the nation's capital stock by devoting resources to the basic physical infrastructure (such as roads, bridges, rail lines, airports, and water distribution)
  - innovative activity (basic research),
  - green investments (clean power sources and weatherization),
  - education (both primary and advanced, as well as job training) that leads to higher productivity and/or higher living standards.
  - near-term boost to the job market
- Pro-growth reform measures, combined with measures to mobilize investment in low-emission and climate-resilient infrastructure, can spur growth and improve well-being while also achieving climate goals.

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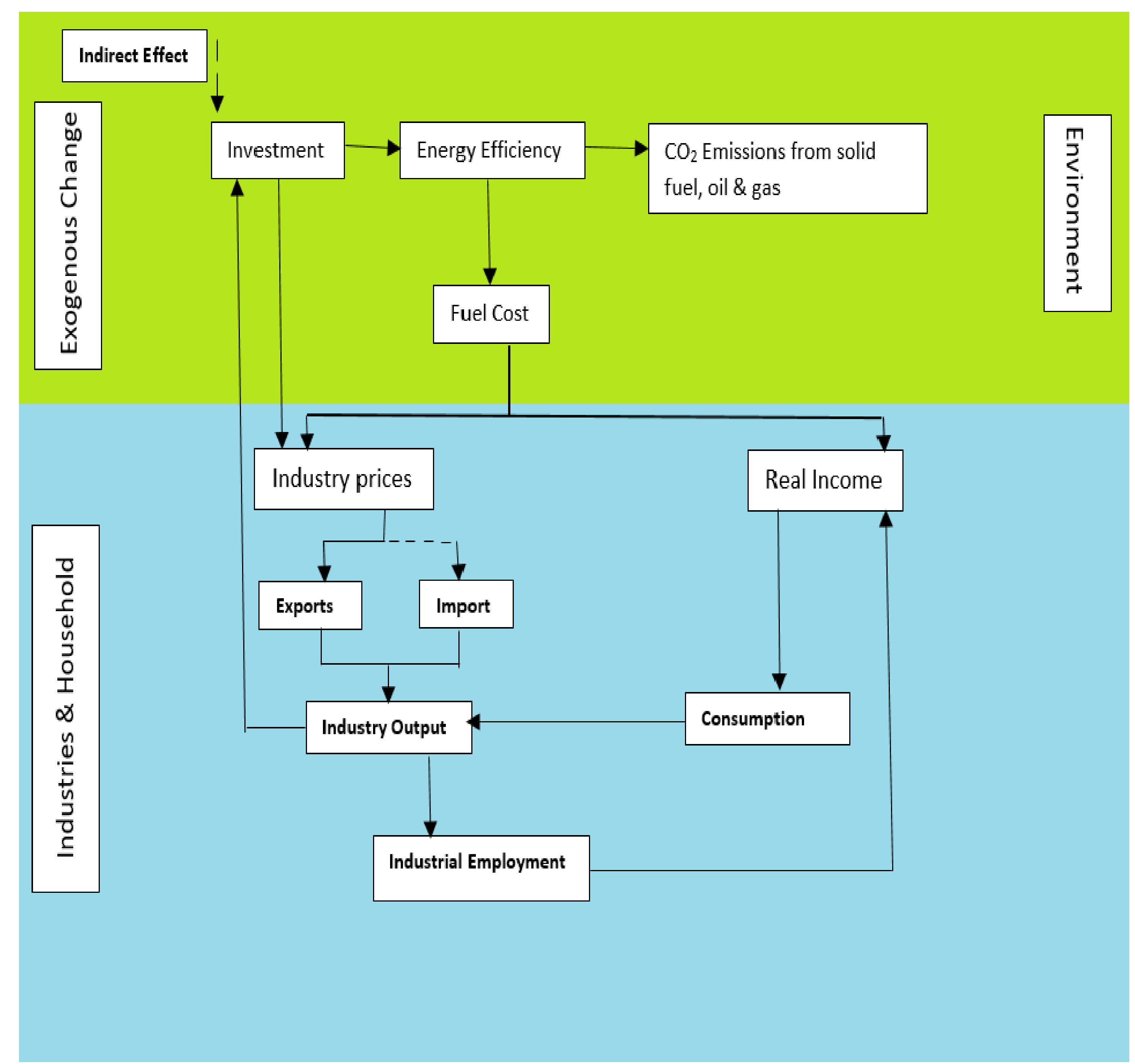
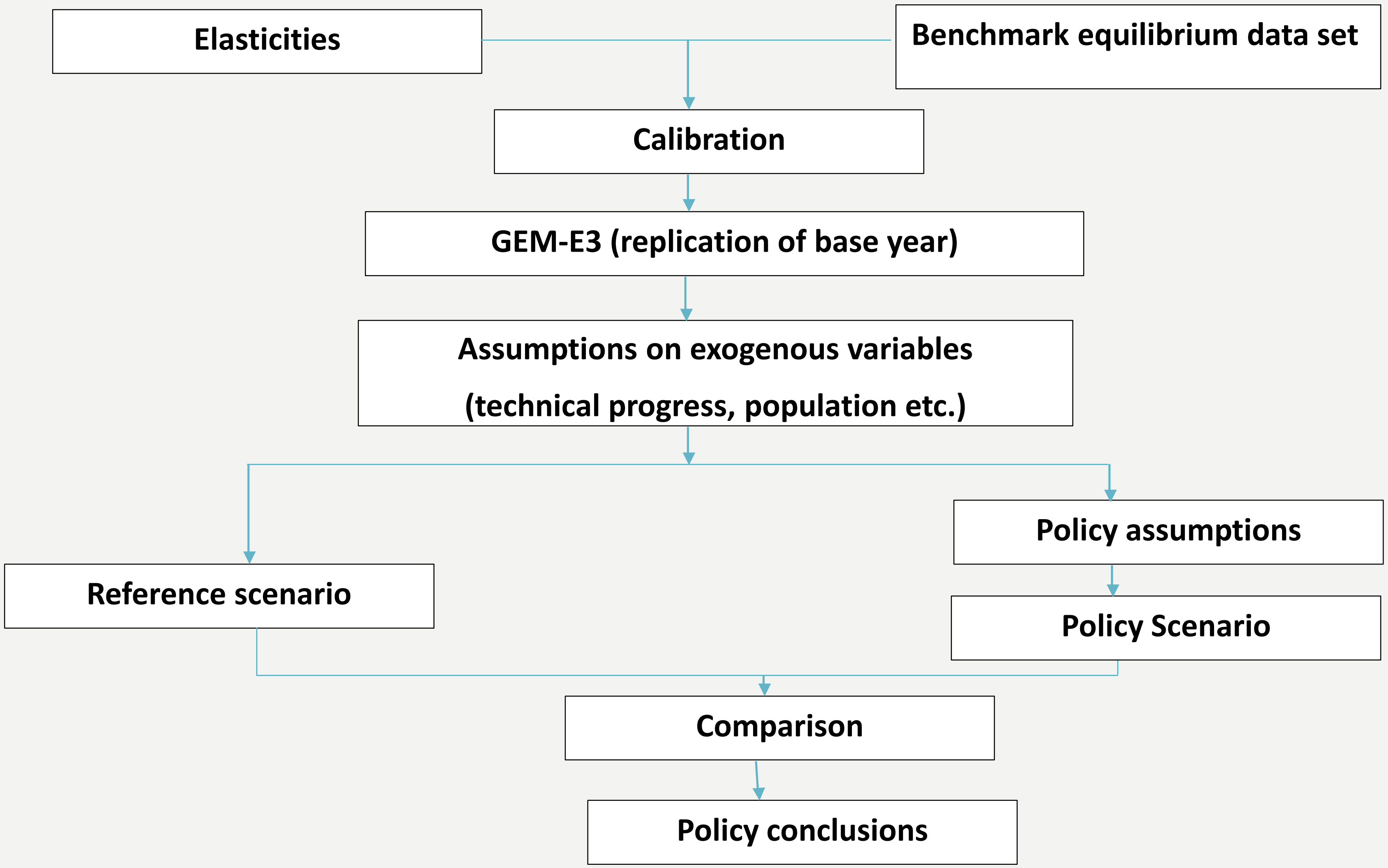
THE MAIN ECONOMIC INTERACTIONS OF ENERGY EFFICIENCY



