4.432/4.433
Modeling Urban Energy Flows

Lisbon Gr.02

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Pombalino Buildings

Baixa, Lisbon | 1755
FAR: 2.5
sDA: 29%
EUI: 87 kWh/m²-yr
PROTOBLOCK CONFIGURATION
PROGRAM DISTRIBUTION

FAR: 2.53.2
Residential: 70%
Commercial: 20%
Retail: 10%
DAYLIGHT PERFORMANCE

- FAR: 2.53.2
- sDA: 29 80%
- Residential: 70%
- Commercial: 20%
- Retail: 10%
- Cash Flow (CFO): $36.56M – $36.63M
- Investment Yield: 14.51% – 14.54%
- Added Cash Flow: $24.0 – $24.3/s/m²/yr
FUTURE SPACE FLEXIBILITY

Commercial

Residence

75 m²

175 m²

175 m²

75 m²
PROJECT OBJECTIVES: AUTONOMY

- **Comfort**
  - achieve thermal comfort entirely passively

- **Electricity**
  - offset all annual electricity with renewables

- **Water**
  - eliminate domestic water heating energy
SEASONAL OUTDOOR COMFORT

- **Summer Comfort Zones**
  E-W Streets, North of Buildings

- **Winter Comfort Zones**
  N-S Streets, South of Buildings

- **Maximum Comfort Overlap**
  Street Intersections, West of Buildings
STREET LAYOUT & HIERARCHY

- **Primeira Avenida**
  Bus + Cars + Bikes + Pedestrians

- **Rua Pequena**
  Cars + Bikes + Pedestrians

- **Pedestre**
  Bikes + Pedestrians
COMMUNITY CONNECTIVITY

Existing Walk Score: **79**
Amenities Present but Points Deducted for Distance

Existing Bike Score: **95**
All Amenities within Biking Distance
NEIGHBORHOOD AMENITIES

1. Parks
2. Banks
3. Bookstores
4. Coffee Shops
5. Entertainment
6. Grocery Stores
7. Restaurants
8. Schools
9. Shopping
NEIGHBORHOOD AMENITIES
NEIGHBORHOOD WALK SCORE

Proposed Walk Score: 98

Cash Flow (CFO): $36.63M – $37.85M

Investment Yield: 14.54% – 15.02%

Added Cash Flow: $24.3 – $30.3 $/m²/yr
BASELINE ENERGY USE

Site EUI: 75 kWh/m²-yr  
Residential: 60 kWh/m²-yr  
Commercial: 100 kWh/m²-yr  
Retail: 110 kWh/m²-yr  

PV offset: 30 kWh/m²-yr
ENERGY USE CHARACTERIZATION

Site EUI: 75 kWh/m²-yr  
Lights / Equipment: 38 kWh/m²-yr  
Heating / Cooling: 07 kWh/m²-yr  
Domestic Hot Water: 30 kWh/m²-yr

PV Offset: 30 kWh/m²-yr
OPTIMIZE BUILDING ENVELOPE
IMPROVED ENVELOPE

Site EUI: 7572 kWh/m²-yr  PV offset: 30 kWh/m²-yr
Lights / Equipment: 38 kWh/m²-yr
Heating / Cooling: 0704 kWh/m²-yr
Domestic Hot Water: 30 kWh/m²-yr
ELECTRICITY, WATER EFFICIENCY
Site EUI: 7245 kWh/m²·yr

Lights / Equipment: 3829 kWh/m²·yr

Heating / Cooling: 0401 kWh/m²·yr

Domestic Hot Water: 3015 kWh/m²·yr

NET ZERO ELECTRICITY

PV offset: 30 kWh/m²·yr
**DOMESTIC WATER HEATING**

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy Usage (kWh/m²-yr)</th>
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<td>Site EUI</td>
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<tr>
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<tr>
<td><strong>PV offset</strong></td>
<td><strong>30</strong></td>
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PROGRAM USE DIVERSITY

Seasonal Hot Water Storage
Utilize Tanks to Store Rejected Heat from Commercial/Retail Cooling
DISTRICT ENERGY SYSTEMS

Seasonal Hot Water Storage
Utilize Tanks to Store Rejected Heat from Commercial/Retail Cooling

Tank Energy Storage Capacity
921 MWh based on Seasonal Changes in Power Supply and Demand
EXISTING TANKS TO STORE HEAT

Seasonal Hot Water Storage
Utilize Tanks to Store Rejected Heat from Commercial/Retail Cooling

Tank Energy Storage Capacity
921 MWh based on Seasonal Changes in Power Supply and Demand

Tank Water Storage Volume
12,000 m³, Roughly two Tanks on Site covers 45% of DHW needs
SEASONAL HOT WATER STORAGE

Site EUI: 7545 kWh/m²-yr
Lights / Equipment: 3829 kWh/m²-yr
Heating / Cooling: 0701 kWh/m²-yr
Domestic Hot Water: 3015 kWh/m²-yr

PV offset: 30 kWh/m²-yr
Tanks: 07 kWh/m²-yr
LOCAL HEAT vs DISTRICT HEAT

Flat Plate Solar Collectors
6,000m² for all DHW needs, Initial investment $1,000/m² panels

District Solar Thermal Collectors
Cost of insulated buried pipes, linear heat density, pipes economics

Preliminary Cost Comparison
Local: DHW @ $0.35/kWh | District: DHW+Heat @ $0.29/kWh
CONCENTRATED SOLAR COLLECTORS

District Solar Thermal Collectors
Cost of insulated buried pipes, linear heat density, pipes economics

Preliminary Cost Comparison
Local: DHW @ $0.35/kWh | District: DHW+Heat @ $0.29/kWh

Concentrating Solar Collectors
Install Collectors on Two Tanks to meet remaining DHW needs
NET ZERO ENERGY

Site EUI: 7545 kWh/m²-yr

Lights / Equipment: 3829 kWh/m²-yr
Heating / Cooling: 0701 kWh/m²-yr
Domestic Hot Water: 3015 kWh/m²-yr

PV Offset: 30 kWh/m²-yr
Tanks: 07 kWh/m²-yr
Solar: 08 kWh/m²-yr
Autônomo

- **Comfort**: achieve thermal comfort entirely passively
- **Electricity**: offset all annual electricity with renewables
- **Water**: eliminate domestic water heating energy