



Regional sustainable energy action planning - CoM

Marcos António Nogueira
marcos.nogueira@irradiare.com
IrRADIARE, Lisbon - Brussels

Presentation structure



The presentation synopsis

On the presentation the following topics are illustrated:

Medium term energy planning: opportunities and requirements;

Methodology for the Energy Consumption Inventory;

Approach for medium-range energy demand assessment;

Draft preliminary target measures for efficiency-based energy saving;

Example of energy consumption reduction targets compliance;

Suggested model for regional public/private implementation platform;

Financial model options for sustainable energy planning implementation;

Proposed regional energy management platform.



Energy consumption targets for 2014 - 2020

Part 1

Presentation structure



Part 1



European Covenant of Mayors

Target: 20% CO₂ reduction by 2020

Adherents: +3000 European municipalities

Main tool: integrated planning and
monitoring



Medium term goals

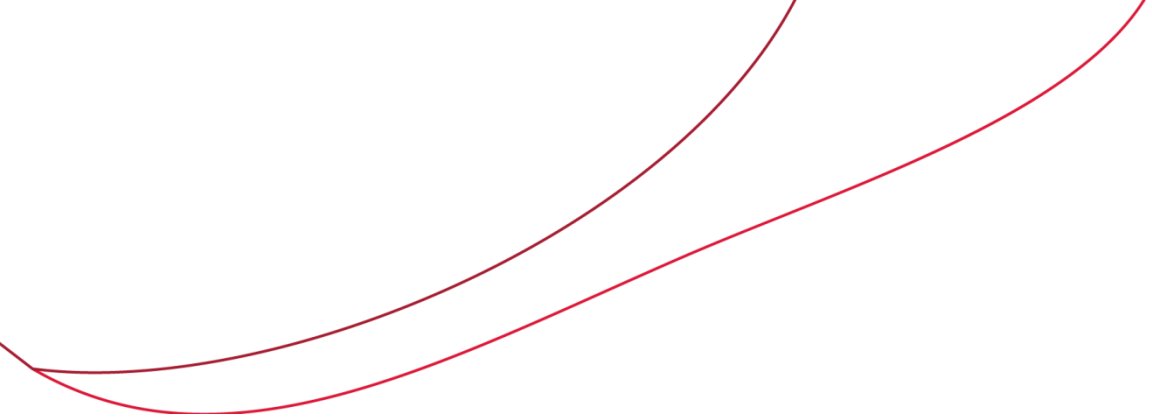
Combining energy sustainability, regional
competitiveness and innovation
attractiveness integrated targets planning

Proposed strategy

Multisectoral integration
Budgetary soundness
Investment attraction
Local commitment
Cost-effectiveness
Symbiotic development

Proposed instruments

Inventory
Action planning
Predictive analysis
Partnership
Monitoring
Innovation platform



Energy balance and consumption inventory Małopolska's example

Part 2

Presentation structure



Part 2

The energy balance and consumption inventory

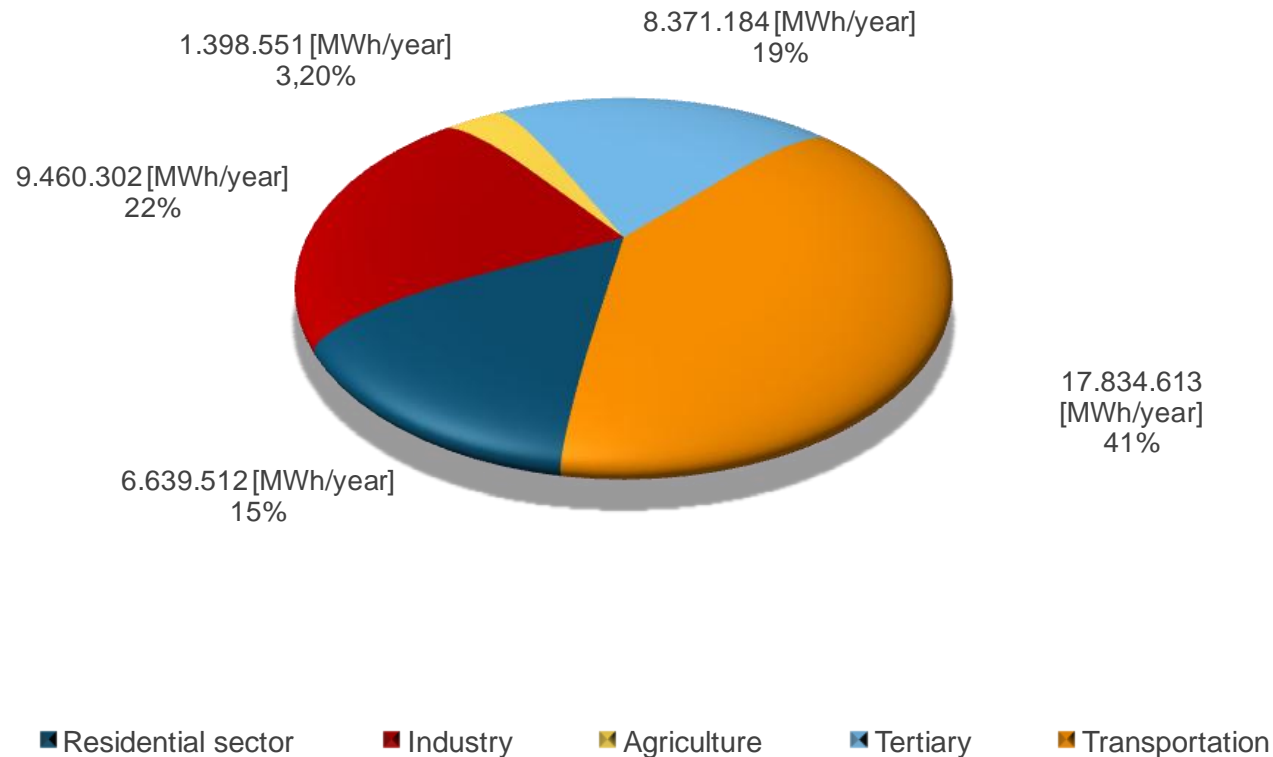
Statistic data and knowledge-based estimation was used.

More detailed data and analysis is indispensable for project level analysis of benefits.

The same applies if municipal adhesions to the Covenant of Mayors may use the proposed methodology and framework is considered.

Energy Demand Inventory Consumption per sector 2010

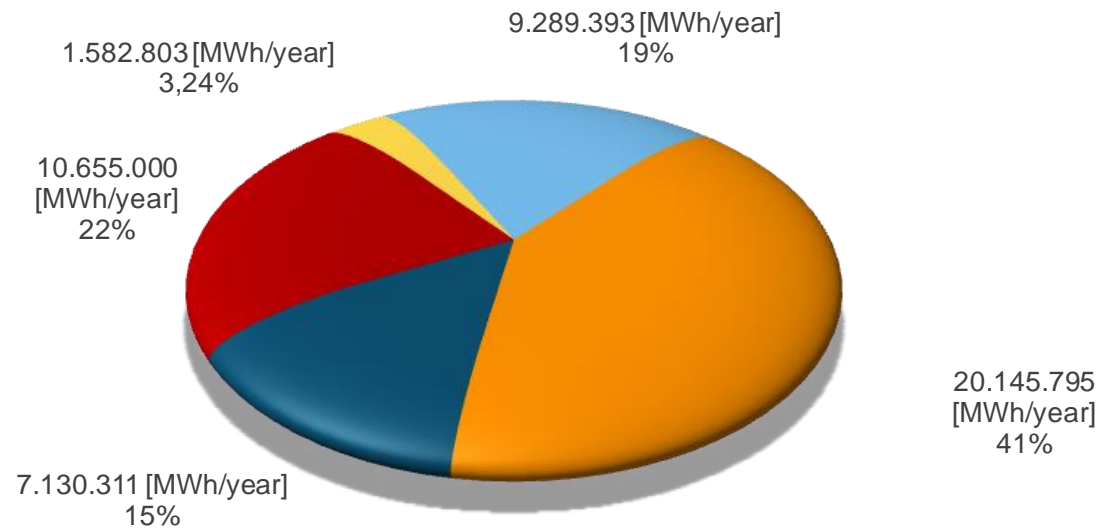
Total final energy consumption by sector (2010)



Estimated energy demand profile for
main activity sectors for Małopolska

Energy Demand Inventory Consumption per sector 2020

Total final energy consumption by sector (2020)