GEM-E3 REFERENCE CASE AND POLICY SCENARIOS SET-UP



FEATURES OF THE GEM-E3 MODEL

- The GEM-E3 model is a multi-regional, multi-sectoral, recursive dynamic computable general equilibrium (CGE) model which provides details on the macro-economy and its interaction with the environment and the energy system.
- The GEM-E3 model includes projections of full Input-Output tables by country/region, national accounts, employment by economic activity, unemployment rate, balance of payments, public finance and revenues, household consumption, energy use and supply, GHG emissions and atmospheric pollutants.
- GEM-E3 model used for this study simultaneously represents 38 regions and 29 sectors linked through endogenous bilateral trade flows.
- The model features perfect competition market regimes, discrete representation of power producing technologies, semi-endogenous learning by doing effects, equilibrium unemployment, different labour skills, option to introduce energy efficiency standards, formulates emission permits for GHG and atmospheric pollutants.
- The environmental module includes flexibility instruments allowing for a variety of options when simulating emission abatement policies, including: different allocation schemes (grandfathering, auctioning, etc.), user-defined bubbles for traders, various systems of exemptions, various systems for revenue recycling, etc.

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ASSESSING THE EMPLOYMENT AND SOCIAL IMPACT OF ENERGY EFFICIENCY IN EC

- This study assesses the direct and indirect linkages between energy efficiency, labour markets and social welfare, at both the micro and the macro levels, using a mixture of qualitative and quantitative approaches to carry out the analysis. The key research questions addressed in the study are:

