*School Low Carbon Footprint in Mediterranean cities*

# La valutazione tecnica e finanziaria di interventi EPC su edifici non Residenziali

*Chiara Wolter*

*Provincia di Treviso – Sant'Artemio – 23 novembre 2018*

# Il progetto TRUST EPC SOUTH

TRUST EPC SOUTH è un progetto europeo finanziato all'interno del programma H2020, che si prefigge lo scopo di aumentare gli investimenti relativi all'Efficienza Energetica (EE) e ad altre tecnologie di Energia Rinnovabile (RES) nel settore terziario privato dei paesi dell'Europa meridionale, con particolare attenzione agli investimenti in un quadro di Energy Performance Contract (EPC).

Infatti si riscontrano i seguenti ostacoli allo sviluppo del mercato degli EPC:

- Scarsa domanda dovuta a una conoscenza insufficiente del modello EPC, alla carenza di progetti di rilevanza importante;
- Difficile accesso ai finanziamenti da parte delle ESCO, a causa di una fiducia limitata da parte degli investitori;
- Mancanza di certificazioni e di meccanismi di finanziamento per i progetti EPC;
- Supporto insufficiente da parte delle politiche e delle normative interne.

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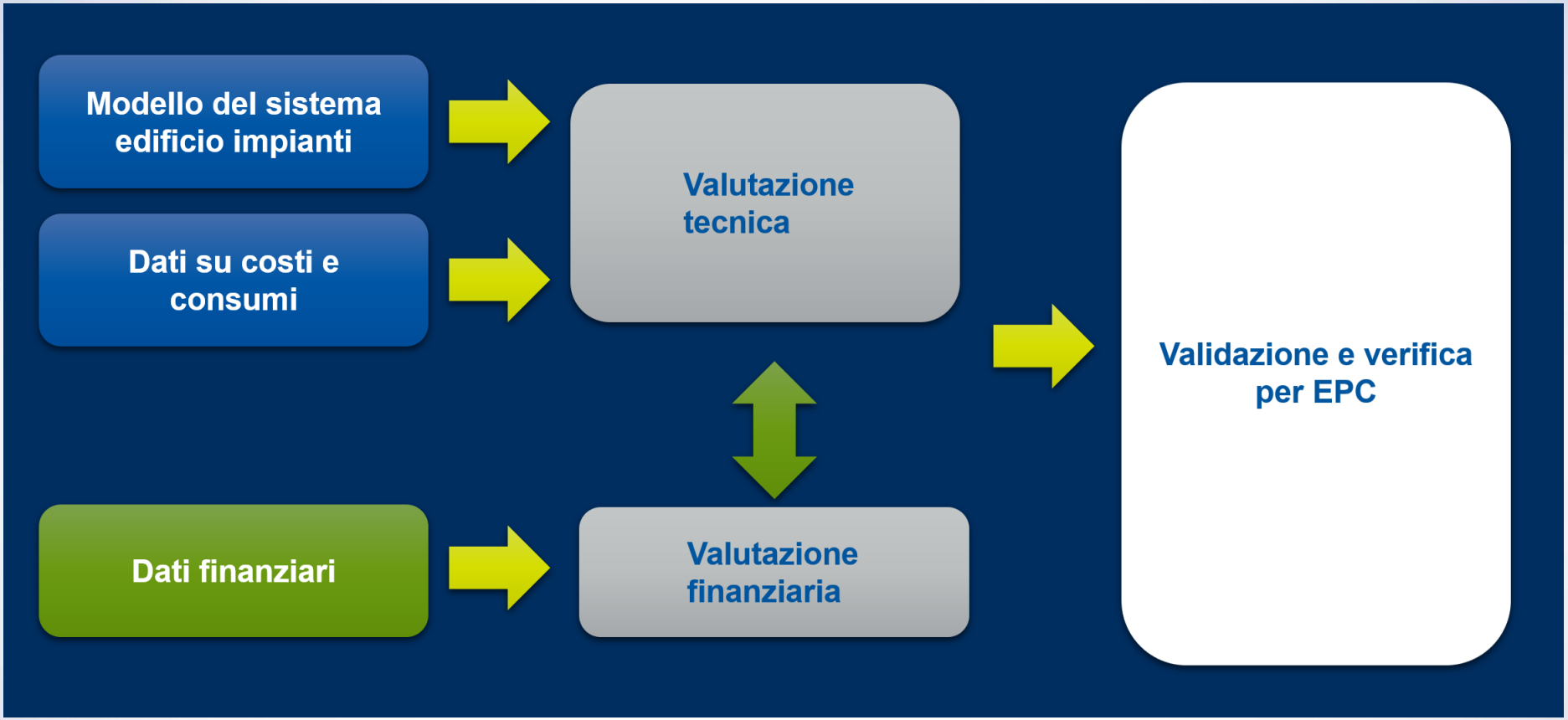
# Analisi della performance di un progetto EE