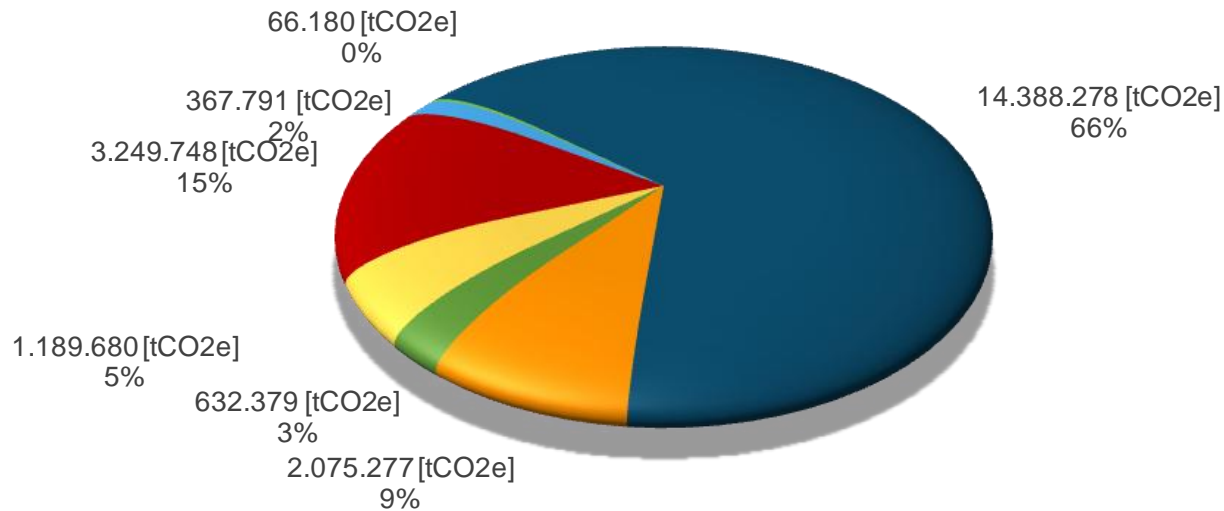


■ Residential sector ■ Industry ■ Agriculture ■ Tertiary ■ Transportation

**Estimated energy demand profile for
main activity sectors for Małopolska**

Energy Demand Inventory CO₂ emissions per fuel 2010

CO₂ emissions by final energy consumption by fuel (2010)

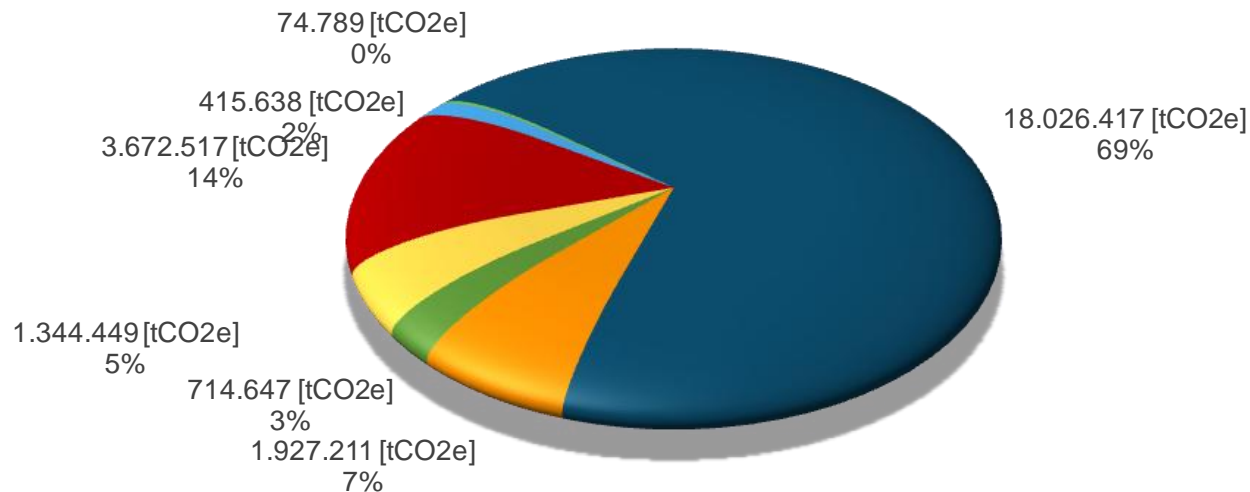


- Electricity
- Natural Gas
- LPG
- Gasoline
- Transport diesel
- Other gasoil
- Other fuels

**Estimated fuel originated CO₂ emissions
for main activity sectors for Małopolska**

Energy Demand Inventory CO₂ emissions per fuel 2020

CO₂ emissions by final energy consumption by fuel (2020)



- Electricity
- Natural Gas
- LPG
- Gasoline
- Transport diesel
- Other gasoil
- Other fuels

**Estimated fuel originated CO₂ emissions
for main activity sectors for Małopolska**



Sustainable energy action planning

Part 3

Presentation structure



Part 3

The sustainable energy action plan

Business-as-usual scenario, considered for sustainable energy measures' impacts modelling, is presented.

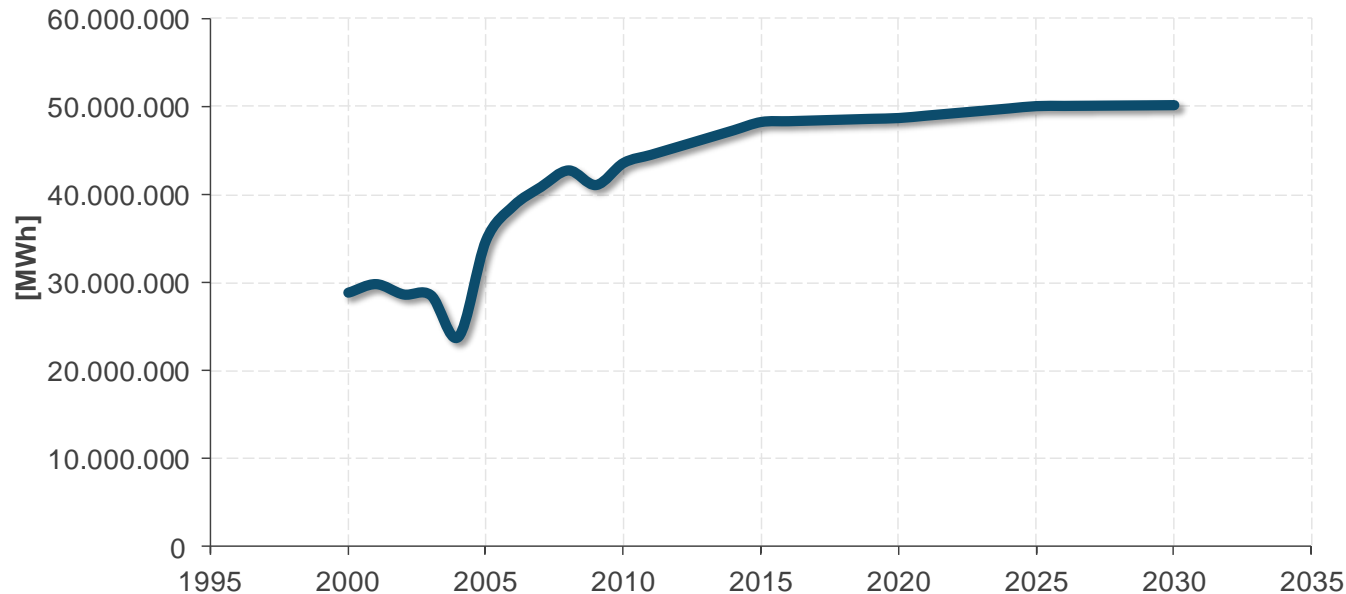
The model-based methodology used to assess measures' cost-benefit and expected contribution to the overall energy sustainability targets is illustrated.

Statistic data and knowledge-based estimation was used.

Dynamic business as usual scenario

Final energy consumption

Final energy consumption



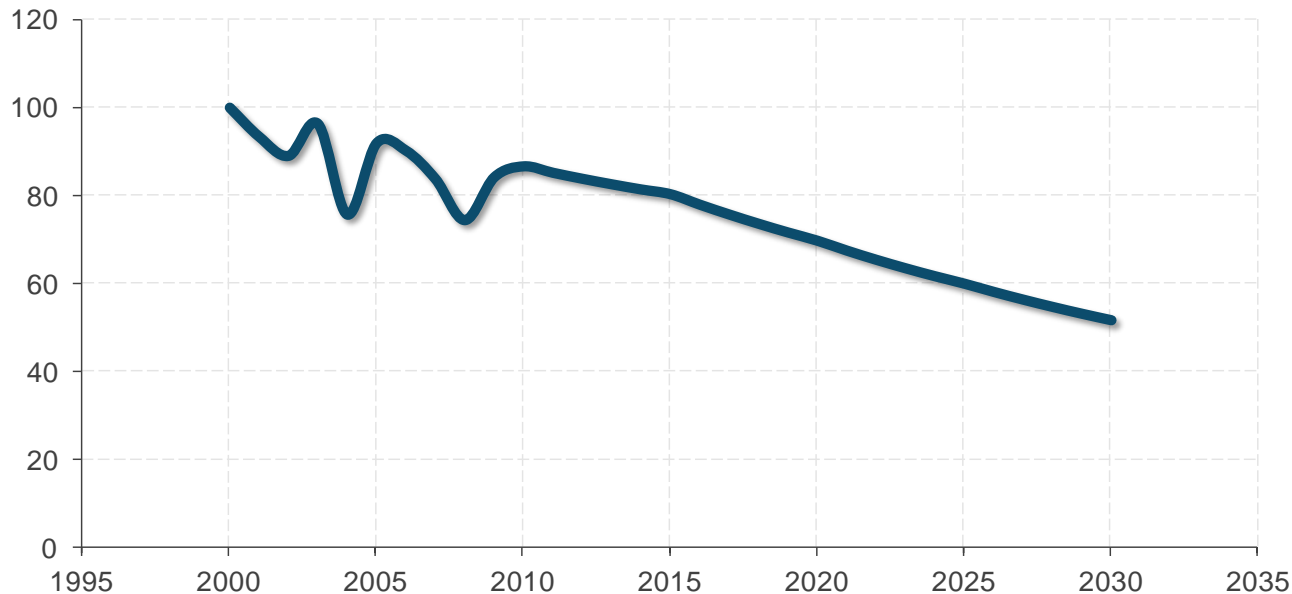
Final Energy Consumption [MWh/year]