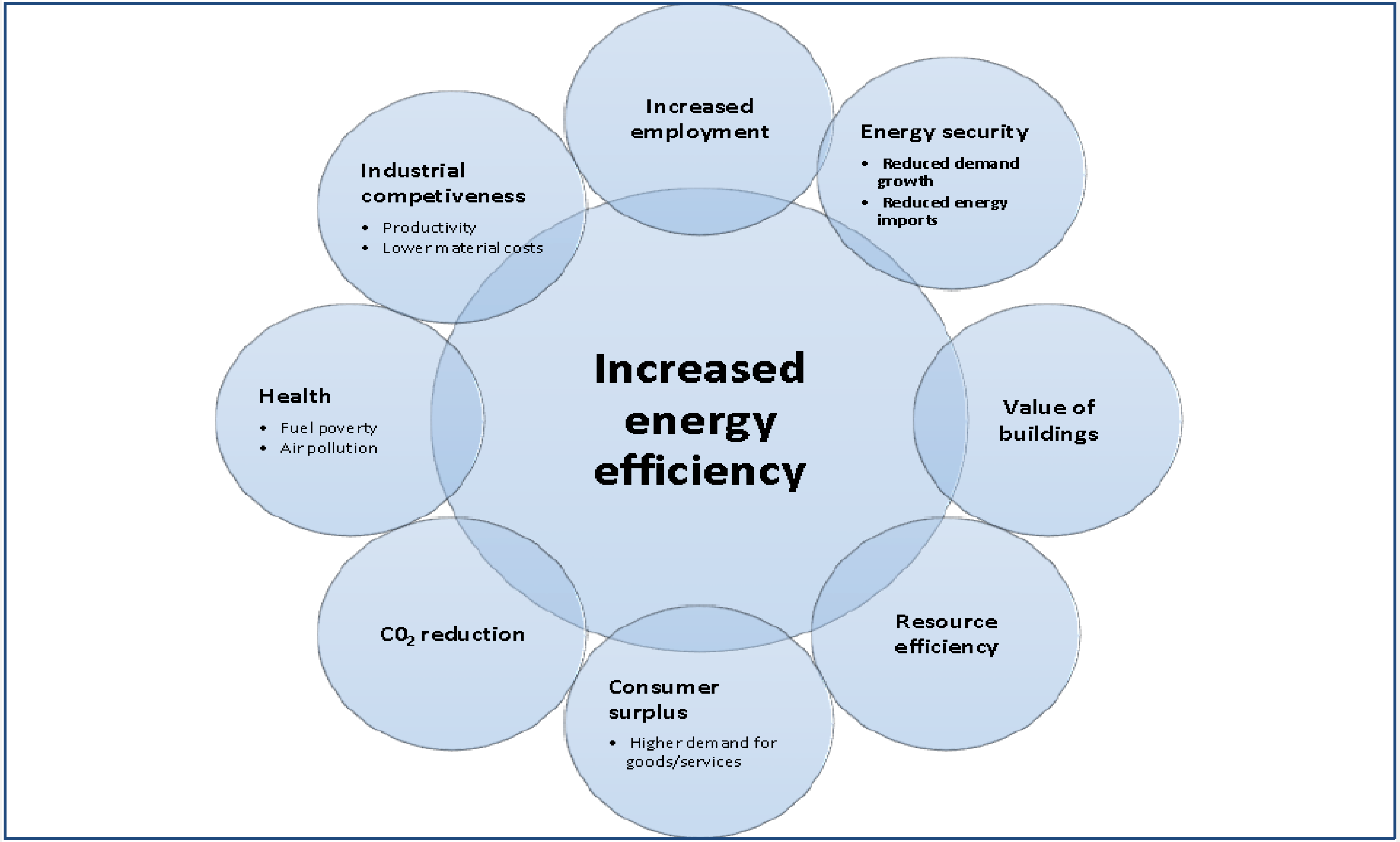
  - What is the level of employment currently associated with energy efficiency across Europe, and what is the potential for creating employment related to energy efficiency improvements and/or investments?

  - What instruments can be provided to policy makers to support assessment of the impact of energy efficiency policies on employment?

  - What are the social impacts of energy efficiency?

  - What are the skills that are needed to implement large-scale energy efficiency programmes?

CO-BENEFITS OF ENERGY EFFICIENCY POLICY



FACTORS DRIVING THE DEMAND FOR ENERGY EFFICIENCY

- The demand for energy efficiency is driven by a number of factors:
  - High energy prices, which can strongly motivate the uptake of energy efficient technologies and procedures
  - Innovation effects of technologies and scale effects when widely used (e.g. learning curves)
  - Government policy to promote energy efficient activities and technologies, and/or the scale of programmes to implement them
  - Consumer preferences: as well as considering energy costs, consumers also act in accordance with personal preferences about patterns of use; moreover, their purchase decisions may also be based on social, environmental or utility considerations

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THE POTENTIAL FOR EMPLOYMENT RELATED TO ENERGY EFFICIENCY ACTIVITIES IN EUROPE

Sector	Final energy saving potential (ktoe)	Share of total (%)
Industry	48,500	16%
Residential	105,500	34%
Tertiary	46,600	15%
Transport	107,400	35%
Total	**308,000**	**100%**

Final energy consumption by end-use sector in the EU27, 2011-2030

Sector	Jobs per unit energy saved	2010	2012	2020	2030
Industry	0.27	33,634	47,001	99,846	152,191
Residential	0.49	90,780	125,839	293,603	601,196
Tertiary	0.62	42,910	70,700	183,726	336,007
Transport	0.19	107,637	118,683	164,989	237,326
Total	-	**274,961**	**362,223**	**742,164**	**1,326,720**

Estimates of additional employment based on savings potential, high

CHANGES AND EFFECTS FROM EXPENDITURES

Change simulated	Trigger effects	Outcome	Total effect on the economy
Expenditures in energy efficiency	Increase in demand for sectors providing inputs to energy efficiency improvement projects.	Positive effect on activity and employment rate in sectors providing inputs to energy efficiency projects.	Depend on the net effect of offsetting factors: economic expansion (Keynesian multiplier) and negative effects stemming from crowding out and pressures on primary factor markets.
Increase in energy savings	Reduced energy demand and energy related imports.	Negative effect on activity and employment rate in energy sectors. Reduction of energy imports. Positive effects due to lower variable and energy commodities.	
Financing scheme	Increase in energy efficiency related expenditures.	Crowding out effects due to equity-based funding, borrowing, increases in interest rates, higher cost of capital, slowdown of productive investment, loss of competitiveness, consumption reduction,	