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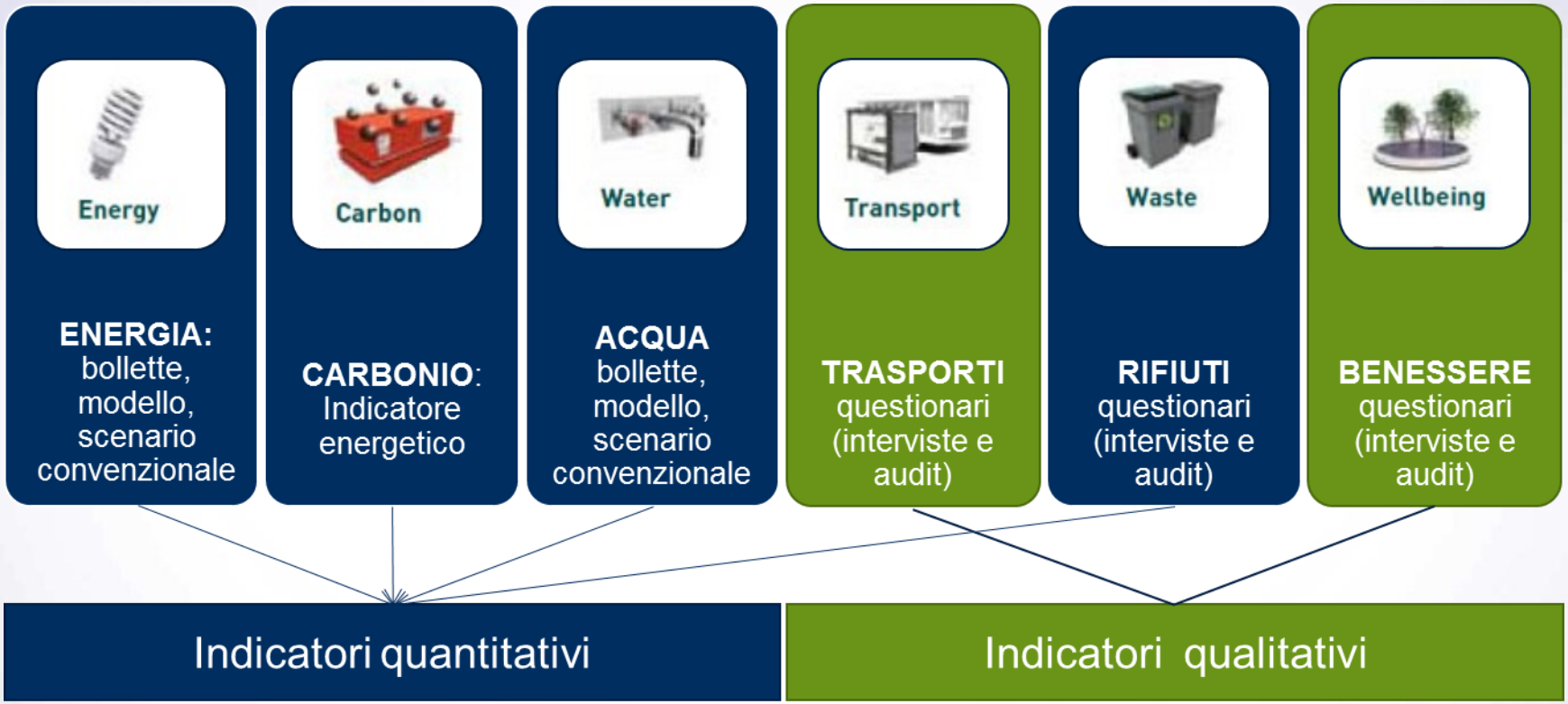
# Metodologia di approccio: indicatori

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# Metodologia di approccio

**Caratteristiche metodologia**

- Calcoli specifici per tipologia di edificio
- Interventi EE standardizzati
- Modellizzazione standardizzata edificio
- Calcolo standardizzato di raccomandazioni

**Integrazione interventi EE**

- 46 interventi identificati e descritti
- Ogni intervento identificato e calcolato separatamente
- Ridotta flessibilità dell'auditor
- Foglio di calcolo indipendente per ogni intervento

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# Metodologia di approccio

**Identificazione delle misure di intervento:**

- dal tool, sulla scorta dei dati dell'edificio
- dall'auditor, da una lista di 46 misure


