Department of energy research & innovation
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Dipartimento Energia ''Galileo Ferraris''

Economic incentives for energy efficiency measures and low-emissions technologies

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Aim of the work

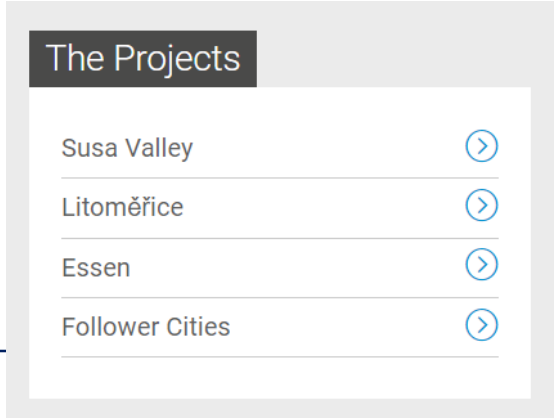
In this work, national energy policies among European countries are compared, according to the actual state of achievement of defined targets. Criteria for the classification of incentives, and the online tool SCORE investment calculator are presented. it represents a useful operational tool for the beneficiaries of the investment, but also to verify the effectiveness of the incentive policies themselves and, if necessary, redefine them.

The purpose of this work is to critically analyse the scenario of alternative measures in three European countries: **Italy, Germany and Czech Republic.**

These countries are member of the EU funded Horizon 2020 SCORE (Supporting Consumer Ownership in Renewable Energies) project .

SCORE
Co-own. Prosume. Renew.
Supporting Consumer Ownership in Renewable Energies

https://www.score-h2020.eu/



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Introduction

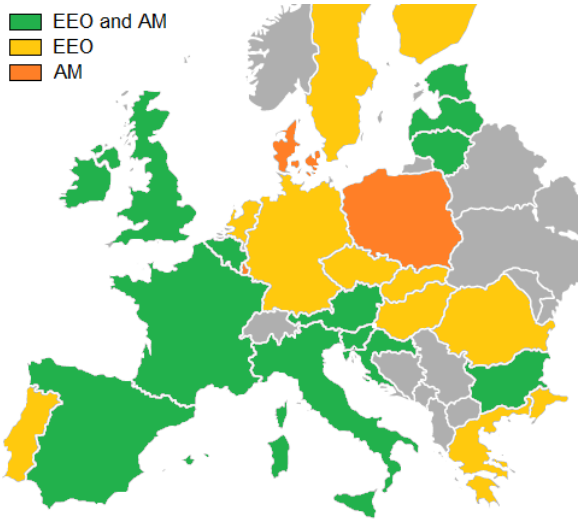
In the scenario of energy policies, EU directives, national and regional resolutions have decreed over time a vast number of different types of incentives, aimed at supporting the objectives of energy transition.

To achieve the objectives set for the 2014-2020 period, the European Directive 2012/27/UE on energy efficiency (EED) required member states to introduce energy efficiency obligation schemes (EEO) and/or alternative measures (AM) in their national legislation.

AM are defined as single energy policy, belonging to:

- Regulations or voluntary agreements
- Energy or carbon taxes → Only in few countries
- Financial instruments or tax incentives → Over 40% of total AM
- Standards and norms
- Energy labels and certificates(2010/30/UE)
- Education and training.

→ Especially, grant schemes and low-cost loans interest; Funding programs and tax deductions contribute about 20% of energy savings planned.



Application of energy efficiency obligation schemes (EEO) and/or alternative measures (AM) in Europe.

- 25 out of 28 countries relied on a combination of EEO and AM measures
- 450 AMs were notified, contributing for the 60% to the achievement of European savings targets

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The three countries (Czech Republic, Germany and Italy) are described and compared, according to the selected indicators of sustainable development goals (SDG), as defined by the United Nation Agenda 2030.
Data are available on the online database Eurostat and refer to the year 2010 and 2018 (in brackets).