EU28 EMPLOYMENT IN THE ENERGY EFFICIENCY POLICY SCENARIOS

% change from reference	2030	2040	2050	Cumulative (2015-2050)
Ref. scenario, million people	218.76	211.24	204.08	7,514.34
EE25	0.5	0.48	0.57	0.3
EE28	1.47	0.67	0.71	0.61
EE30	1.9	0.81	1.07	0.77
EE32	2.02	0.89	1.22	0.84
EE35	2.53	0.97	1.24	1.03
EE40	2.96	1.21	1.59	1.3

EU28 ENERGY EFFICIENCY EXPENDITURES IN THE ENERGY EFFICIENCY POLICY SCENARIOS

(% change from reference)	2030	2040	2050	Cumulative (2015-2050)
Ref. scenario (€2010bn)	3,369.52	3,937.83	4,576.48	1,24,818.96
EE25	0.07	0.19	0.3	0.14
EE28	0.16	0.19	0.32	0.16
EE30	0.4	0.2	0.29	0.19
EE32	0.44	0.21	0.33	0.2
EE35	0.53	0.34	0.53	0.28
EE40	0.51	0.32	0.65	0.3

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KEY CONCLUSIONS THE GEM-E3 MODELLING

- The GEM-E3 model was used to simulate scenarios of energy efficiency policies in a stepwise manner from **25% (least ambitious) to 40% (most ambitious) till 2050**. Energy efficiency is achieved with **additional expenditures financed by economic agents (firms, households) and aggregate savings** with borrowing that extends to 2050.
- The results obtained are the outcome of a set of complex interactions:
  - **positive effects** from higher demand for sectors that provide **inputs to energy efficiency projects**;
  - **negative effects** from crowding out that **curbs other** productive investment and consumption;
- Due to energy efficiency expenditures, several sectors (equipment goods, electrical goods etc.) benefit from a **decrease in variable costs** which positively impacts the economy and help it reach the reference scenario growth rates later.
- **Maximum impact** on the economy was achieved in the **moderate energy efficiency scenario**, highly efficient scenario provided a negative effect on the economy due to higher marginal costs.
- Overall, energy efficiency expenditures are found to impact **positively on employment** and have a **small negative effect on EU GDP** compared to the reference scenario.
- Specific sectors, such as construction and market services experience the largest benefits from the energy efficiency programs. The effects are more pronounced during the implementation phase of the programmes and diminish in the long term.
- The sensitivity run with the GEME3 model where EU financial constraints were eased showed that increasing financing availability can reduce the negative impacts of the crowding out effect and improve the overall adjustment of the economic system.

THANK YOU

BACKUP SLIDES FOR S&L

ANALYSIS PERSPECTIVES

- Consumer Perspective
- Utility Perspective
- Manufacturer Perspective
- Environmental Perspective

INPUT DATA REQUIRED FOR MODELLING

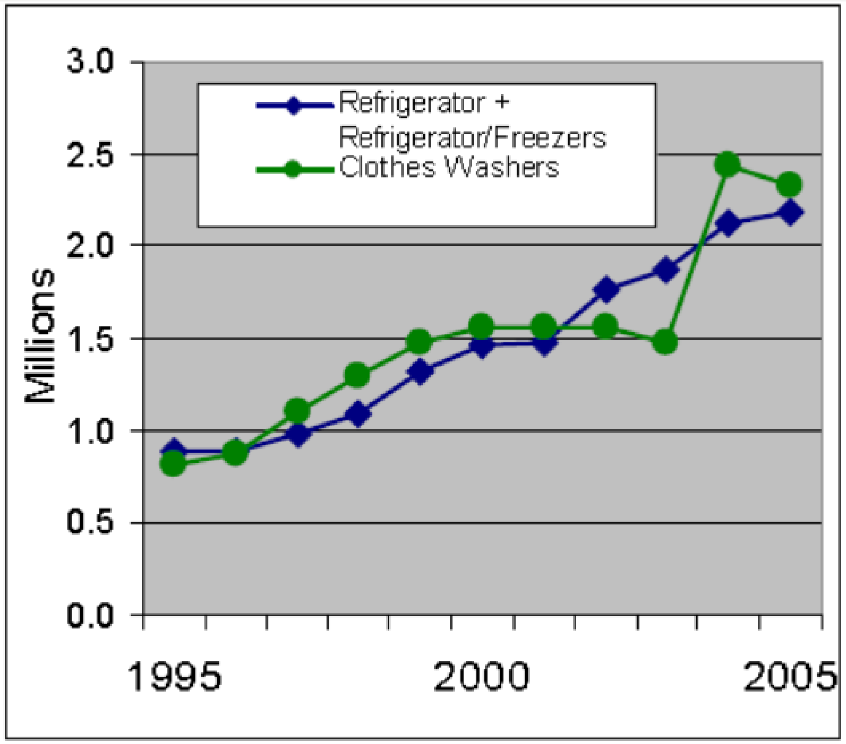
- Efficiency Data
- Market Data
- Financial Data
- Power Sector Data
- Emissions Data