| Energy use | Measure n.° | Title | | | |
|---|---|---|---|---|---|
| Lighting | 1 | Substitution of conventional lamps | 50 | 0 | 0 |
| | 2 | Replacement of lamps ballast | 3000 | | |
| | 3 | Occupancy and presence sensors | 0 | 0 | 0 |
| | 4 | Photocell to dim luminous flux based on natural light | 0 | 0 | 0 |
| | 5 | Occupancy and presence sensors combined with photocell | 0 | 0 | 0 |
| Heating, Ventilation and Air Conditioning | 6 | Substitution of a low efficiency chiller with inverter chiller | 2 | 0 | |
| | 7 | Substitution of a low efficiency heat pumps with high efficiency | 0 | 0 | |
| | 8 | Freecooling system | 1 | | |
| | 9 | Thermostatic valves for radiators | 1 | | |
| | 10 | Variable frequency drives for air handling units by CO2 sensors or occupancy sensors | 1 | | |
| | 11 | Variable frequency drives for extraction vents controlled by CO2 sensors or occupancy sensors | 1 | | |
| | 12 | Variable frequency drives for air handling units and extraction vents controlled by CO2 sensors or occupancy sensors | 1 | | |
| | 13 | Installation of biomass boiler for heating | 3 | 5 | 0 |
| | 14 | HVAC schedule definition | 0 | | |
| | 15 | Automatically shut off air conditioning or heating when a monitored door or window remains open for a period of time | 0 | | |
| | 16 | Substitution of doors | 1 | | |
| | 17 | Substitution of windows | 0 | | |
| | 18 | Air curtains | 1 | | |
| | 19 | Thermal insulation of building envelope | 0 | | |
| | 20 | Installation of sun shading devices | 0 | 0 | |
| | 21 | Improve solar factor | 0 | | |
| | 22 | Substitution of conventional boiler with condensing boiler | 3 | 5 | |
| | 23 | Substitution of the boiler burner | 0 | 0 | 0 |
| | 24 | Pipework and boiler insulation | 0 | 0 | |
| | 25 | Variable frequency drives for pumps | 0 | | |
| Hot Water | 26 | Heat recovery systems | 0 | | |
| | 27 | Water saving aerators | 0 | 0 | |
| | 28 | Swimming pool heat cover | 0 | | |
| | 29 | Substitution or implementation of heat exchanger | 0 | 0 | 1 |
| | 30 | Substitution of conventional boiler with condensing boiler | 1 | | |
| | 31 | Substitution of the boiler burner | 0 | 1 | |
| | 32 | Pipework and boiler insulation | 1 | 0 | 0 |
| | 33 | Variable frequency drives for pumps | 0 | | |
| Renewable Energy Sources | 34 | Micro Cogeneration | 0 | | |
| | 35 | Geothermal heat pump | 1 | | |
| | 36 | Solar thermal plant | 1 | | |
| | 37 | Photovoltaic plant | 1 | | |
| | 38 | Small wind turbine | 1 | | |
| | 39 | Micro hydropower | 1 | | |
| | 40 | Capacitive power factor correction | 1 | | |
| | 41 | Building Energy Management System | 0 | 0 | 0 |


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# Metodologia di approccio

## Generazione Misura

Il tool calcola le misure di efficientamento energetico

## Trasferimento Misura

Il tool genera un foglio finanziario per misura o per gruppo di misure

Il tool trasferisce i dati dell'intervento al tool finanziario

## Calcolo finanziario iterativo

Ogni copia del tool finanziario calcola il proprio set di misure

Il tool estrae infine i risultati da tutti i fogli del tool finanziario e presenta i 6 risultati migliori

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# Il processo

Identification and calculation of EE and RES measures

**Il calcolo di ogni misura EE e FER è basato sui dati inseriti dall'auditor**

| Measure n.º | Title | Criterion 1 |
|---|---|---|
| 9 | Thermostatic valves for radiators | No |

| | | | | |
|---|---|---|---|---|
| *Gas* | **Heating 1** | **1,500,000** | ***kWh/year*** | **34%** |
| *Electricity* | **Heating 2** | **456,000** | ***kWh/year*** | **10%** |
| *Electricity* | **Cooling** | **500,000** | ***kWh/year*** | **11%** |

| Heating system | Number of radiators | Current consumption (kWh/year) | Introduce TRV's? | Number of TRV's to be installed | TRV unitary cost (€) |
|---|---|---|---|---|---|
| Heating system 1 | 75 | 1,500,000.00 | Yes | 75 | 128 |
| | | | | | |
| | | 1,500,000 | | | |

| Total cost (€) | New consumption (installed) (kWh) | New consumption (total) (kWh) | Savings (kWh/year) | Savings (€) | Simple payback time (years) |
|---|---|---|---|---|---|
| 9,600 | 1,425,000 | 1,425,000 | 75,000 | 1,875 | 5.1 |
| | | | | | |
| 9,600 | 1,425,000 | 1,425,000 | 75,000 | 1,875 | 5.1 |

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# Il processo

## EPC RECOMMENDATION SHEET

Energy Efficiency Measure 2

**Replacement of lamps ballast**

| | |
|---|---|
| Measure automatically identified? | YES |
| Building system link: | Lighting |
| Recommendation criterion type: | Lamp ballast type |
| Number of possible criteria: | 1 |
| Number of criteria met: | 1 |

Measure criteria

| | | Criterion met? |
|---|---|---|
| Criterion 1: | Standard ballasts | Yes |

| | | |
|---|---|---|
| Total system consumption: | **724,048** | kWh/year |
| Total sub-system(s) consumption: | **718,848** | kWh/year |

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# La valutazione finanziaria

## PROJECT GENERAL DATA

| Project indexes | | Project financial data | |
|---|---|---|---|
| (1) Energy inflation rate | 2,0% | (7) Project direct investment | 232,49 |
| (2) General inflation rate | 1,0% | (8) % of adittional expenses | 5% |
| (3) Euribor (select) | 2,0% | Total investment amount | 244,11 |
| (4) Spread | 2,0% | (9) % debt | 0% |
| Interest rate | 4,0% | % equity | 100% |
| (5) Loan formalisation fee | 0,5% | Debt | 0,0 |
| | | Equity | 244,1 |
| (6) EBT tax rate | 25% | (10) K asset (required return) | 8% |
| | | (11) K equity (required return) | 9% |
| Euribor (select) | | | |
| IRS (select) | | (12) Client shared savings (%): | 0% |