Małopolska's example.
Sustainable energy measures' impacts modelling

Dynamic business as usual scenario

Overall energy intensity

Local energy intensity (2000 = 100)



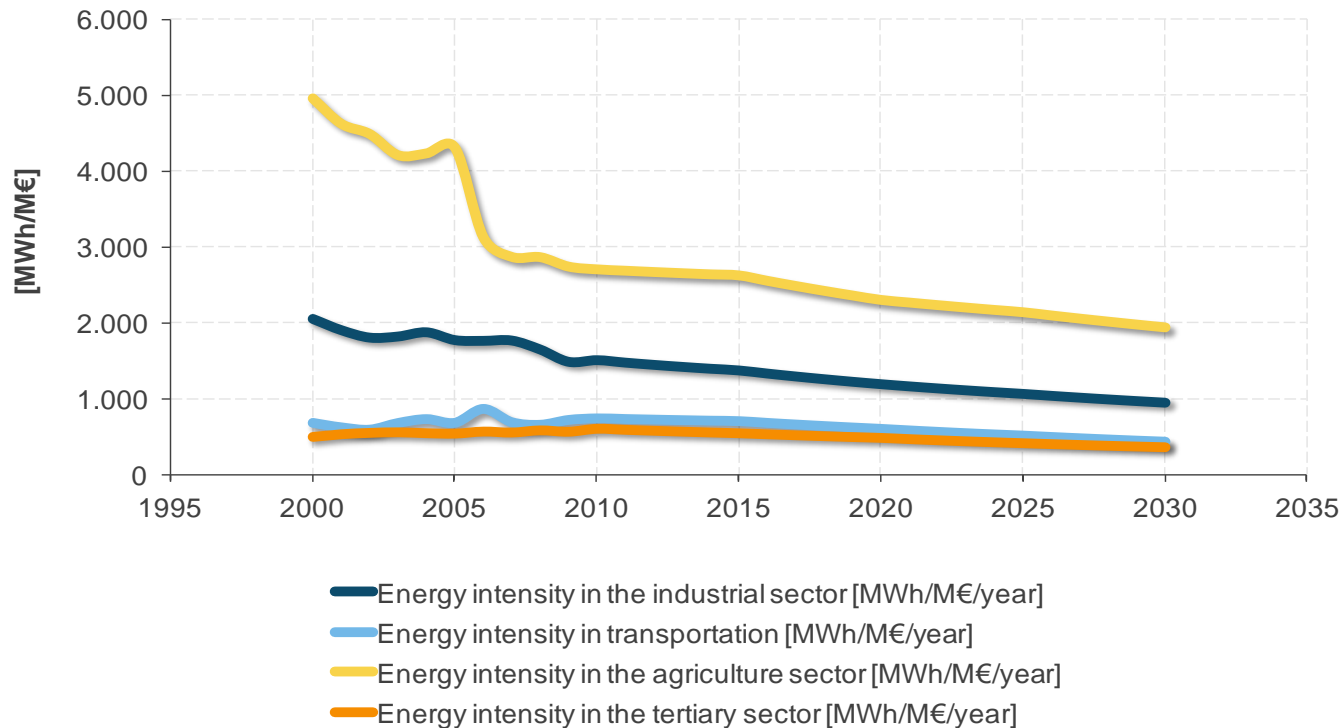
— Local energy intensity (2000 = 100)

Małopolska's example.
Sustainable energy measures' impacts modelling

Dynamic business as usual scenario

Energy intensity per sector

Energy intensity by activity sector

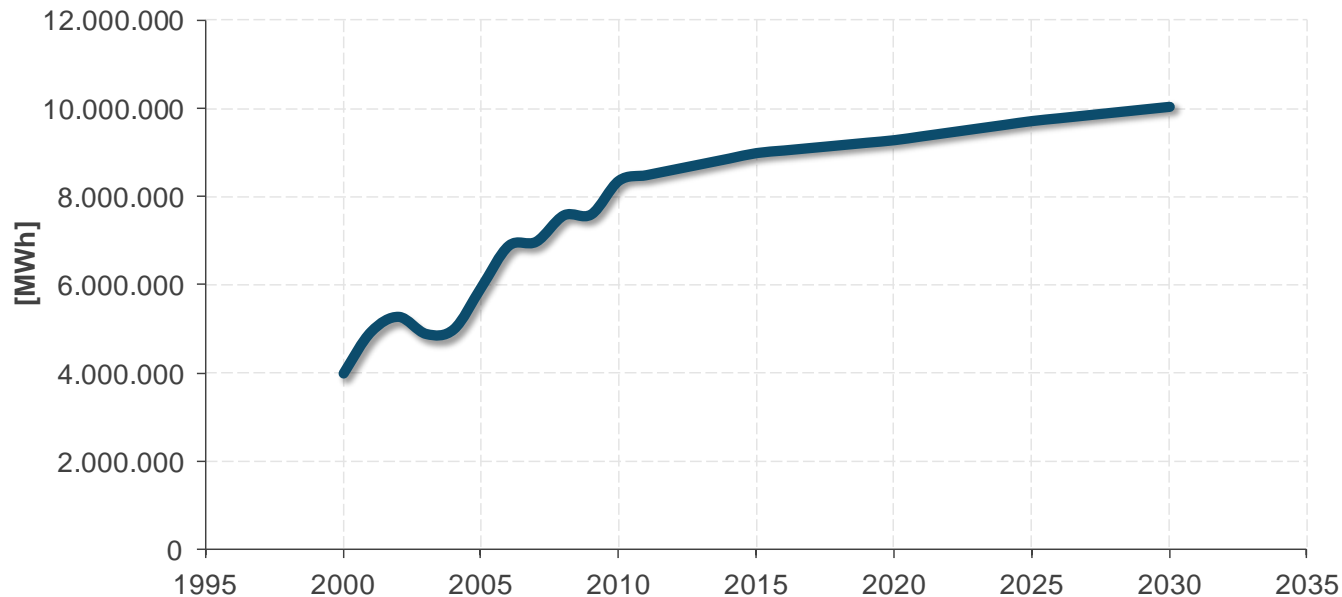


Małopolska's example.
Sustainable energy measures' impacts modelling

Dynamic business as usual scenario

Total energy intensity in terciary

Total final energy consumption in the tertiary sector



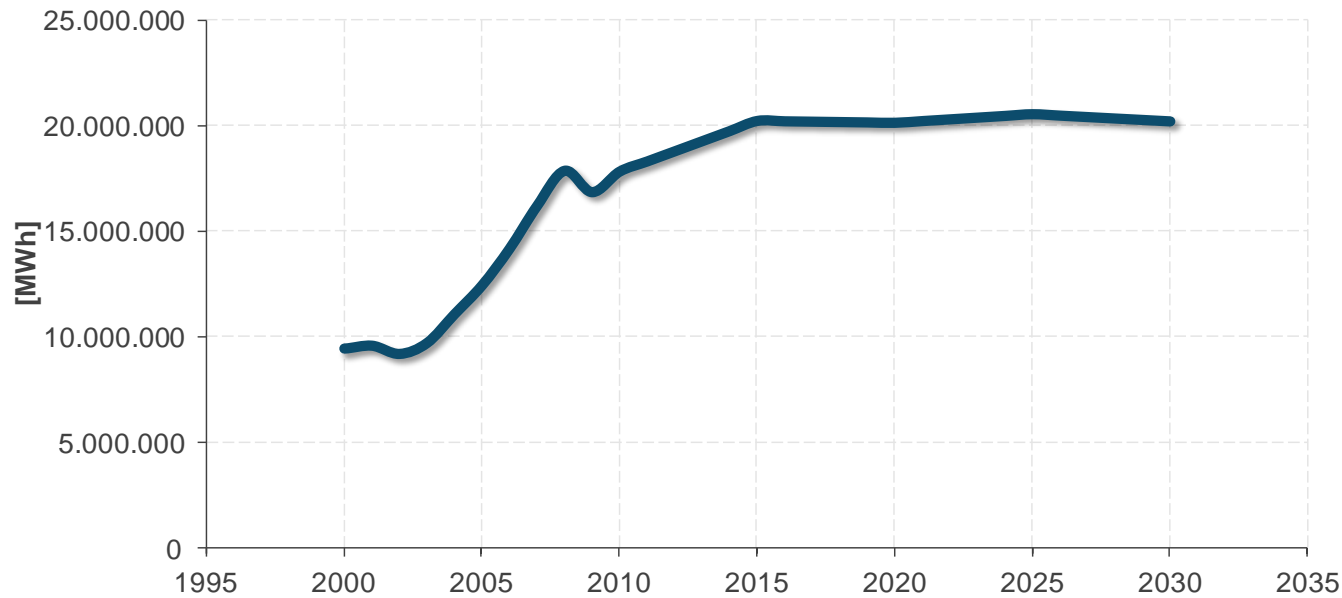
— Total energy consumption in the tertiary sector [MWh/year]