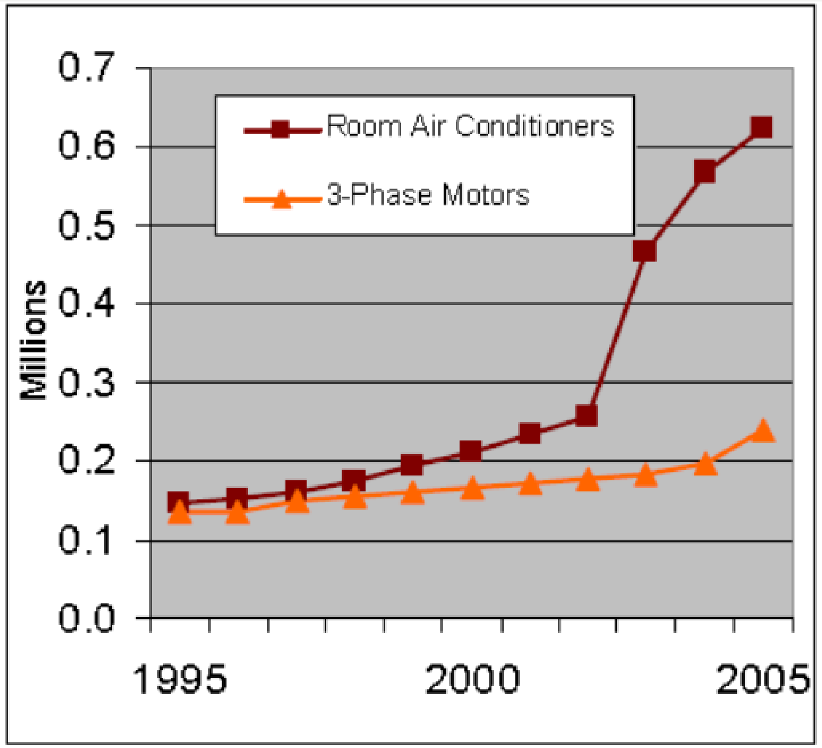
EFFICIENCY DATA

- 2167 refrigerator and refrigerator/freezer models;
- 620 room air conditioner models;
- 666 three-phase electrical motor models; and
- 1350 clothes washer models from 1995 until 2004.

MARKET DATA

Shipments data (units sold) for each product throughout the analysis period were provided by individual manufacturers and manufacturer associations.





FINANCIAL DATA

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Inflation Rate (%)	52.0	27.7	15.7	18.6	12.3	9.0	4.4	5.7	4.0	5.2	N/A
Exchange Rate pesos/dollar	6.6	7.7	8.1	9.9	9.5	9.6	9.1	10.3	11.2	11.3	10.9

Perspective	Rate Used	Source	Value
Consumers	Mutual Funds	CONUSER	8.51%
Manufacturers	Typical ROI	ANFAD	17%
Utilities	Capital Investment Rate	CFE	12%

POWER SECTOR DATA

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Residential	9.8	8.2	18.0	17.9	17.2	17.1	17.2	17.9	18.1	18.4	18.5
Commercial Tariff 2	22.7	18.5	17.0	16.8	16.2	15.3	14.5	14.2	15.6	17.5	18.2
Commercial Tariff 3	20.0	16.4	9.4	9.3	8.9	8.4	8.0	7.8	8.6	9.6	10.0
Commercial Tariff 6	12.1	9.7	14.3	14.8	14.3	14.2	14.1	14.4	14.5	14.8	14.9
Industrial Tariff OM	8.4	8.2	8.5	9.2	8.9	8.9	8.8	8.9	9.0	9.1	9.2
Industrial Tariff HM	7.9	7.3	5.8	5.1	5.0	5.4	5.2	5.3	6.1	6.8	7.1
Industrial Tariff HS	6.0	6.1	15.2	14.3	13.7	14.3	13.4	13.6	15.6	17.3	17.9

Transmission and Distribution losses

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average
14.4%	15.2%	15.2%	14.9%	14.9%	15.0%	14.0%	15.1%	15.2%	15.7%	**15.0%**

Use and Peak Coincidence Factor

	Use Factor	Peak Coincidence Factor
Refrigerator	40%	68%
Air Conditioner	25%	40%
Motor	30%	82%
Clothes Washer	7%	0%

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EMISSIONS DATA

Primary Fuel	Gross Generation	Fraction	SO_x	NO_x	CO_2	CO	Suspended particles	Hydro - carbons
	(GWh)	%	Tons/GWh					
Fuel Oil	61297	38%	15.7	2.0	669	0.14	1.1	0.29
Natural Gas	33729	21%	0.003	2.0	539	0.19	0.00	0.01
Hydro	24155	15%						
Coal	23431	15%	8.6	4.9	1542	0.13	26.3	0.03
Nuclear	9194	6%						
Endogenous Vapor	6577	4%						
Diesel	1144	1%	15.7	2.0	669	0.14	1.1	0.29
Wind	6	0.004%						
Total	**159533**	**100%**	**7.4**	**1.9**	**602**	**0.1**	**4.3**	**0.1**