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# La valutazione finanziaria

| | PROJECT SPECIFIC DATA | |
|---|---|---|
| | **RESULTS (k€)** | |
| | **Income (Sales)** | **45,4** |
| *(13)* | Energy savings | **45,4** |
| *(14)* | Energy production | **0,0** |
| *(15)* | Water savings | **0,0** |
| *(16)* | Carbon credits trading | **0,0** |
| | **Expenses** | **0,0** |
| *(17)* | Energy supply | **0,0** |
| *(18)* | O&M | **0,0** |
| *(19)* | Overhead | **5,0%** |
| *(20)* | % Of the investment subject to depreciation | **100%** |
| | Investment subject to depreciation | **244,1** |
| | Depreciation period (years) | **6** |
| | **BALANCE (k€)** | |
| *(21)* | Working capital requirements (% of income) | **0,0%** |
| *(22)* | EPC Project duration (years) | **8** |

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# Analisi del rischio

## Matrice del rischio

**Variabili analizzate**

- *Higher investment*
- *Smaller energy savings*
- *Lower energy production*
- *Higher O&M cost*

**Probabilità che si verifichino**

- *Percentile 10/20/50/100*

**Impatto**

- *Standardized risk assessment*

**RISK MATRIX**

| | | Impact | | | |
|---|---|---|---|---|---|
| **Risks** | | Insignificant | Restrained | High | |
| **Higher investment amount** | | <2% | 2%<I<5% | 5%<I<10% | **percentile** |
| Probability of occurrence | Rare | 0,050% | 0,175% | 0,375% | 10% |
| | Unlikely | 0,150% | 0,525% | 1,125% | 20% |
| | Likely | 0,350% | 1,225% | 2,625% | 50% |
| | Very likely | 0,750% | 2,625% | 5,625% | 100% |

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# Analisi del rischio

| RETURNS SENSITIVITY ANALYSIS | | | |
|---|---|---|---|
| **Coeteris Paribus analysis** | | | |
| **Income: Energy and water savings** | **98,9%** | **100,0%** | **101,1%** |
| Asset IRR | 10,3% | 10,6% | 10,9% |
| Asset NPV | 22 | 25 | 28 |
| Equity IRR | 8% | 9% | 8% |
| Equity NPV | -10 | -4 | -6 |
| **Income: Energy production** | **100,0%** | **100,0%** | **100,0%** |
| Asset IRR | 10,6% | 10,6% | 10,6% |
| Asset NPV | 25 | 25 | 25 |
| Equity IRR | 8% | 9% | 8% |
| Equity NPV | -8 | -4 | -8 |
| **Investment overcost** | | **0,0%** | **1,9%** |
| Asset IRR | | 10,6% | 10,1% |
| Asset NPV | | 25 | 20 |
| Equity IRR | | 9% | 8% |
| Equity NPV | | -4 | -11 |
| **O&M overcost** | | **0,0%** | **0,0%** |
| Asset IRR | | 10,6% | 10,6% |
| Asset NPV | | 25 | 25 |
| Equity IRR | | 9% | 8% |
| Equity NPV | | -4 | -8 |
| **Energy inflation rate** | **-1,1%** | **2,0%** | **5,1%** |
| Asset IRR | 7,2% | 10,6% | 14,0% |
| Asset NPV | -7 | 25 | 62 |
| Equity IRR | 5% | 9% | 11% |
| Equity NPV | -31 | -4 | 19 |
| **General inflation rate** | **-0,5%** | **1,0%** | **2,5%** |
| Asset IRR | 10,6% | 10,6% | 10,6% |
| Asset NPV | 25 | 25 | 25 |
| Equity IRR | 8% | 9% | 8% |
| Equity NPV | -8 | -4 | -8 |
| **Interest rate** | **2,6%** | **4,0%** | **5,4%** |
| Asset IRR | 10,6% | 10,6% | 8,2% |
| Asset NPV | 25 | 25 | 22 |
| Equity IRR | 8% | 9% | 8% |
| Equity NPV | -8 | -4 | -8 |

| TOTAL IMPACT OF THE TECHNICAL RISKS: | |
|---|---|
| **Risks** | **Impact** |
| Higher investment amount | 1,89% |
| Smaller energy and water saving | 1,06% |
| Lower energy production | 0,00% |
| Higher O&M costs | 0,00% |