Małopolska's example.
Sustainable energy measures' impacts modelling

Dynamic business as usual scenario

Energy consumption in transportation

Total final energy consumption in transportation

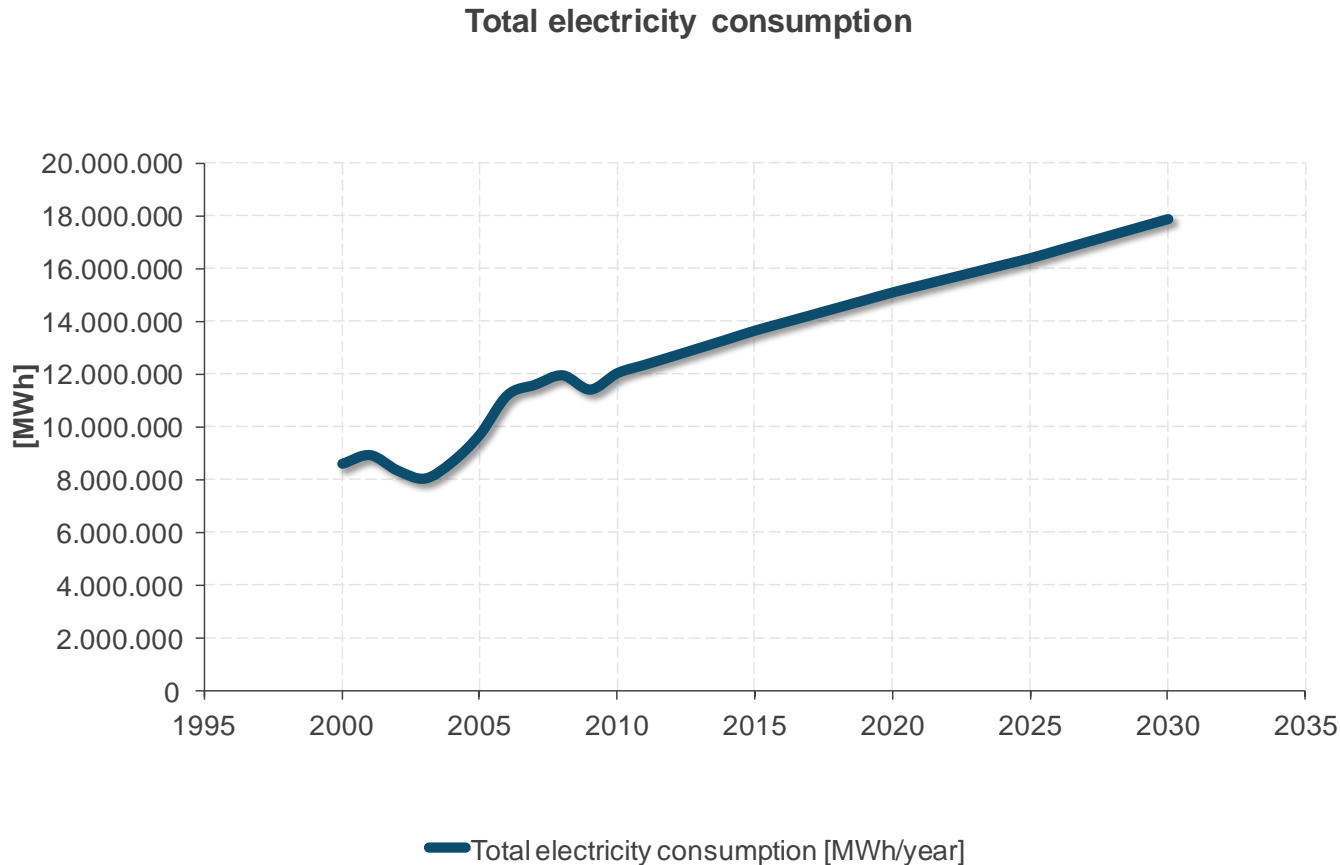


— Total energy consumption in transportation [MWh/year]

Małopolska's example.
Sustainable energy measures' impacts modelling

Dynamic business as usual scenario

Total power consumption

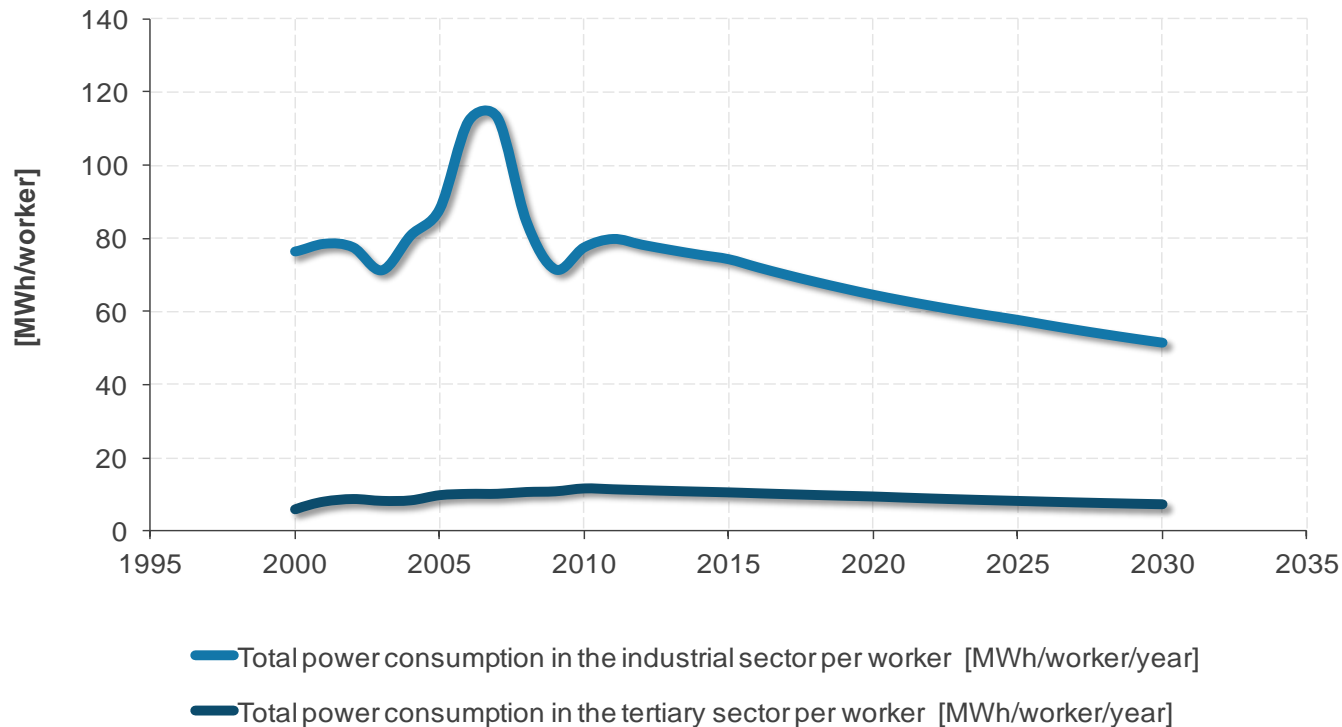


Małopolska's example.
Sustainable energy measures' impacts modelling

Dynamic business as usual scenario

Energy consumption per work

Total energy consumption per worker in the industrial and tertiary sectors



Małopolska's example.

Sustainable energy measures' impacts modelling

Example of energy saving targets and scenarios

DRAFTED SUSTAINABLE ENERGY PLANNING MEASURES IMPACT	REDUCTION
Energy consumption	18,4%
CO ₂ emissions	31,1%
Energy bill reduction (at 2010 prices)	24,2%

DRAFTED SCENARIOS	YEAR	ENERGY CONSUMPTION [GWh]	CO ₂ EMISSIONS [ktCO ₂]	OVERALL ENERGY BILL [M PLN ₂₀₁₁]
Base scenario without measures	2010	42,844	19,804	16,636
Medium-term scenario without measures	2020	48,231	22,785	18,635
Medium-term scenario with measures	2020	39,379	15,699	14,122

Business as usual scenario compared to possible regional framework targets

Example of integrated measures' contribution to energy saving targets

ENERGY SUSTAINABILITY MEASURES	ENERGY SAVINGS (%)
Efficient lighting	0,97
Efficient street lighting	0,44
Tertiary buildings certification and labelling	0,44
Efficient vehicles, parts and fleets	5,90
Electric vehicles	1,78
Transport network improvements	2,11
Equipment modernisation and plants retrofitting	0,15
Active monitoring (direct effect)	0,11
LED and innovative lighting systems	0,58
Solar energy	0,17
Heat pumps	0,05
Biomass heating and hot water	0,05
Efficient boilers	0,05
Biodiesel	0,91
Urban rehabilitation and accessibilities improvement	0,04
Water management	0,10
→ Waste management	0,11

Modelled measures' contribution to a regionally projectable energy saving target

Example of integrated measures' contribution to energy saving targets

ENERGY SUSTAINABILITY MEASURES	ENERGY SAVINGS (%)
Urban supply fleets	0,21
Office equipment renovation and retrofitting	0,33
Natural gas consumption expansion	0,01
Domestic equipment renewal	0,75
Public awareness, education, awards	0,19
Energy management in housing common facilities	0,04
Voluntary carbon reduction programmes	0,01
Cycling and walking	1,92
Industry and business mobility efficiency planning	0,53
Large events mobility optimisation	0,13
Public procurement (green procurement)	0,01
Urban planning	0,16
Improvement of support mechanism for green industries	0,01
Professional performance improvement	0,02
TOTAL	18,27

Modelled measures' contribution to a regionally projectable energy saving target



Energy and environment integrated vision

Part 4

Presentation structure



Part 4

The energy sustainability and urban environment integrated vision

Symbiotic development of (energy) sustainability and innovation is a classic example of policies integration.