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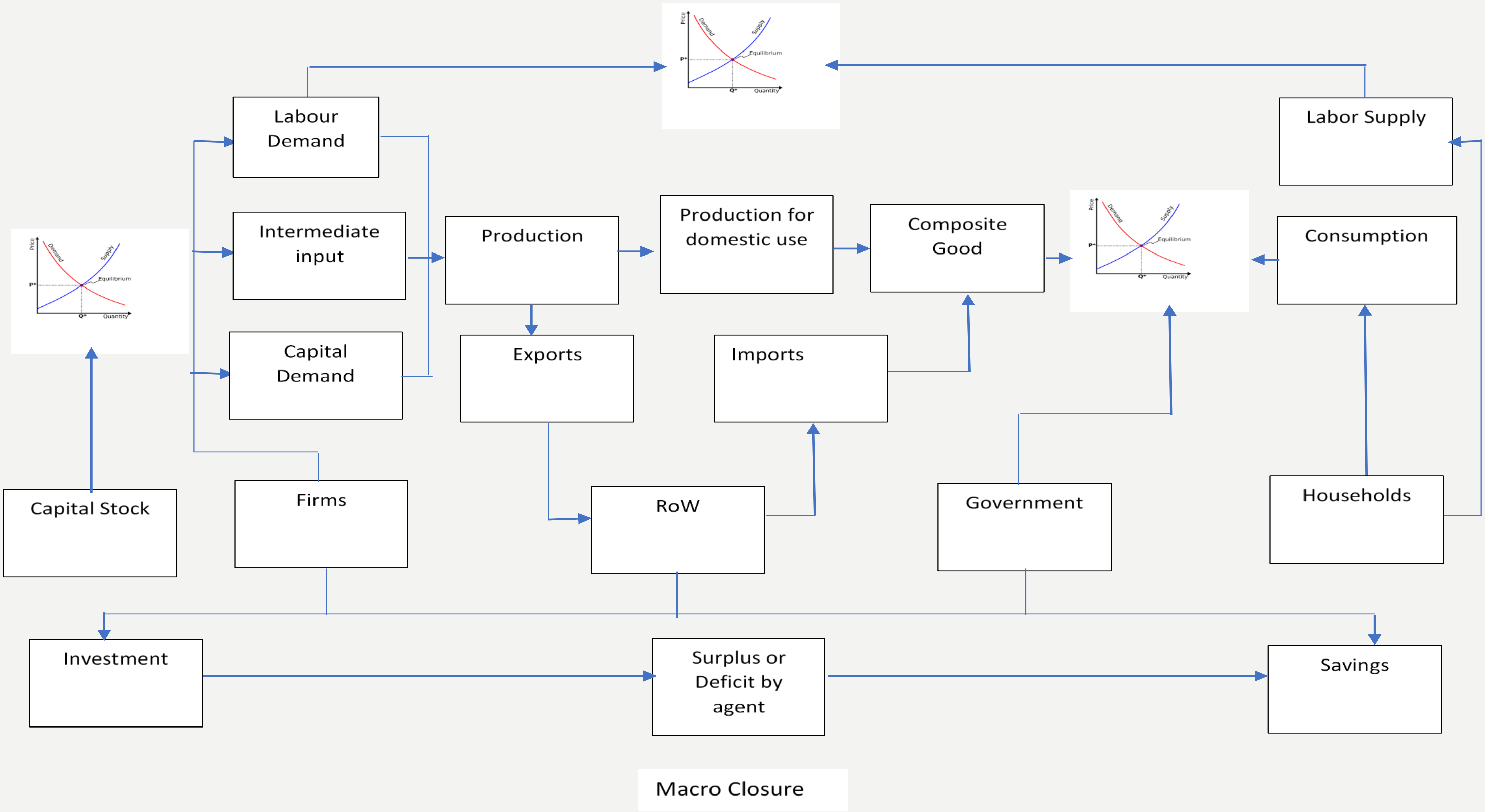
BACKUP SLIDES FOR GEM-E3 ENERGY EFFICIENCY