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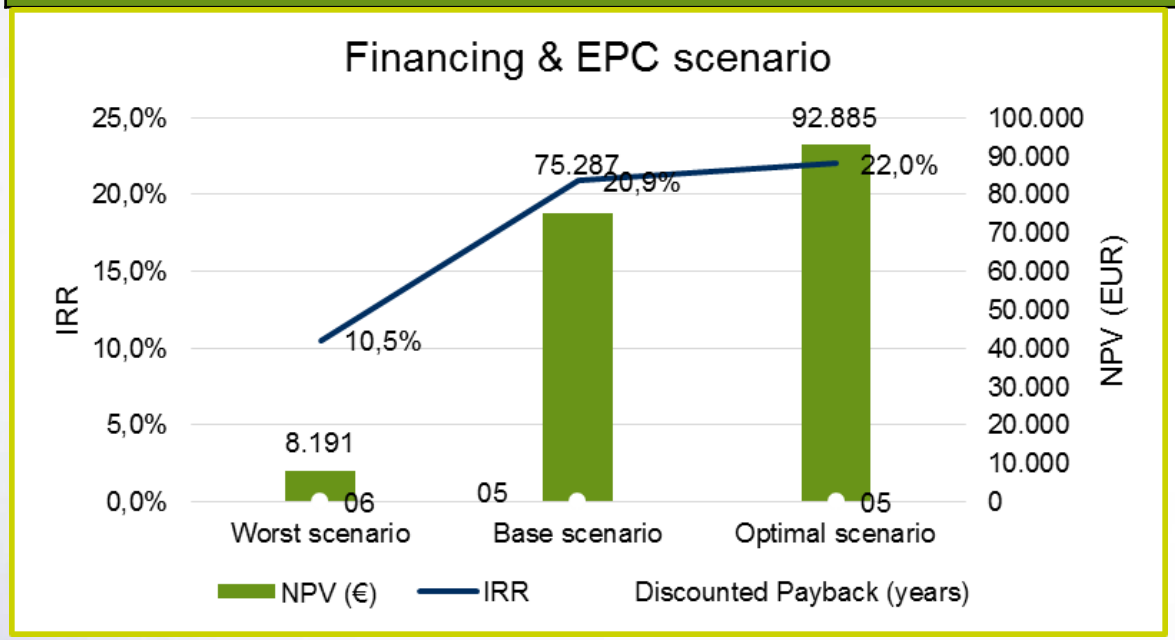
# Valutazione finale

| FINANCIAL KPIs | IRR | NPV (€) | Discounted Payback (years) | Min DSCR | Average DSCR | Negative FCF (years) |
|---|---|---|---|---|---|---|
| **Worst scenario** | 10,5% | 8.191 | 6,0 | 2,2 | 2,4 | 0,0 |
| **Base scenario** | **20,9%** | **75.287** | **5,0** | **2,8** | **3,0** | **0,0** |
| **Optimal scenario** | 22,0% | 92.885 | 5,0 | 3,2 | 2,4 | 0,0 |

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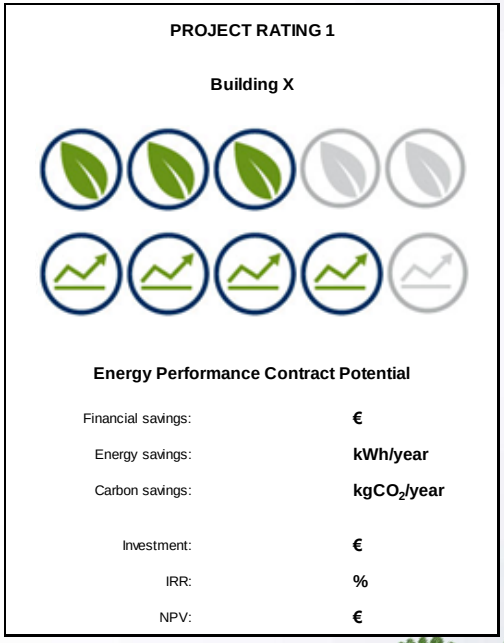
# Valutazione finale

La valutazione tecnica del rischio può rientrare in un sistema di valutazione più globale che tiene conto anche di parametri finanziari

| LABEL | DESCRIPTION |
|---|---|
| E | Low Profitability, high likelihood of bad performance, long payback time, with a low level of security in the loan |
| D | Medium-Low Profitability, medium-high likelihood of bad performance, medium-long payback time, with a medium-low level of security in the loan |
| C | Medium Profitability, medium likelihood of bad performance, medium payback time, with a medium level of security in the loan |
| B | Medium-High Profitability, medium-low likelihood of bad performance, medium-short payback time, with a medium-high level of security in the loan |
| A | High Profitability, low likelihood of bad performance, very robust structure, short payback time, with a high level of security in the loan |