Among the “integratable” environment related, the following predominate:

Air quality;

Urban waste management;

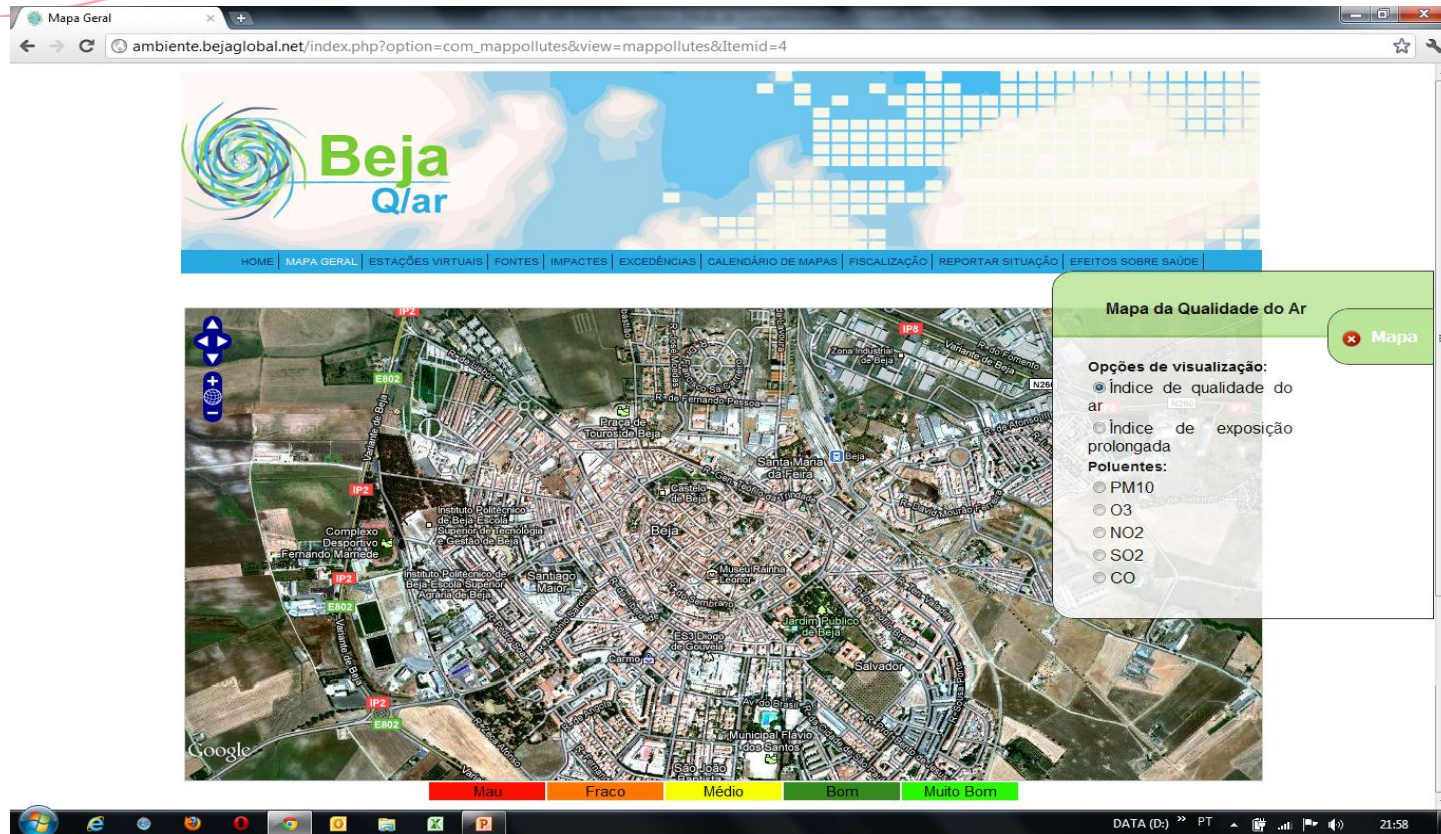
Water supply and waste water treatment;

Public realm management;

Biomass and biowastes management and upgrading;

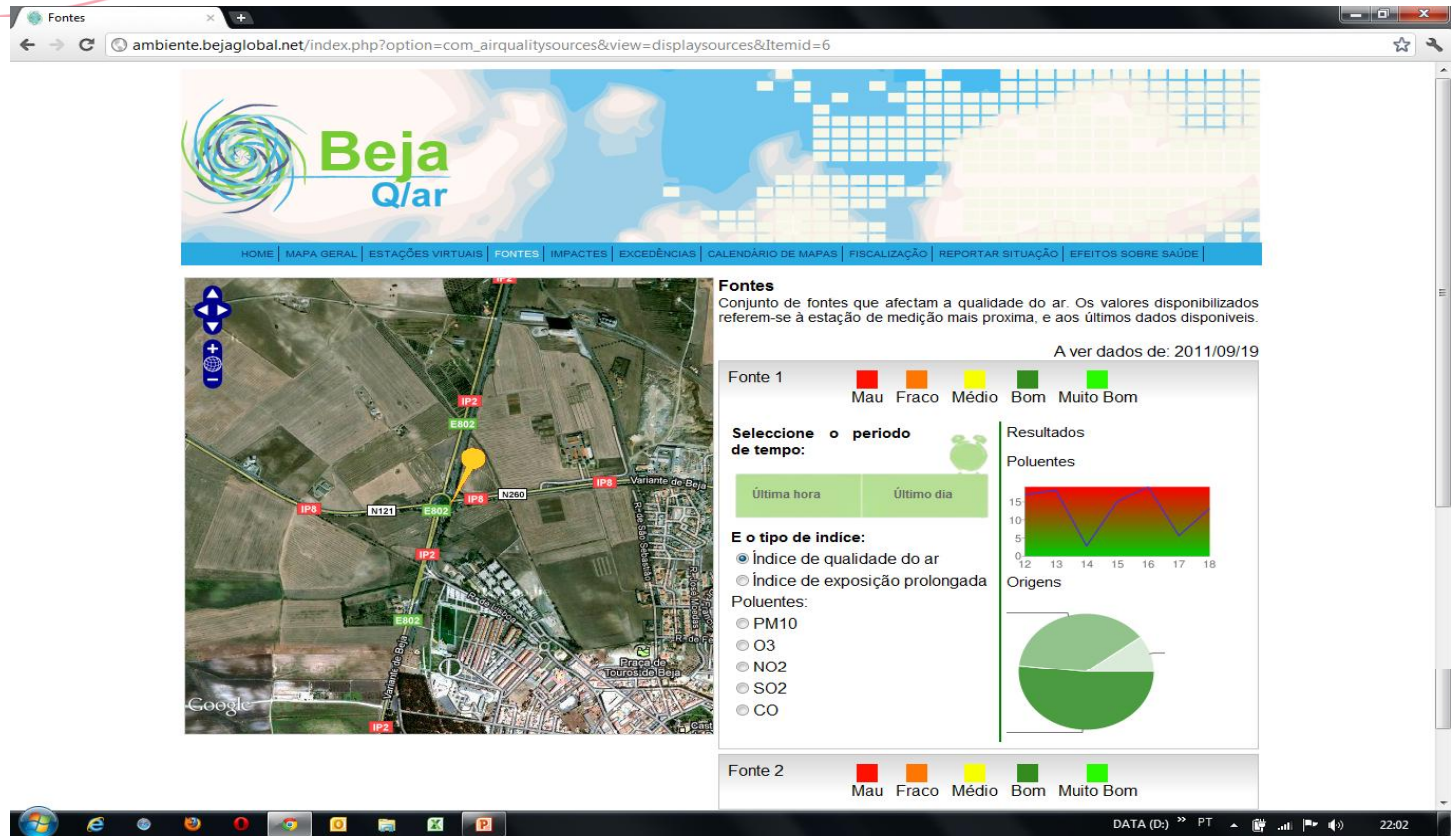
Urban environment and quality of life.

Coordinated monitoring of energy and environment data



Illustrated in the figure: on-line data on electric mobility impacts on air quality

Coordinated monitoring of energy and environment data



Illustrated in the figure: on-line data on electric mobility impacts on air quality



Energy and competitiveness integrated vision

Part 5

Presentation structure



Part 5

Sustainability and competitiveness integrated vision

Considered innovation paradigm assesses six dynamic innovation factors and the corresponding key-indicators is proposed:

knowledge → Indicator: research and development;

qualification → Indicator: skills training;

technology → Indicator: transfer;

