CITY-ZEN ROADSHOW ‘SEVILLA’

20th – 24th NOV 2017
TECNOLOGÍAS FUTURAS

THE LCA OF A CONSTRUCTION PRODUCT

- Maintenance
- Repair, replacement, refurbishment
- Building's operational use

JUNTA DE ANDALUCÍA

Sustainable Morphosis, Architecture & Technologies in a T.V.

CITY-zen

New urban energy
PARALLEL TALLERS

DAYS 2 - 4
PARALLEL TALLERS

DAYS 2-4
PARALLEL TALLERS

DAYS
2 - 4
JUEGO SERIO ‘Go2Zero’
JUEGO SERIO ‘Go2Zero’
## HOUSEHOLD ENERGY USE

<table>
<thead>
<tr>
<th>AVG EU</th>
<th>lighting appliances (kWh/yr)</th>
<th>cooling (kWh/yr)</th>
<th>heating (kWh/yr)</th>
<th>cooking (kWh/yr)</th>
<th>hot water (kWh/yr)</th>
<th>TV (kWh/yr)</th>
<th>total (kWh/yr)</th>
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<td>Alejandra</td>
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**SEVILLA: UNA CIUDAD DE BAJAS EMISIONES!**

**DAY 3 (WED)**

![Classroom scene with a presentation slide and students engaged in learning.](image_url)
WALKING TOUR

DAY 3 (WED)
DAY 4
(THUR)

PARALLEL TALLERS
VISIÓN
SEVILLA
SOSTENIBLE
Unit kg CO$_2$eq and the GLOBAL WARMING Potential
GWP100: CO$_2$ = 1; CH$_4$ = 34; N$_2$O = 298

I DON'T BELIEVE IN GLOBAL WARMING
ANDALUCIA (2015)

Electricity production  **83.0 TWh**

**THERMO-ELECTRICITY 54.98 TWh (66.2%)**
- Natural gas  **19.0 TWh (22.9%)**
- Coal  **34.70 TWh (41.8%)**
- Oil and others  **1.28 TWh (1.5%)**

**RENEWABLE 27.98 TWh (30.8%)**
- Solar thermal  **13.70 TWh (16.5%)**
- Solar PV  **1.60 TWh (1.9%)**
- Hydro  **0.59 TWh (0.6%)**
- Wind  **6.39 TWh (6.2%)**
- Biomass  **5.70 TWh (5.6%)**
- Geothermal –
- Biofuel & Waste –

**ELECTRICITY EMISSION FACTOR**
(LCA based)

**0.534 kg CO₂eq/kWh**

*Source: Agencia Andaluza de la Energía*
<table>
<thead>
<tr>
<th><strong>RESIDENTIAL ENERGY</strong></th>
<th>1,945,729 t CO₂eq/yr</th>
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<tbody>
<tr>
<td>Electricity</td>
<td>3,223.84 GWh/yr</td>
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<tr>
<td>Natural gas</td>
<td>345.41 GWh/yr</td>
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<tr>
<td>Diesel</td>
<td>182.59 GWh/yr</td>
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<tr>
<td>LGP</td>
<td>650.12 GWh/yr</td>
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<td>Biomass + thermosolar</td>
<td>594.29 GWh/yr</td>
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</table>