SDG	Indicator	EU country			
		Czechia	Germany	Italy	EU
1. No poverty	People at risk of poverty or social exclusion [%]	14.4 (12.2)	19.7 (18.7)	25.0 (27.3)	23.8 (21.8)
4. Quality education	Tertiary educational attainment [%]	20.4 (33.7)	29.7 (34.9)	19.9 (27.8)	32.6 (39.4)
7. Affordable and clean energy	Primary consumption [Mtons Oil_{eq}]	42.7 (40.4)	315.2 (291.8)	167.3 (147.2)	1,458 (1,375)
	Energy productivity [€/kg Oileq]	3.44 (4.30)	7.52 (9.40)	8.96 (10.1)	6.84 (8.11)
	Share of RES in gross final consumption [%]	10.5 (15.1)	11.7 (16.5)	13.0 (17.8)	14.4 (18.9)
8. Economic growth	Real GDP per capita [k€/per capita]	15.0 (18.0)	33.2 (35.7)	26.9 (26.7)	24.9 (27.9)
13. Climate action	GHSs emissions intensity of consumption [%]	83.4 (75.2)	93.3 (90.2)	92.0 (83.7)	91.8 (85.2)

- Primary energy has decreased in all countries
- Productivity has increased and so has the share of RES
- Economic growth has decreased in Italy, leading to an increase in energy poverty

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Comparison of National Energy Policies

Economic and financial incentives have a function of promoting and guiding investments in the energy sector:

- create new opportunities of investments
- allow the dissemination of good practices and innovative technological solutions
- facilitate the initiative of different categories of end users (SMEs, public entities, private citizens), supporting their economic accessibility, including the most financially disadvantaged subjects

Motivations underlying the Energy Transition differing between countries and regions.

- Differences are mostly path dependent rooting in geography, historical development of energy markets and cultural factors.
- Conflicting elements resulting in discrepancies between the declared goals and the actually implemented energy policies.

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Comparison of National Energy Policies

CHALLENGES, TARGETS, GOALS OF THE ENERGY TRANSITION IN THE CZECH REPUBLIC, GERMANY AND ITALY

	Main challenges	RE targets and climate policy	Policy goals	
CZ	Coal-related air pollution; loop flows from neighbouring countries; shift from net exports (mostly coal and nuclear) to net imports foreseeable	*RES targets by 2030:* 22% TFEC, 16.9% electricity, 22% heating and cooling; 14% transport *GHG reduction (ESR):* 14% by 2030 (compared to 2005); *EC's assessment:* unambitious as systematically below the formula calculation 13.5% of TFEC from RES by 2020 (14% heating and cooling, 14% electricity)	Energy independence; security of supply; nuclear and coal share reduction in gross production	→ Lack of RE
DE	Exit from coal; high energy prices for households stemming from RES surcharge; cleaner natural gas-fired thermal power plants are unprofitable most of the time (operating reserve is affected)	*RES targets*: TFEC (30% by 2030, 60% by 2050), 65% electricity, 27% heating and cooling, 27% transport by 2030. *GHG reduction (ESR):* 38% by 2030 (compared to 2005); 80% by 2050 (compared to 1990; separate target of 55% total reduction by 2030 to achieve climate neutrality by 2050; *EC's assessment*: mostly adequate, very ambitious for the transport target 60% of TFEC from RES by 2050; gross consumption targets by 2020: 35% electricity, 14% heat, 10% transport.	Foster greater market proximity; competitive determination of electricity prices; exit from nuclear power by 2022	→ RE exporter
IT	High dependence on fossil fuel and electricity imports (highest worldwide, mostly French nuclear energy); market concentration obstructing access for new players; coal related air pollution	*RES targets:* 30% TFEC, 55% electricity (hydropower, geothermal and PV), 33.9% heating and cooling and 22% transport. *GHG reduction (ESR) by 2030:* 33% (compared to 2005), 38% (since 1990); *EC's assessment:* adequate although the consistency between targets and policy measures is questioned. RES by 2030: 30% TFEC and 55% electricity consumption (mostly from hydropower, geothermal, PV).	Reduction of TFEC; strengthen supply security; narrowing energy price gap (high industrial electricity prices); maintain 1990 nuclear exit; phase out coal	→ RE for electricity production Electricity importer

Renewable Energy (RE), in the narrower sense, is energy produced from sources not using fuels at all, that is, wind and solar power (PV and solar thermal), geothermal power and hydropower as well as "marine" tidal and wave power.