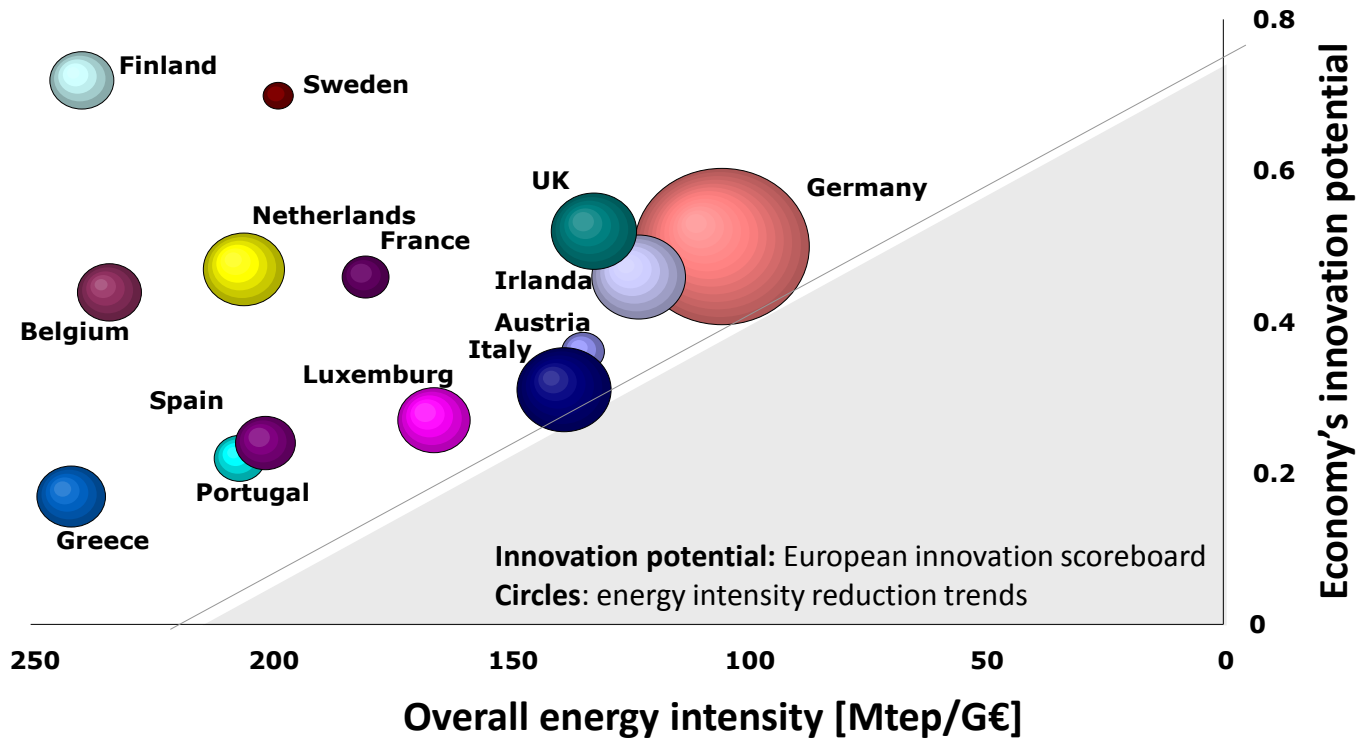
mobility → Indicator: cross-sectoral and trans-regional;

investment → Indicator: financial mechanisms, resources;

initiative → Indicator: entrepreneurship, business expansion.

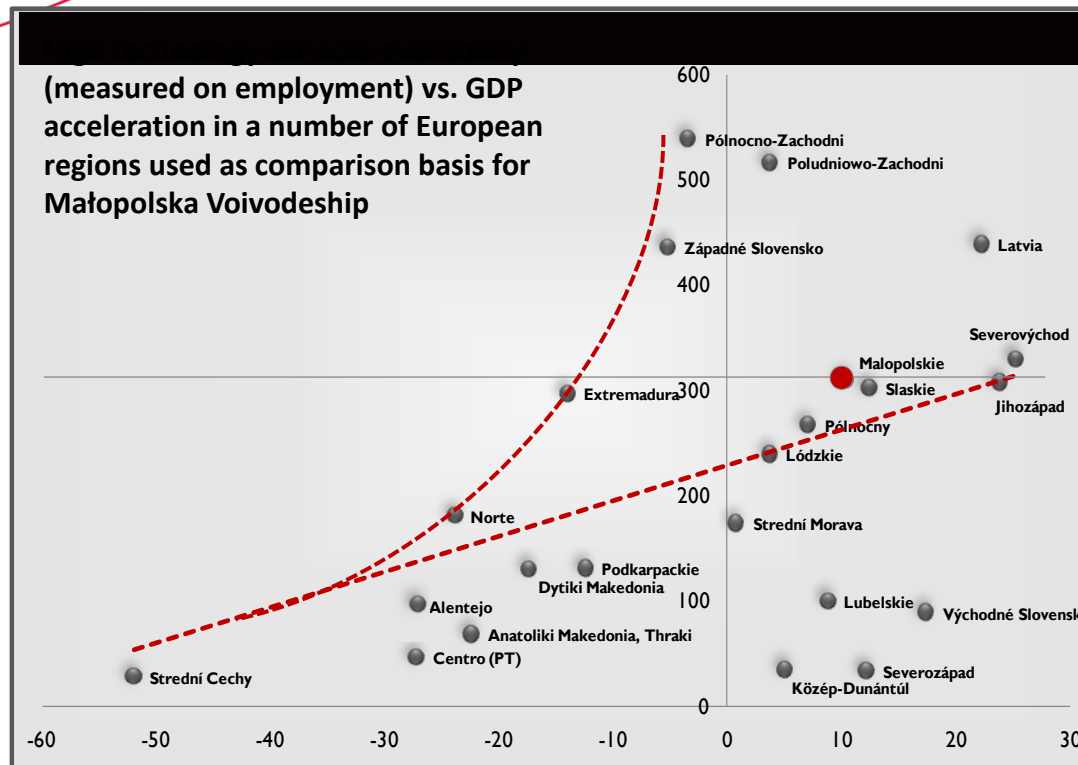
By favouring these factors energy sustainability measures are expected to operate as an innovation driver for competitiveness and growth.

Integrating energy and innovation strategies is a key for success and growth



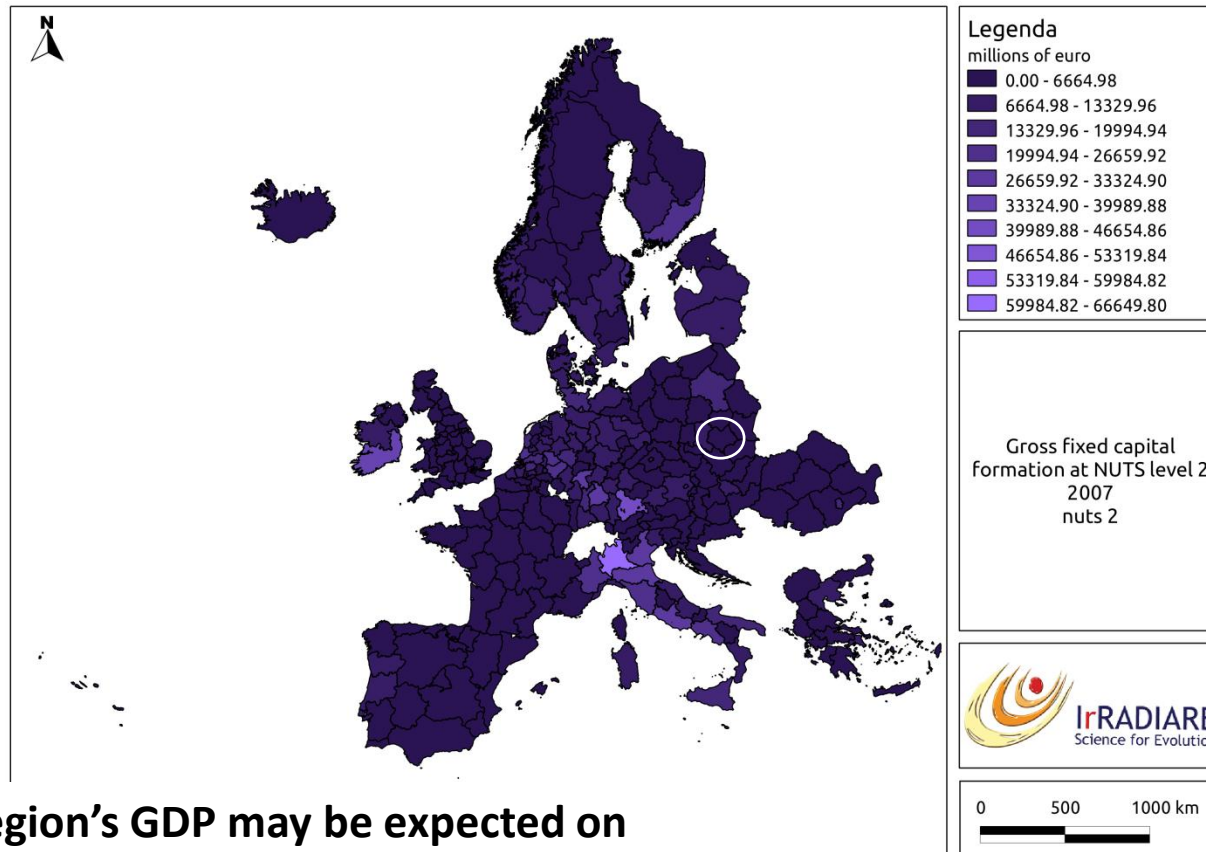
Evidence on the need of conducting sustainability and innovation twofold policies to succeed energy targets is well apparent

Integrating energy and innovation strategies is a key for success and growth



High-tech services, often procured in implementing advanced energy saving measures, such as smartgrids, are vital to secure economic growth

Comparing Małopolska's with other European regions key-data - GFCF



Impacts in region's GDP may be expected on the long-term from implementing energy sustainability measures such that a 20% reduction magnitude may be attained



Regional innovation platform

Part 6

Presentation structure



Part 6

The regional innovation platform

A Web platform may support SEAP implementation, communication among involved stakeholders.

In order to simplify documenting on the running projects, maintaining an on-line observatory as part of the supporting Web platform is highly recommended.