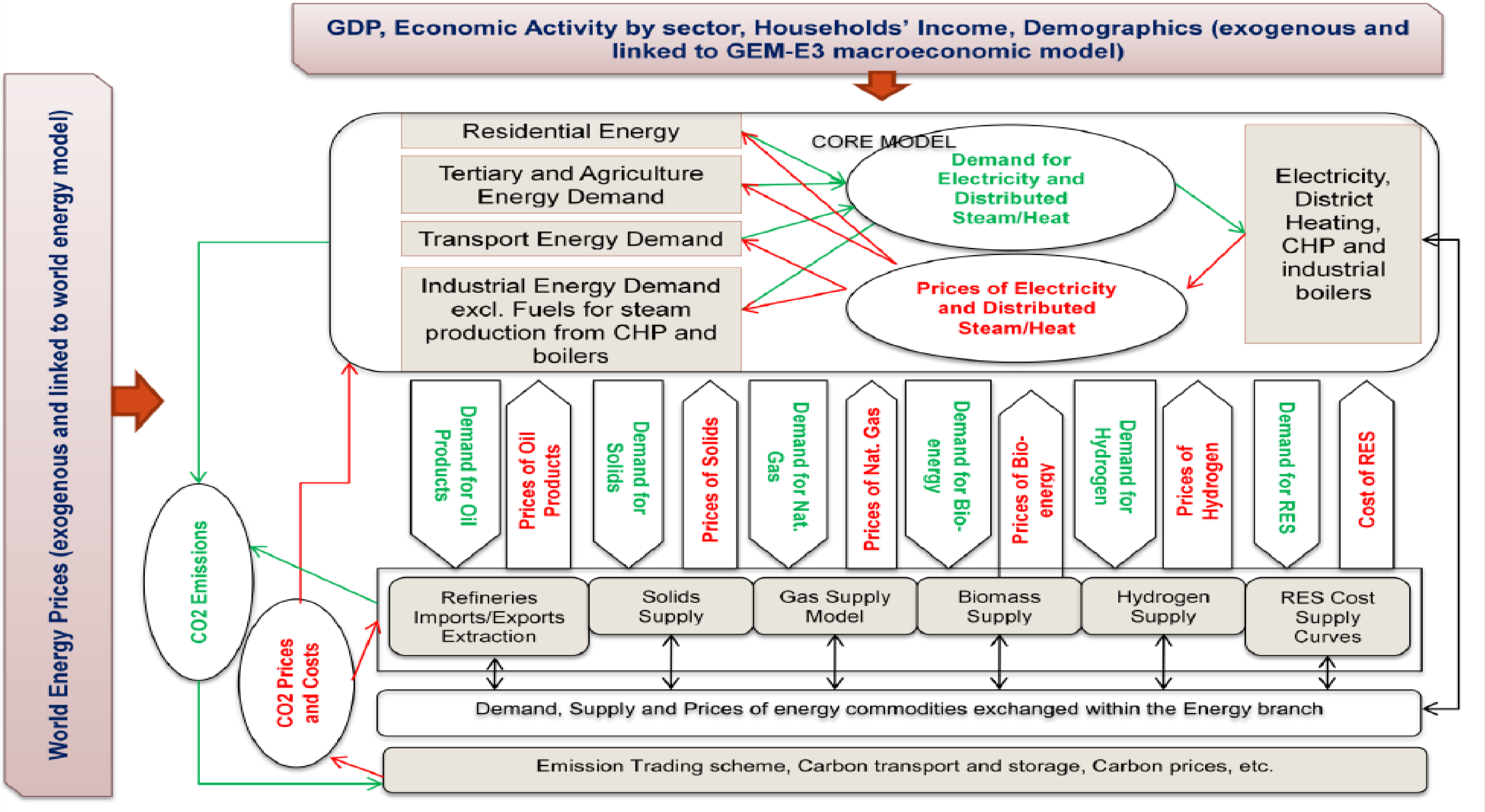
ECONOMIC CIRCUIT IN GEM-E3



OVERVIEW OF THE PRIMES MODEL

- The PRIMES model is organized in sub-models (modules), each one representing the behaviour of a specific (or representative) agent, a demander and/or a supplier of energy. The sub-models are linked together by applying an algorithm which determines equilibrium prices in multiple markets and equilibrium volumes meets balancing and overall (e.g. emission) constraints.
- Mathematically PRIMES solves an EPEC problem (equilibrium problem with equilibrium constraints) which allows prices to be explicitly determined.
- The agents' behaviours are modelled by sector based on microeconomic foundation: each demand module formulates a representative agent maximising benefits (profit, utility, etc.) from energy demand and non-energy inputs (commodities, production factors) subject to prices, budget and other constraints that refer to activity, comfort, equipment, technology, environment or fuel availability; each supply module formulates stylised companies aiming at minimising costs (or maximising profits in model variants focusing on market competition) to meet demand and respect constraints referring to capacities, fuel availability, environment, system reliability, etc.
- PRIMES is a hybrid model in the sense that it captures technology and engineering detail together with micro and macro interactions and dynamics. Because PRIMES follows a structural modelling approach, in contrast with reduced-form modelling, it integrates technology/engineering details and constraints in economic modelling of behaviours. Microeconomic foundation is a distinguishing feature of the PRIMES model and applies to all sectors.
- The model thus combines economics with engineering, ensuring consistency in terms of engineering feasibility, being transparent in terms of system operation and being able to capture features of individual technologies and policies influencing their development.
- Prices influence demand and a closed-loop is modelled between demand and supply simultaneously for all markets. Both demand and supply modules may be subject to system-wide constraints, mirroring overall targets for example on emissions, renewables, efficiency, import dependency, etc. The demand and supply modules are influenced by system-wide constraints and if they are