Financing condition for RE (and EE)

The volatility of the most important RE (i.e. wind and solar power) destroys their market price, discouraging financial investment and jeopardizing the objective of increasing RE's share in the energy mix by closing the financing gap.

The Czech Republic, Germany and Italy show a similar picture:

- energy mix with regard to total energy production is still dominated by conventional fossil fuels and is sometimes driven by dirty imports accompanied by low levels of autarky;
- share of RE in primary energy consumption which includes processing and transmission losses is low;
- only the share of RE in total electricity consumption is usually higher.

RES IN THE ENERGY MIX IN CZECH REPUBLIC, GERMANY AND ITALY

	B. Energy production	C. Energy Consumption	D. Electricity
CZ	Conventional: 11% RE and waste share on gross available production and17% on primary production Medium: 37%	Low: 11%	•Biofuels 5.6% •Hydro 3.6%, solar PV 2.6%, wind 0.8% Medium: 13%
DE	Conventional: 13% RE and waste share on total energy supply and 42% on primary production High: 64%	Medium: 15%	•Biofuels 7.2%, waste 2.0% •Wind 20.4%, solar PV 7.7%, hydro 4.2% High: 40%
IT	Conventional: RE and waste share 8% on total energy supply, 74% on primary production High: 76%	Medium: 18%	•Biofuels 5.8%, waste 1.7% •Hydro 16.3%, solar PV 8.1%, wind 6.9% High: 40%

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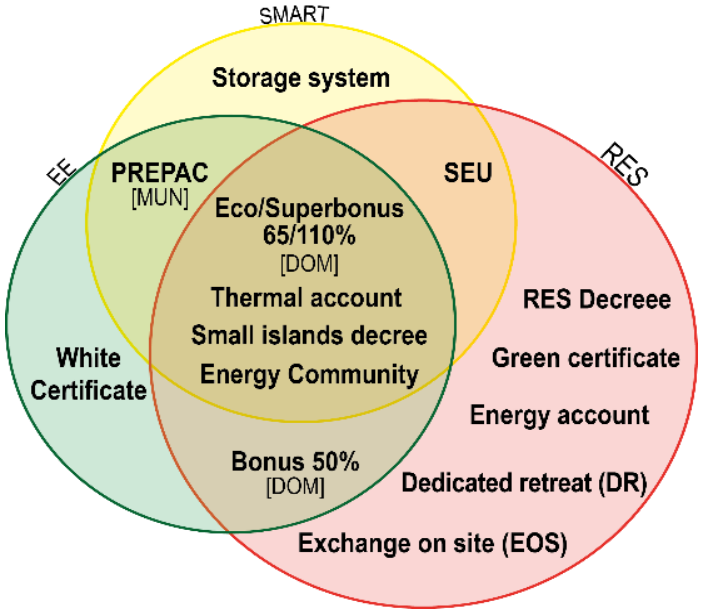
Economic incentive classification

A. Type of intervention

- EE Energy efficiency
- RES Renewable production
- SMART Smart management

Example of the Italian incentives



B. Recipient of the incentive

- DOM Domestic
- MUN Municipal
- COM Company

Single user

Aggregated user

C. Methods of remuneration

Monetary

- Capital Reimbursement
- Project funding
- Operating account
  - Warranty
  - Discount
  - Premium