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# Casi pilota

| Averages per country | HR | FR | GR | IT | PT | ES | Sum/ Global average |
|---|---|---|---|---|---|---|---|
| **Number of pilot projects** | 5 | 9 | 6 | 10 | 5 | 11 | **46** |
| **Building size [$m^2$]** | 12,600 | 9,166 | 13,293 | 10,613 | 10,089 | 39,434 | **17,730** |
| **Energy consumption [MWh/year]** | 6,371 | 1,211 | 3,985 | 1,742 | 637 | 2,879 | **2,586** |
| **Energy expenditure [k€/year]** | 521 | 84 | 385 | 251 | 101 | 325 | **267** |
| **Specific energy cost [€/kWh]** | 0.09 | 0.12 | 0.14 | 0.12 | 0.16 | 0.10 | **-** |
| **Investment [k€]** | 331 | 83 | 261 | 250 | 82 | 260 | **212** |
| **Energy savings [MWh/year]** | 750 | 249 | 465 | 217 | 80 | 294 | **329** |
| **RES production [MWh/year]** | 43 | 4 | 115 | 33 | 51 | 103 | **58** |
| **Energy saving [%]** | 21 % | 27 % | 28 % | 30 % | 21 % | 12 % | **24 %** |
| **Payback Time [years]** | 8.3 | 7 | 4.7 | 7.2 | 4.1 | 5.9 | **6.3** |
| **Cost of saved energy[1] (10 year horizon) [€/kWh saved]** | 0.042 | 0.033 | 0.045 | 0.082 | 0.063 | 0.066 | **0.057** |

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# Casi pilota: Albergo

| Project name | Sector | Size [m²] | Estimated energy savings [MWh/year] | Investment [€] | Payback [years] |
|---|---|---|---|---|---|
| IT1_Hotel | Hospitality | 4.000 | 400,72 | 411.016 | 8,9 |

**The key aspects and open issues of this project are:**

- Lighting and HVAC are the key energy saving measures foreseen
- Insulation of the courtyard side of the building is skipped to a later time
- The project is almost approved by the client
- Different financing options are being considered, but the Client prefers to use its equity
- The main issue is the definition of the time needed for the intervention

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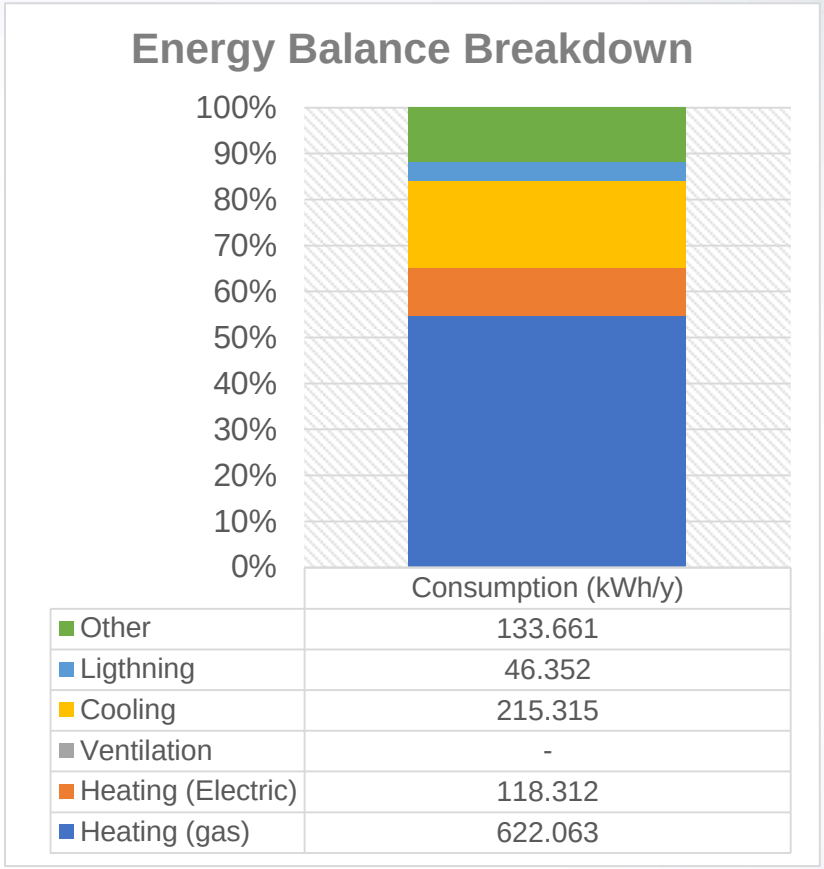
# Casi pilota: Albergo

- The overall annual energy consumption is 1.135.703 kWh/year
- The corresponding annual energy costs of the building account for 166.419 €/year
- The emissions associated are of 416.378 $kgCO_2eq/year$
- Heating and cooling are the main consumption items.




| | Consumption (kWh/y) |
|---|---|
| Other | 133.661 |
| Ligthning | 46.352 |
| Cooling | 215.315 |
| Ventilation | - |
| Heating (Electric) | 118.312 |
| Heating (gas) | 622.063 |

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# Scenario 1

| ESM Recommendation | Savings [kWh/year] | Savings [€/year] | Investment [€] | Simple Payback [years] |
|---|---|---|---|---|
| Substitution of conventional lamps | 16.344 | 3.269 | 11.524 | 3,5 |
| Occupancy and presence sensors | 4.635 | 927 | 5.592 | 6,0 |
| Substitution of a low efficiency chiller with inverter chiller | 55.057 | 11.011 | 80.000 | 7,3 |
| HVAC Schedule definition | 68.661 | 7.688 | 40.000 | 5,2 |
| Substitution of windows | 116.583 | 12.312 | 158.400 | 12,9 |
| Thermal insulation of building envelope | 93.604 | 10.160 | 105.500 | 10,4 |
| Substitution of conventional boiler with condensing boiler | 45.836 | 3.822 | 40.000 | 10,5 |
| **TOTAL** | **400.720** | **49.189** | **441.016** | **8,9** |