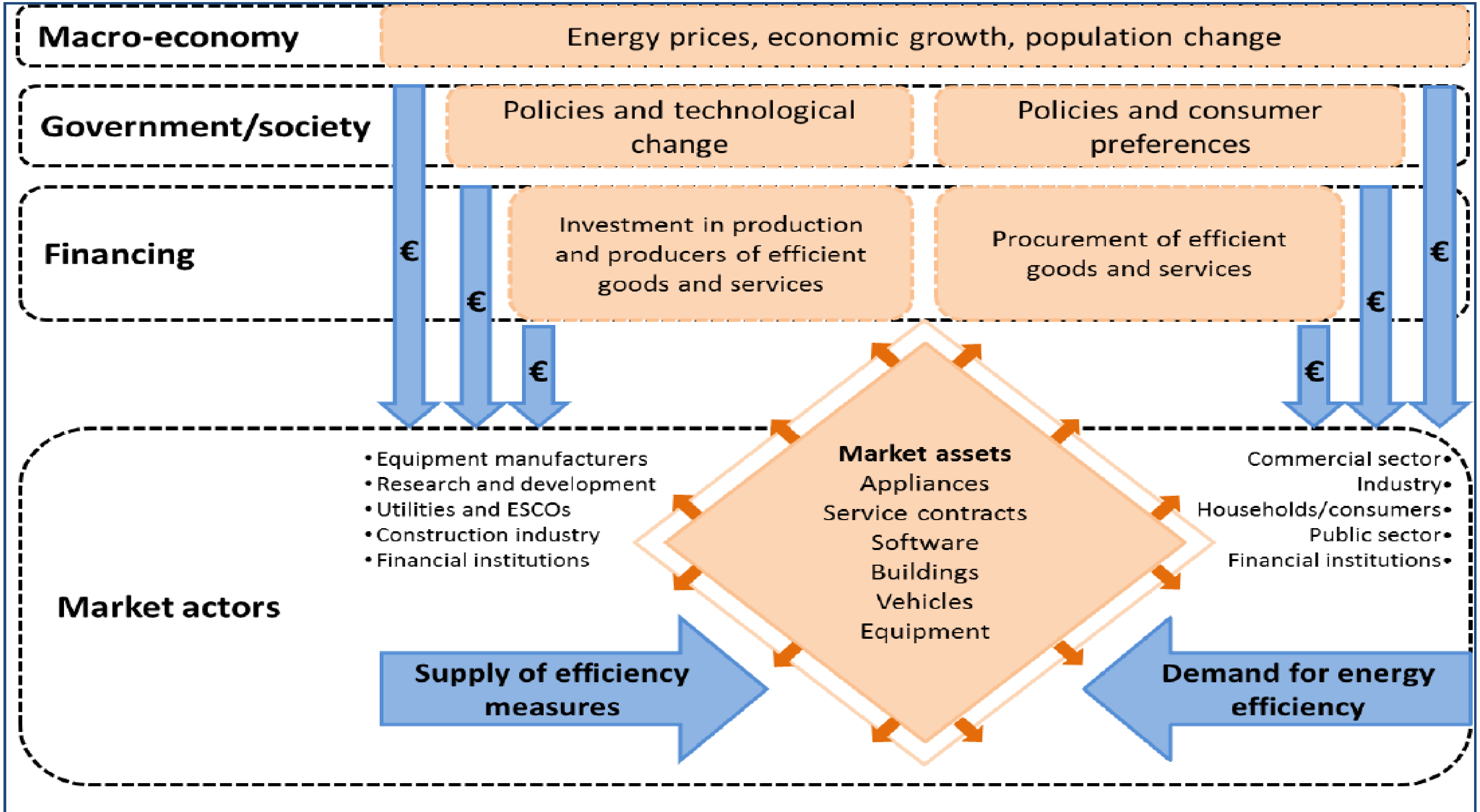
INPUTS TO THE GEM-E3 MODEL



ENERGY EFFICIENCY

- What are energy efficiency activities?
  - EU Energy Efficiency Directive (EED) 2012/27/EU defines energy efficiency as 'the ratio of output of performance, service, goods or energy, to input of energy'
- Energy efficiency improvement : An increase in energy efficiency as a result of technological, behavioural or economic changes.
- Energy savings: An amount of saved energy determined by measuring and/or estimating consumption before and after implementation of an energy efficiency improvement measure, whilst ensuring normalisation for external conditions that affect energy consumption.
- Some Classifications of EE activity:
  - According to Environmental Goods and Services Sector (EGSS), Eurostat - Identifies purchases of goods and services that are deemed to have the specific purpose of providing environmental protection. The EGSS includes reference to a Classification of Resource Management Activities (CReMA). This categorises activities in relation to the management of energy resources disaggregated by a) The production of energy from renewable resources; b) Heat/energy saving and management; and c) Minimization of the use of fossil energy as raw materials.
  - According to the green goods services survey Products and services that improve energy efficiency. Included in this group are energy efficient equipment, appliances, buildings and vehicles, as well as products and services that improve the energy efficiency of buildings and the efficiency of energy storage and distribution, such as Smart Grid technologies.

THE MARKET FOR ENERGY EFFICIENCY



Note: ESCO = energy service company

RESULTS PROVIDED BY GEM-E3

- Dynamic annual projections in volume, value and deflators of national accounts by country.
- Full Input-Output tables for each country/region identified in the model.
- Distribution of income and transfers in the form of a social accounting matrix by country.
- Employment by economic activity and skill and unemployment rate by country.
- Capital and investment by country and sector.
- Greenhouse gasses, atmospheric emissions, pollution abatement capital, purchase of pollution permits and damages.
- Consumption matrix by product and investment matrix by ownership branch.
- Public finance, tax incidence and revenues by country.
- Full bilateral trade matrices.

EU28 GDP IN THE ENERGY EFFICIENCY POLICY SCENARIOS (SENSITIVITY)

(% change from reference)	2030	2040	2050	Cumulative (2015-2050)
Ref. scenario (€2010bn)	16,766	19,277	22,129	6,15,622
EE25_v2	0.01	-0.17	-0.14	-0.09
EE28_v2	0.1	-0.23	-0.25	-0.12
EE30_v2	0.34	-0.19	-0.14	-0.06
EE32_v2	0.38	-0.21	-0.13	-0.08
EE35_v2	0.32	-0.18	-0.11	-0.09
EE40_v2	0.28	-0.32	0	-0.11

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EU28 EMPLOYMENT IN THE ENERGY EFFICIENCY POLICY SCENARIOS (SENSITIVITY)

(% change from reference)	2030	2040	2050	Cumulative (2015-2050)
Ref. scenario, millions	218.76	211.24	204.08	7,514.34
EE25_v2	0.47	0.22	0.35	0.18
EE28_v2	1.13	0.32	0.47	0.39
EE30_v2	1.88	0.61	0.82	0.64
EE32_v2	1.99	0.68	0.94	0.7
EE35_v2	2.56	0.94	1.27	0.96
EE40_v2	2.85	1.1	1.62	1.09