Non-Monetary

- Bond issue
- Tax Deduction (TD)
  - Discounted Loan (TD-DL)
  - Tax Break (TD-TB)

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Economic incentive classification

Existing incentives in Czech Republic, Germany and Italy, according to the presented classification

Country	A. Type of intervention	B. Recipient of incentives	C. Method of remuneration	Name of the incentive	Energy vector
CZ	RES	COM	TD (DL)	PV-storage 30-50%)	El
		DOM	TD (DL)	PV (30-40%)	El
		DOM	TD (DL)	PV-storage system (50%)	El
		MUN	TD (DL)	PV (70%)	El
		MUN	TD (DL)	RES in public transport(85-90%)	El
	SMART	COM	TD (DL)	Storage system (60-80%)	El
		COM	TD (DL)	Electro-mobility (20-30%)	El
	EE+RES	DOM	TD (DL)	PV (25% or 30% with thermal insulation	El, Th
DE	EE	DOM	TD (DL)	KfW (up to 40%)	El, Th
		COM	TD (DL)	KfW (up to 55 %)	El, Th
		MUN	TD (DL)	KfW (up to 27,5 %)	El, Th
	SMART	MUN	TD (DL)	Model project Smart Cities (up to 65%)	El, Th
		DOM	TD (DL)	KfW (up to 30%)	El, Th
		DOM, COM	TD (DL)	BAFA - SMART-home appliances	El, Th
	RES	All users	Premium and TD	RE Act; KfW – New RES plants	El
	EE+RES	DOM	Premium for organisational slacks and reimbursement	KfW; Renewable Energy Act - investments in PV or RE-Heating; up to 40% (up to 40%)	El, Th
		COM	TD	KfW RE-Heating; up to 55%	Th
IT	EE	All users	Bond issue	White Certificate	El,Th
	SMART	All users	Reimbursement	Storage system	El
	RES	All users	Premium	RES Decree	El,Th
		All users	Premium	Exchange on site (EOS)	El
		All users	Warranty	Dedicated retreat (DR)	El
		All users	Premium	Green certificate	El,Th
		All users	Premium	Energy account	El,Th
	EE+RES	DOM	TD (TB)	Bonus 50%	El,Th
		MUN	Project	PREPAC	El.Th
	RES+SMART	Aggregated	Discount	SEU	El
	EE+ SMART+ RES	DOM	TD (TB)	Eco- Superbonus (65- 110%)	El,Th
		All users	Reimbursement	Thermal account	Th
		All users	Reimbursement/ Premium	Small italian islands decree	El,Th
		Aggregated	Project/Premium	Energy Community	El,Th

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Economic incentive classification

Principal Alternative Measure in the building sector individuated for the three countries and their contribution in the achievement of target 2020.

Country	*Principal AMs*	Energy savings				
		Achieved 2016 (Mtep)	*Estimated 2020 (Mtep)*	*Total Estimated 2020 (Mtep)*	*Total Target 2020 (Mtep)*	*Total Target 2020 achieved (%)*
CZ	Requalification of concrete buildings	0.005	0.108	0.108	4.564	2.4
DE	Energy savings standards – new constructions	0.616	2.173	17.017	41.989	40.5
	Energy savings standards – existing buildings	1.619	6.771			
	EE – construction and retrofit	0.982	5.255			
	ER network	0.010	2.818			
IT	Thermal account	0.030	0.431	8.818	25.502	34.6
	TD "eco-bonus"	1.176	8.387			

For each one, is express the amount of energy saving (Mtep) that is already achieved (update at 2016) and the one estimated to reach in 2020, comparing them to the energy saving 2020 targets.

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The SCORE cash flow calculator

An online tool for consumers developed by SCORE team to calculate the economic feasibility of RE installations based on different technologies and varying investment volumes.