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# Scenario 2

| ESM Recommendation | Savings [kWh/year] | Savings [€/year] | Investment [€] | Simple Payback [years] |
|---|---|---|---|---|
| Substitution of conventional lamps | 16.344 | 3.269 | 11.524 | 3,5 |
| Occupancy and presence sensors | 4.635 | 927 | 5.592 | 6,0 |
| Substitution of a low efficiency chiller with inverter chiller | 55.057 | 11.011 | 80.000 | 7,3 |
| HVAC Schedule definition | 68.661 | 7.688 | 40.000 | 5,2 |
| Substitution of windows | 116.583 | 12.312 | 158.400 | 12,9 |
| Thermal insulation of building envelope | 93.604 | 10.160 | 105.500 | 10,4 |
| Substitution of conventional boiler with condensing boiler | 45.836 | 3.822 | 40.000 | 10,5 |
| **TOTAL** | **400.720** | **49.189** | **441.016** | **8,9** |

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# Confronto tra i due scenari

| | TECHNICAL SCENARIO 1 | TECHNICAL SCENARIO 2 |
|---|---|---|
| | EPC Financing | EPC Financing |
| **Investment (€)** | **441.016** | **177.116** |
| **Financial savings (€/year)** | **49.189** | **29.245** |
| **Project Rating** | B | A |
| **IRR (%)** | 18,3 | 22,1 |
| **NPV (€)** | 159.284 | 77.827 |
| **Discounted payback (years)** | 6,0 | 5,0 |
| **Min DSCR** | 3,4 | 4,1 |
| **Average DSCR** | 5,7 | 7,0 |
| **Negative FCF (years)** | 1 | 1 |

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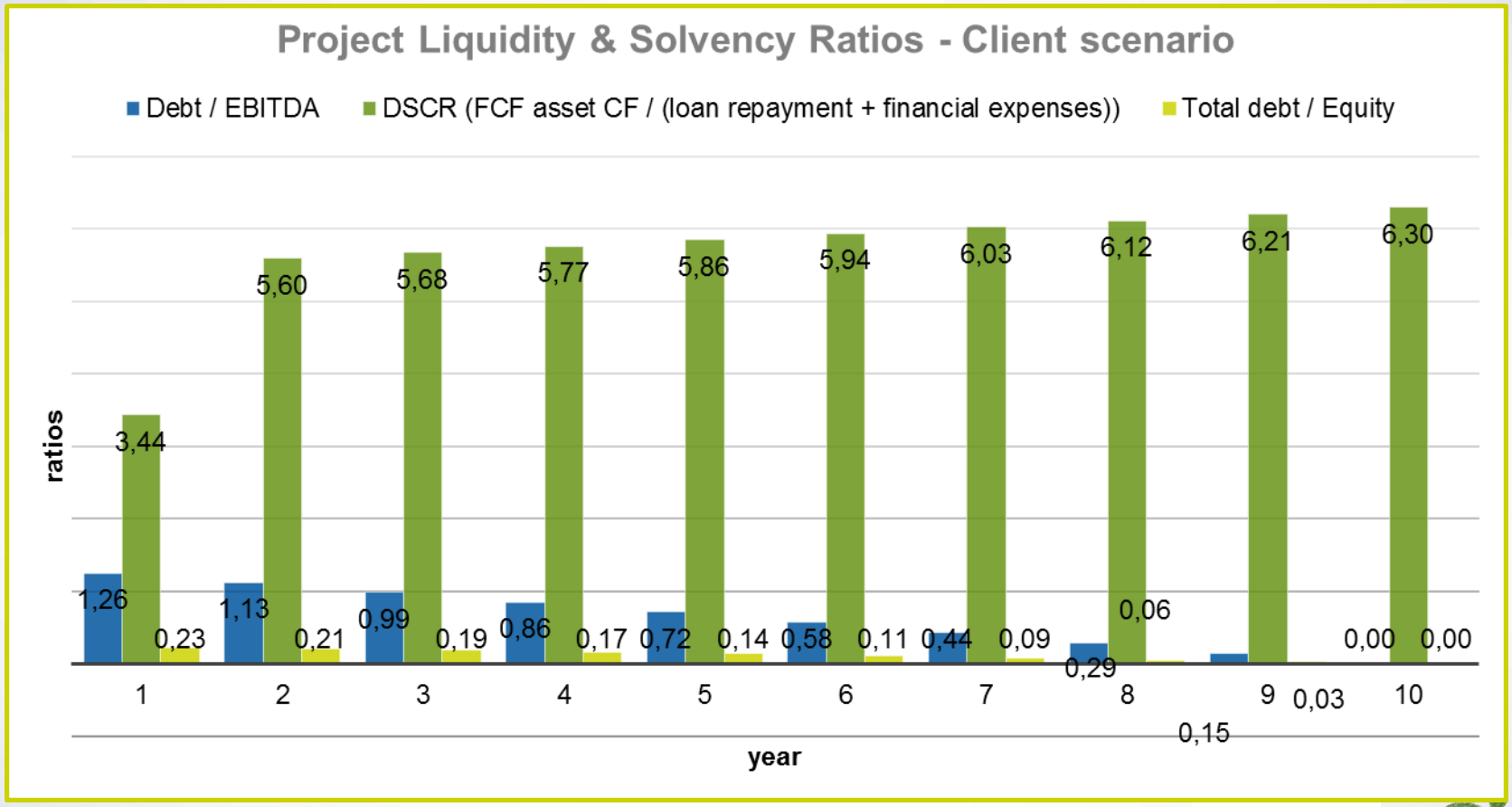
# Scenario 2