<table>
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<tr>
<th><strong>SERVICES</strong></th>
<th>1,282,478 t CO₂eq/yr</th>
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<tbody>
<tr>
<td>Electricity</td>
<td>2,329.49 GWh/yr</td>
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<tr>
<td>Natural gas</td>
<td>252.37 GWh/yr</td>
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<td>Diesel</td>
<td>36.05 GWh/yr</td>
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<tr>
<td>LPG</td>
<td>13.06 GWh/yr</td>
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<tr>
<td>Biomass+Biogas</td>
<td>124.44 GWh/yr</td>
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<th><strong>PRIMARY SECTOR</strong></th>
<th>551,995 t CO₂eq/yr</th>
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<tr>
<td>Electricity</td>
<td>282.61 GWh/yr</td>
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<tr>
<td>Natural gas</td>
<td>143.05 GWh/yr</td>
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<td>Diesel</td>
<td>1,337.45 GWh/yr</td>
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<td>LPG</td>
<td>6.98 GWh/yr</td>
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<tr>
<td>Biodiesel+Bioethanol</td>
<td>73.27 GWh/yr</td>
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<table>
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<th><strong>INDUSTRIAL ENERGY</strong></th>
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<tr>
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<td>Coal</td>
<td>8.14 GWh/yr</td>
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<td>Natural gas</td>
<td>1,761.95 GWh/yr</td>
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<td>Diesel</td>
<td>24.42 GWh/yr</td>
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<td>LPG</td>
<td>58.15 GWh/yr</td>
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<td>Petroleum</td>
<td>909.47 GWh/yr</td>
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<tr>
<td>biomas+biogas</td>
<td>377.98 GWh/yr</td>
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<table>
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<tr>
<th><strong>MOBILITY</strong></th>
<th>2,910,884 t CO₂eq/yr</th>
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<tr>
<td>Electricity</td>
<td>79.08 GWh/yr</td>
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<tr>
<td>Diesel</td>
<td>7,572.29 GWh/yr</td>
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<td>Fuels</td>
<td>3,230.82 GWh/yr</td>
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<table>
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<th><strong>WASTE MANAGEMENT</strong></th>
<th>210,981 t CO₂eq/yr</th>
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<tr>
<td>Collected quantity</td>
<td>871,725 t/yr</td>
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<tr>
<td>Waste to landfill</td>
<td>155,952 t/yr</td>
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<td>Composting</td>
<td>330,514 t/yr</td>
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<table>
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<th><strong>WATER MANAGEMENT</strong></th>
<th>46,430 t CO₂eq/yr</th>
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<tr>
<td>Water use</td>
<td>79,367,702 m³/yr</td>
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</table>

Source: Agencia Andaluza de la Energía
Source: Anuario Estatistico de la Ciudad de Sevilla
CARBON ACCOUNTING
CARBON FOOTPRINT ASSESSMENT OF THE PROVINCE OF SEVILLA

Sevilla Province 14,036 km²

CARBON FOOTPRINT
8,308,886 t CO₂eq/yr

FORESTLAND GRABBING
6155 km² forestland

existing forestland
4220 km² forest i.e. 70%

<table>
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<tr>
<th>Sector</th>
<th>Contribution</th>
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<tr>
<td>Housing</td>
<td>23%</td>
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<tr>
<td>Services</td>
<td>15%</td>
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<tr>
<td>Primary sector</td>
<td>7%</td>
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<tr>
<td>Industry (energy use)</td>
<td>16%</td>
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<tr>
<td>Transport (includes flights)</td>
<td>35%</td>
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<tr>
<td>Waste management</td>
<td>3%</td>
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<tr>
<td>Water management</td>
<td>1%</td>
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New urban energy
CARBON ACCOUNTING
HOUSEHOLD PROFILE
### SEVILLA HOUSEHOLD (DISTRICT SUR)

<table>
<thead>
<tr>
<th>Category</th>
<th>Avg inhabit.</th>
<th>kg CO₂ eq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg inhabit.</td>
<td>2.6</td>
<td></td>
<td>n.</td>
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<tr>
<td>Gross floor surface</td>
<td>70</td>
<td>m²</td>
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#### ENERGY DEMAND

- **E - Cooling**: 3,177 kWh/m²
- **E - Lighting & appliances**: 1,116 kWh/m²
- **H – Heating (energy mix)**: 1,204 kWh/m²
- **H – DHW (energy mix)**: 1,157 kWh/m²

#### MOBILITY

- **Driven km/house**: 6,410 km/yr

#### WASTE MANAGEMENT

- **Waste per household**: 1162.9 kg/yr
- **Waste to energy**: 0.4%
- **Waste to landfill**: 17.9%
- **Organic waste**: 37.9%
- **Recicled**: 44.2%

#### WATER MANAGEMENT

- **Water use per household**: 106 m³/yr

### CARBON FOOTPRINT ASSESSMENT OF THE AVG. HOUSEHOLD IN SEVILLA (DISTRICT SUR)

**Average values per household**

- **Energy**: 2,591 kg CO₂eq
- **Mobility**: 2,307.9 kg CO₂eq
- **Waste Management**: 284.5 kg CO₂eq
- **Water Management**: 61.9 kg CO₂eq

**Per person**

- **Energy**: 987 kg CO₂eq
- **Mobility**: 863.3 kg CO₂eq
- **Waste Management**: 116.2 kg CO₂eq
- **Water Management**: 20.6 kg CO₂eq

**Energy Demand**

- **Energy mix**: 1133 kWh/m²
- **Heat (energy mix)**: 1,204 kWh/m²
- **H – DHW (energy mix)**: 1,157 kWh/m²