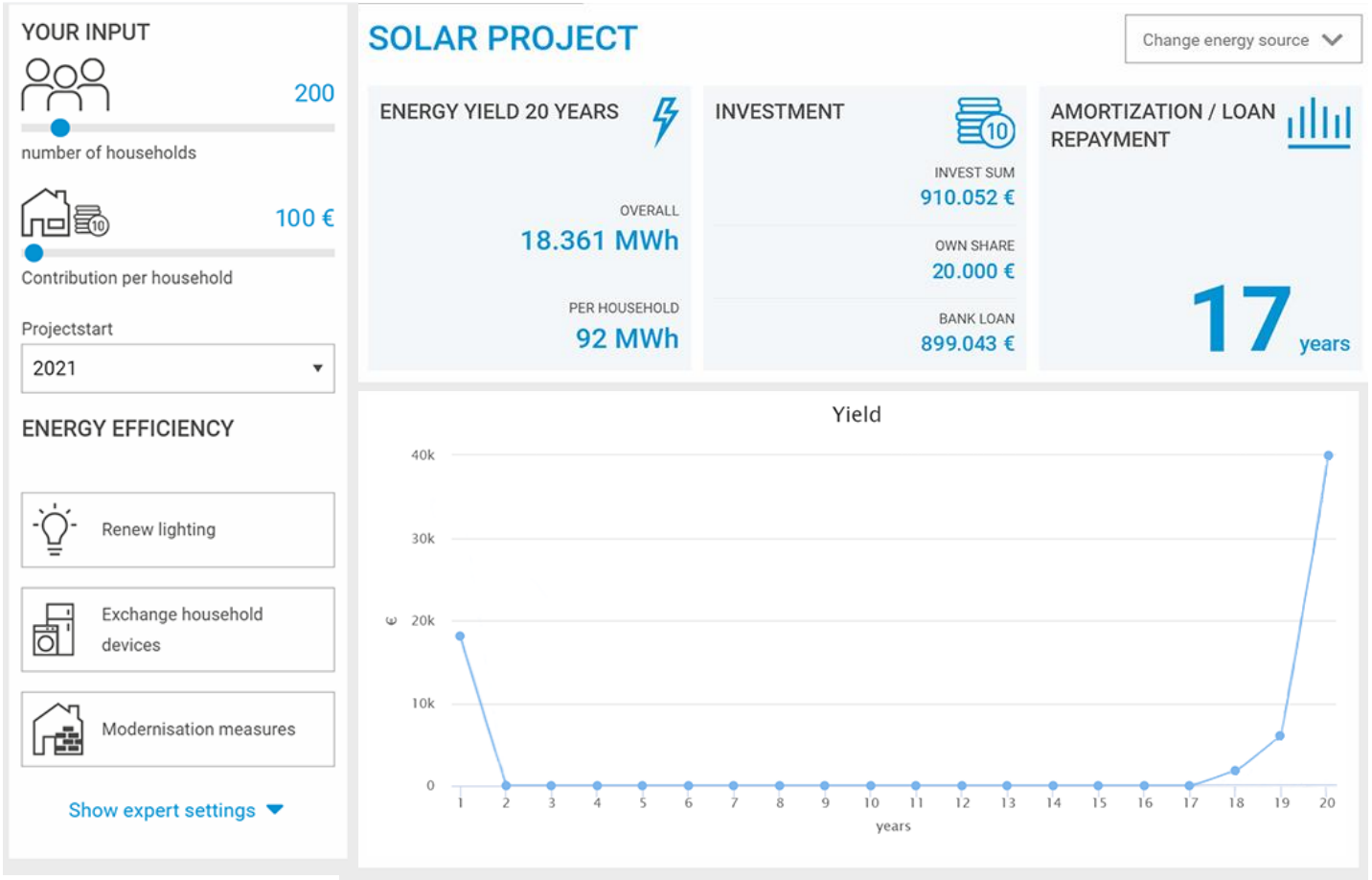
INPUT

Country selection
(Czechia, Germany, Italy)

RE installation:
- Solar PV
- Wind
- Combined Heat Power

OUTPUT
- Energy yield
- Cash flow
- Taxes and costs overview
- Operational costs
- Pay-back period
- Self-sufficiency simulation

https://www.score-h2020.eu/csop-calculator/



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Another example compare the annual economic savings consider a typical residential user in Italy (IT) and German (DE) family, located in Turin and Frankfurt, respectively.