Monitoring and evaluating results is important for following-up on the main achievements.

The same Web platform may be also of use to support the awareness rising.

Muemsys today's banner!

Budynki publiczne

muemsys.irradiare.com/index.php/pl/

Małopolski System zarządzania energią

Jesteś tutaj: Home

opis budynku | ulica | współrzędne GPS | akcje

Music hall	Rua x	50.06736 , 19.94785		
City council head quarters - city hall	Avenida 1	50.05966 , 19.93739		
Regional library	Avenida y	50.0637 , 19.94409		

nowe budynki

19-97001, 50-06092

DATA (D:) >> PT 18:09

<http://muemsys.irradiare.com>



Funding and financing mechanisms

Part 7

Presentation structure



Part 7

Funding and financing mechanisms

On the basis of specific measures market profitability, public budget impacts and internalized social, economic and environmental benefits, the following funding sources may be combined:

Structural funding (ERDF)

Private investment from energy service companies (ESCO and EPC)

Direct private (entrepreneurial) investment in tertiary sector

Direct industrial investment

Private (and CAP funded) investment in agriculture

Private domestic investment in housing

Private investment in transport sector

Municipal investment in public services and urban management

Municipal investment in fleets renewal

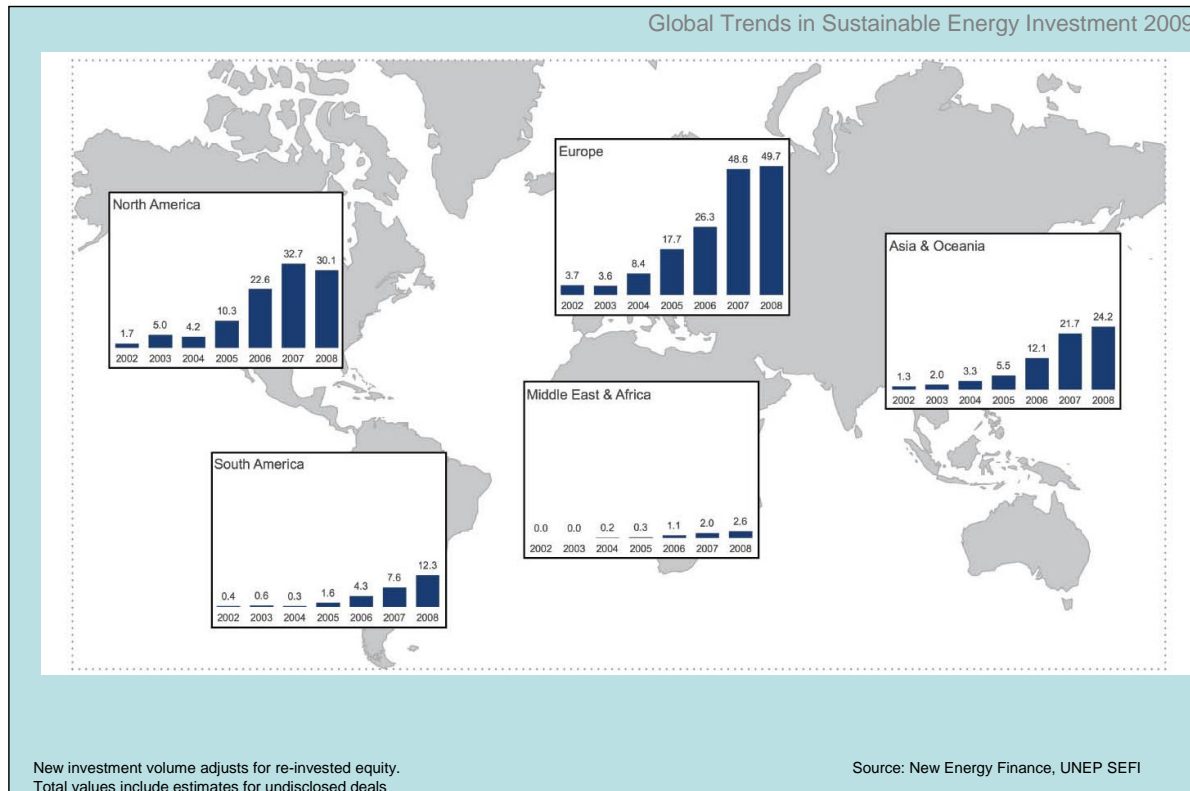
Governmental programmes

Private or public funding provision sources

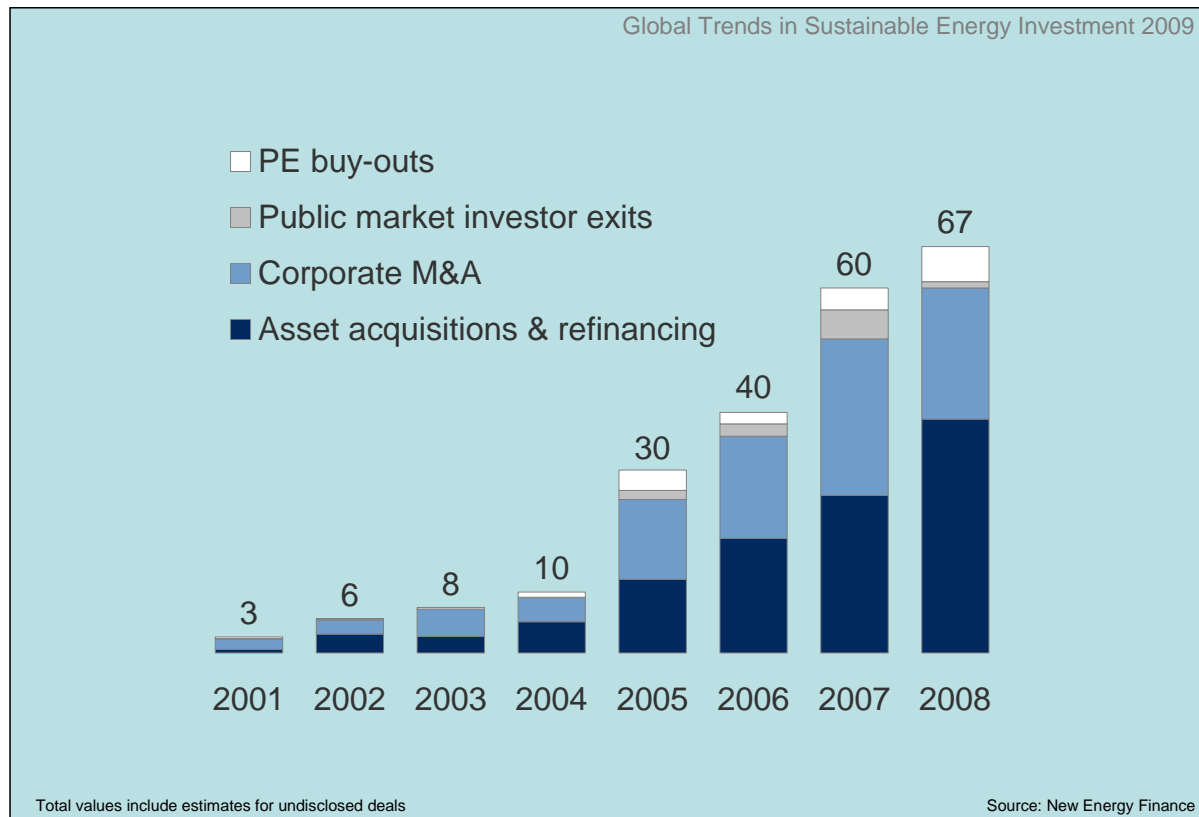
FUNDING AND INVESTMENT SOURCES	INVESTMENT 2012-2020 [M PLN ₂₀₁₁]
Structural funding (ERDF)	1,393
Private investment from energy service companies (ESCO and EPC)	32
Direct private (entrepreneurial) investment in tertiary sector	737
Direct industrial investment	127
Private (and CAP funded) investment in agriculture	0.24
Private domestic investment in housing	2,405
Private investment in transport sector	7,891
Municipal investment in public services and urban management	3,784
Municipal investment in fleets renewal	71
Governmental programmes	4,596
Private investment in renewable power generation	7,095
TOTAL	21,036

Modelled measures' related long term investment focused on 2020 targets

European investment panorama in sustainable energy solutions



European investment panorama in sustainable energy solutions





Programme management and implementation

Part 8

Presentation structure



Part 8

Programme management and implementation

Energy sustainability planning and inventory efforts may be effectively integrated with other sectors:

urban environment, rural development, science, innovation, competitiveness, attractiveness, employment and, more generically, sustainability are adjacent sectors to energy.

Thus, integrated planning instruments – in which energy demand and supply foresight is assessed together with causes and impacts on other sectors – allow converging visions, resources and goodwill.

Public buildings

The screenshot shows the website interface for MUEMSY (Municipal Energy Management System). At the top, there is a navigation menu with icons for various services: Public buildings, Water supply and wastewater treatment, Urban solid waste collection and treatment, Public lighting, Municipal fleets, Other consumers, Reports, and Parameterization. A 'Register' button is located at the bottom of the menu.

The main content area features a map of Krakow, Poland, with a red location pin. Below the map is a table listing building designations, streets, GPS coordinates, and actions.