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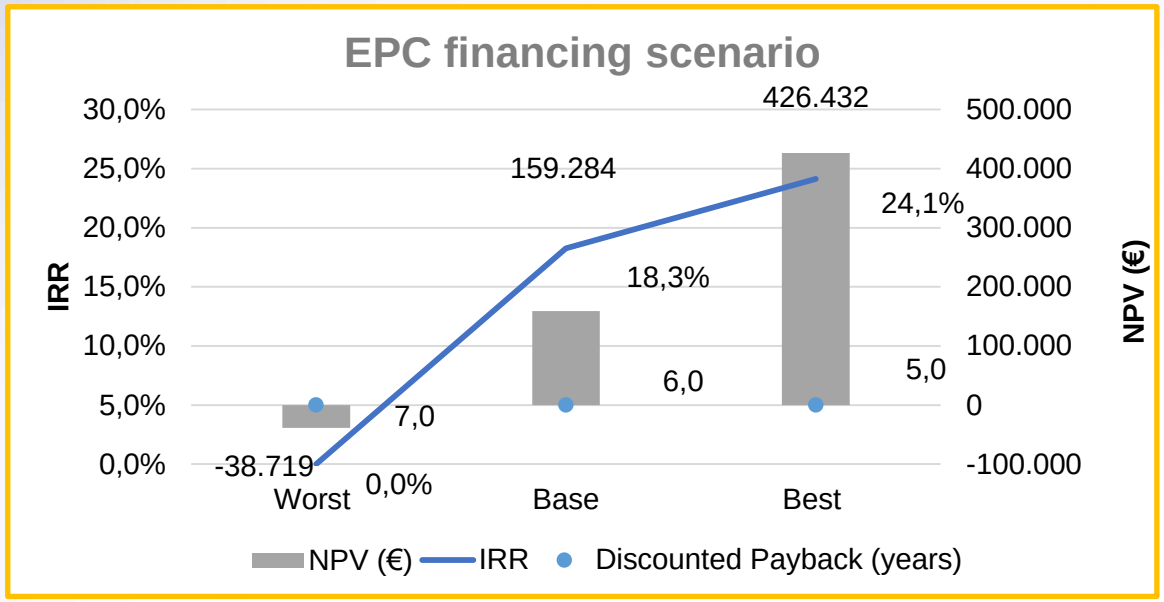
# Valutazione finanziaria




| PROJECT RATING |
|---|
| B |

**EPC financing scenario**

| FINANCIAL KPIs | IRR | NPV (€) | Discounted Payback (years) | Min DSCR | Average DSCR | Negative FCF (years) |
|---|---|---|---|---|---|---|
| Worst scenario | 0,0% | -38.719 | 7,0 | 3,1 | 3,9 | 1 |
| Base scenario | 18,3% | 159.284 | 6,0 | 3,4 | 5,7 | 1 |
| Best scenario | 24,1% | 426.432 | 5,0 | 3,9 | 8,1 | 1 |

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# Valutazione finale

**PROJECT RATING 1**

**Hotel**

**Energy Performance Contract Potential**

| | | |
|---|---|---|
| Financial savings: | **62.092** | **€** |
| Energy savings: | **543.466** | **kWh/year** |
| Energy savings percentage: | **37,31** | **%** |
| Carbon savings: | **83.302** | **kg$CO_2$/year** |
| Investment: | **441.016** | **€** |
| Equity percentage: | **80,00** | **%** |
| IRR: | **22,1** | **%** |
| NPV: | **159.284** | **€** |
| avg. DSCR: | **5,7** | |
| min. DSCR: | **3,4** | |
| Discounted payback: | **6** | **years** |

| PROJECT RATING |
|---|
| B |

| LABEL | DESCRIPTION |
|---|---|
| A | High Profitability, low likelihood of bad performance, very robust structure, short payback time, with a high level of security in the loan |
| B | Medium-High Profitability, medium-low likelihood of bad performance, medium-short payback time, with a medium-high level of security in the loan |
| C | Medium Profitability, medium likelihood of bad performance, medium payback time, with a medium level of security in the financing |
| D | Medium-Low Profitability, medium-high likelihood of bad performance, medium-long payback time, with a medium-low level of security in the financing |
| E | Low Profitability, high likelihood of bad performance, long payback time, with a low level of security in the financing |

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# Grazie per l'attenzione

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