- Same PV investments:
  - polycrystalline technology - 2.5kW power
  - roof-integrated system
  - life span of 25 years

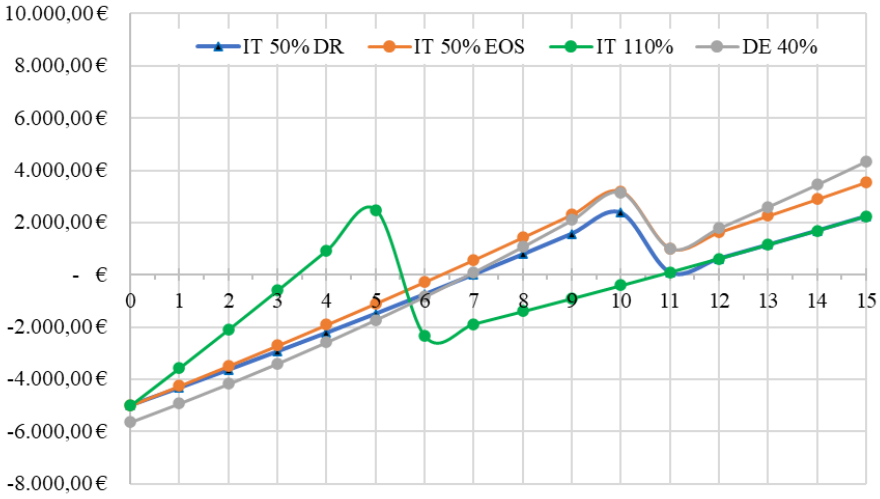
- Selection of existing economic incentives:

Germany (DE)	Italy (IT)
• Bonus 40%	• Bonus 50% • Superbonus 110% • Dedicated Retreat (DR) • Exchange On Site (EOS)

- Polysun software tool to estimate annual electric consumption, production and self-consumption

- Cash flow analysis, considering energy costs and financial parameters

	IT 50% DR	IT 50% EOS	IT 110%	DE 40%
Total Consumption [kWh/yr]	2,700	2,700	2,700	3,400
PV production [kWh/yr]	2,942	2,942	2,942	2,300
Self-consumption [kWh/yr]	1,147	1,147	1,147	1,173
Energy withdrawn [kWh/yr]	1,552	1,552	1,552	2,227
Energy sale [kWh/yr]	1,795	1,795	1,795	1,127
Energy price (purchase) [€/kWh]	0.23	0.23	0.23	0.3
Energy price (sale) [€/kWh]	0.08	0.13	0.08	0.1
Investment cost [€]	5,000	5,000	5,000	5,637
Number of instalments	10	10	5	10
Interest rate [%]	2	2	2	-0.5
Economic saving [€/yr]	412	486	412	459
Pay-back period [years]	7	6	4	7



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Conclusion

- Importance of defining a single direction for all countries of the European Union
- The complexity of the incentive scenario affects its activation and implementation

- The more complex the incentive system, the more difficult is access for beneficiaries, and the lower the probability of achieving the targeted objectives.
- Confusing or fragmented communication of the panorama of incentives accessible to the different energy users limits the take up by those directly involved.

- Tool as SCORE calculator are valuable about a double use:

- an operational use by comparing the payback times of the different types of investment, facilitating beneficiaries in accessing the more suitable incentive
- a strategical use for policy makers to evaluate which policy is most effective, achieving energy targets

Facilitate low-threshold consumer participation in RE projects

- Further developments: cost-optimal analysis to consider environmental performance of the energy efficiency and low GHG emissions interventions and future climate changes