Building designation	Street	GPS coordinates	Actions
Music hall	Rua x	50.06736 , 19.94785	
City council head quarters - city hall	Avenida 1	50.05966 , 19.93739	
Regional library	Avenida y	50.0637 , 19.94409	
New building			

<http://muemtsy.irradiare.com>

Water and sanitation

MUEMSY
Municipal Energy Management System

IrRADIARE
Science for Evolution

You are here: Home

- Public buildings
- Water supply and wastewater treatment
- Urban solid waste collection and treatment
- Public lighting
- Municipal fleets
- Other consumers
- Reports
- Parameterization
- Register

Map showing locations: Radków, Łęka Siedlecka, Rudno, Smigno, Lisia Góra, Skalka, Siedlec, Łęczec, Bobrowniki Wielkie, Bobrowniki Małe, Dobczyce, Partyn, Zagrody, Nivka, Rudka, Zaczarnie, Brzozówka.

Name	GPS coordinates	Type	Actions
Water pumping station	50.06736 , 20.94785	Captação superficial	
New water supply and treatment system			

<http://muemsys.irradiare.com>

Street lighting

The screenshot shows the website interface for muemtsy.irradiare.com. At the top, the title "MUEMSY" is displayed in large green letters, with "Municipal Energy Management System" underneath. To the right, there is a logo for "IrRADIARE Science for Evolution" and a graphic of a globe with various city-related icons and a QR code. Below the header, there is a navigation menu with icons for different services: Public buildings, Water supply and wastewater treatment, Urban solid waste collection and treatment, Public lighting, Municipal fleets, Other consumers, Reports, and Parameterization. A "Register" button is also present. The main content area features a map of Kraków with a location marker. Below the map is a table with the following data:

Name	GPS coordinates		Flux regulator	Actions
Street light grid 1	50.0573	19.9478	No	
Street light grid 11	50.0656	19.8985	No	
Street light grid 54	50.0724	19.9566	No	
Street light grid 62	50.0748	19.8872	Yes	

Below the table, there is a link for "Transformation station".

<http://muemtsy.irradiare.com>

Fleets

Municipal Energy Management System

IrRADIARE
Science for Evolution

You are here: Home

Type	Car plate	Brand	Model	Color	Actions
Bus (upto 20 seats)	23-DE-52	Marca ou Domínio	Corolla	Cinza	
Bus (more than 20 seats)	aa-11-22				
Waste management	aa-55-66				
Car	27-JT-36	Audi	A6		
Car	qq-77-88				
Construction machinery	80-GC-61				
Light duty vehicle	39-DF-37	Citroen	Jumper		
Motorcycle	52-FN-49	Yamaha	DT 50		
Trailer (301 kg - 2500 kg)	ww-88-99				

New vehicle

Register

<http://muemsy.irradiare.com>

Other energy consumptions

The screenshot shows a web browser window with the URL muemtsy.irradiare.com/index.php/en/outros-consumidores. The page features the MUEMSY logo (Municipal Energy Management System) and the IrRADIARE logo (Science for Evolution). A navigation menu on the left includes: Public buildings, Water supply and wastewater treatment, Urban solid waste collection and treatment, Public lighting, Municipal fleets, Other consumers, Reports, Parameterization, and Register. The main content area displays a table of energy consumption data for Vila Nova de Gaia.

You are here: Home

Consumer	Municipality	Start date	End date	Consumption value	Vector	Unit	Actions
Radio	Vila Nova de Gaia	2012-07-12	2012-07-12	50	Eletricidade	kWh	
Grass cutter	Vila Nova de Gaia	2012-06-04	2012-06-04	123	Eólica	kWh	

[New other consumer](#)

<http://muemtsy.irradiare.com>

Dynamic reporting

The screenshot displays the Muemsys web application interface. At the top, the browser address bar shows the URL muemsys.irradiare.com/index.php/en/relatorios. The main header features the 'MUEMSY' logo in green, with 'Municipal Energy Management System' below it. To the right is the 'IrRADIARE Science for Evolution' logo and a QR code. A navigation menu on the left lists various categories: Public buildings, Water supply and wastewater treatment, Urban solid waste collection and treatment, Public lighting, Municipal fleets, Other consumers, Reports, Parameterization, and Register. The main content area shows a breadcrumb trail 'You are here: Home' and three dropdown menus for location, fuel type, and power type. The 'Building' tab is selected, displaying a horizontal bar chart for energy consumption. The chart shows three bars: 'Regional library' (approx. 2,000), 'City council head quarters - city hall' (approx. 42,000), and 'Music hall' (approx. 12,000). The x-axis represents energy consumption from 0 to 70,000.

MUEMSY
Municipal Energy Management System

IrRADIARE
Science for Evolution

You are here: Home

Public buildings
Water supply and wastewater treatment
Urban solid waste collection and treatment
Public lighting
Municipal fleets
Other consumers
Reports
Parameterization
Register

Start date: 2011-09-11
End date: 2012-09-11

Building | Circuits | Vehicle | Consumers | Waste | Transformation station | Water supply system

Building	Consumption (Estimated)
Regional library	2,000
City council head quarters - city hall	42,000
Music hall	12,000

<http://muemsys.irradiare.com>

Model and platform parameterization

The screenshot shows a web browser window with the URL muemtsy.irradiare.com/index.php/en/parametrizacao. The page features the MUEMSY logo (Municipal Energy Management System) and the IrRADIARE logo (Science for Evolution). A navigation menu on the left includes: Public buildings, Water supply and wastewater treatment, Urban solid waste collection and treatment, Public lighting, Municipal fleets, Other consumers, Reports, Parameterization, and Register. The main content area displays a list of parameterization options: Municipalities, Road types, IP levels, Level of impact resistance, Fixtures, Lamp types, Lamp models, Ballast types, Diffusor types, Sensor types, Fixation types, Vehicle types, Energy consumption period, Quantity methods, Vetors, Units, Vector - units, Produced energy destinations, Water supply typologies, Water supply equipment types, Hot water equipment type, Energetic classes, and Home and office equipment types. A QR code is visible on the right side of the page.

<http://muemtsy.irradiare.com>



Project-based financial assessment

Part 8

Financial assessment parameters

Simple payback (PP)

Net Present Value (NPV)

Benefit-cost ratio (C/B)

Internal Rate of Return (IRR)

Simple payback (PP)

It was calculated the year in which the NPV reaches zero, going from negative to positive.

$$PP = n_{NPV=0} - n_{t0}$$

Where:

PP - Simple payback [years]

n_{t0} - Year of project start [years]

$n_{VAL=0}$ - Year in which the NPV reaches zero years]

Net Present Value (NPV)

It was calculated by the sum of the difference between income obtained and investment until a year t , where the income obtained corresponds to energy invoice savings during this period.

The NPV calculation begins in the phase zero year until the year 2030.

$$NPV = \sum_{t=1}^n R_t - I_t$$

Where:

NPV – Net Present Value [years]

R_t – Income obtained in the year t [€]

I_t – Investment in the year [€]

n – Lifetime of the project [years], $n = 2030$

Benefit-cost ratio (C/B)

The cost-benefit ratio was calculated dividing the NPV of the 15th year after the assessment / certification year by the investment in the project execution phase.

$$B/C_t = \frac{NPV_t}{I_{execution}}$$

Where:

B/C_t – Benefit-cost ratio in the year t , $t = 15$ years

NPV_t – Net Present Value in the year t [€], $t = 15$ years

$I_{execution}$ – Investment in the phase of execution [€]

Internal Rate of Return (IRR)

Is the profit rate which, in the year 2025, makes the capital available to the NPV of 2025. The IRR calculation was based on the following equation:

$$CA_{P2012n} = \frac{\sum_{t=1}^n \left(I_{PC_t} + \left(I_{CP_t} + \frac{CA_{CP_{t-1}}}{1 - i_t} \right) \times pr \right)}{\sum_{t=1}^n (1 + i_t)}$$

Where:

CA_{P2012n} – Capital available at 2012 prices in the year t [€]

I_{CP_t} – Investment at current prices in the year t [€]

$CA_{CP_{t-1}}$ – Capital available at current prices in the year t–1 [€]

pr – Profit rate [%], $pr = IRR$

i_t – Inflation rate in the year t [%]

Internal Rate of Return (IRR)

Equations base for IRR calculation:

$$CA_{P2012n} = \frac{CA_{CPn}}{\sum_{t=1}^n (1 + i_t)} = \frac{\sum_{t=1}^n (I_{CPt} + CF_{CPt})}{\sum_{t=1}^n (1 + i_t)}$$
$$= \frac{\sum_{t=1}^n \left(I_{CPt} + \left(I_{CPt} + \frac{CD_{CPt-1}}{1 - i_t} \right) \times pr \right)}{\sum_{t=1}^n (1 + i_t)}$$

Where:

CA_{P2012n} – Capital available at 2012 prices in the year t [€]

CA_{CPt} – Capital available at current prices in the year t [€]

i_t – Inflation rate in the year t [%]

I_{CPt} – Investment at current prices in the year t [€]

CF_{CP} – Cash-flow at current prices in the year t [€]

CA_{CPt-1} – Capital available at current prices in the year t–1 [€]

pr – Profit rate [%], $pr = IRR$



Conclusions

Conclusions

The proposed methodology allows moving beyond of smart energy management pilots towards full regional scale implementation.

The integrated planning and management allows combining investment resources throughout areas such as urban environment or economic competitiveness.

A cost effective approach is offer for sustainable energy policies and investments assessment and monitoring, namely for 2014-2020 funding period.



paldies

Marcos António Nogueira
marcos.nogueira@irradiare.com
IrRADIARE, Lisbon - Brussels