**Mobility**

- **Average km/house**: 6,410 km/yr

**Waste Management**

- **Waste per household**: 1162.9 kg/yr
- **Organic waste**: 37.9%
- **Recicled**: 44.2%

**Water Management**

- **Water use per household**: 106 m³/yr

**Carbón Footprint**

- **Energy**: 5.92 t CO₂eq/yr
- **Mobility**: 5.04 t CO₂eq/yr
- **Waste Management**: 5.70 t CO₂eq/yr
- **Water Management**: 5.80 t CO₂eq/yr

**Combined Footprint**: 5.25 t CO₂eq/yr
SEVILLA HOUSEHOLD

Ref: 2014-2015
People: 2.6 inhab./house
Avg surface: 70 m²/house
Electricity: 4293 kWh/yr
Heat: 1204 kWh/yr
(mix: 19% CH₄, 10% diesel, 37% LPG, 34% RES)
Mobility: 30 km/day x 1.06 car/house
Waste: 1.16 t/house yr
Water: 106 m³/house yr

The carbon footprint offset of one household is equivalent to 0.39 ha forestland

Source: Agencia Andaluza de la Energía; Anuario Estatistico de la Ciudad de Sevilla 2017
CARBON ACCOUNTING
NEIGHBOURHOOD
What is the impact of the Barrio Tiro de Linea?

BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households
BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

Carbon Footprint: 28,136 t CO$_2$-eq
Forestland grabbing: 2084 ha
BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

Carbon Footprint: 28,136 t CO$_2$-eq
Forestland grabbing: 2084 ha

- ELECTRICITY 12700 MWh
- HEAT ENERGY 23000 MWh
- MOBILITY 34400 km/house yr
- WASTE 6240 t (1160 kg/house)
- WATER 568,000 m$^3$ (106 m$^3$/house)

12205 t CO$_2$-eq; 904ha forestland
1694 t CO$_2$-eq; 125ha forestland
12380 t CO$_2$-eq; 917ha forestland
1526 t CO$_2$-eq; 113ha forestland
332 t CO$_2$-eq; 25ha forestland
TAPPING INTO THE POTENTIAL
MOVIENDO
Copenhague expertos en movilidad:
Si dejas el espacio para conducir en coche,
la gente usará el coche
Si dejas el espacio para ir en bicicleta,
la gente usará la bicicleta
peatones, bici, coches, buses (travías)
How Seville transformed itself into the cycling capital of southern Europe

Manuel Calvo @ The Guardian

GREEN HEROS
GREEN HEROS
Huerta del Rey Moro
GREEN HEROES
TIRO DE LÍNEA
TIRO DE LÍNEA
TIRO DE LÍNEA
NEVERTHELESS
NEVERTHELESS
DISRUPTIVE CHANGE
Equipa Urbanista

City-zen roadie

- **Prof. Greg Keeffe** (Queens University Belfast)

Interpreter and guest roadie

- **Jesús Cardona** (Nontropía)

Student facilitators

- **Dora Vancsó** (TU Delft)
- **Laura Solarino** (TU Delft)
- **Antigoni Karaiskou** (TU Delft)
Equipa Energetica

City-zen roadies
- Prof. Andy van den Dobbelsteen (TU Delft)
- Dr. Riccardo Pulselli (Università di Siena)
- Matteo Maccanti (Università di Siena)
- Dr. Han Vandevyvere (EnergyVille)
- Dr. Leen Peeters (Think!E)

Student facilitators
- Eva Farrugia (TU Delft)
- Michael Cobb (TU Delft)
- Álvaro Rodríguez García (TU Delft)
CITY-ZEN ROADMAPPING SCHEME

[City-zen WP4T2 team, image by Siebe Broersma and Michiel Fremouw, TU Delft]
What does the sustainable city look like in 2050?

Hammarby Sjöstad, Stockholm
Aims of the Roadshow energy studio

Main aim: to support Sevilla in its energy transition from fossil fuels to renewable sources

Stepped objectives

1. Creating a good overview of energy demand, supply and local potentials
2. Converting energy usage to a carbon footprint
3. Finding solutions to get to net zero-carbon developments
   - Reduce the energy demand (urban planning, building design, appliances)
   - Reuse waste energy (program, attune, exchange, store)
   - Produce renewables (sun, wind, water, soil, air, biomass, humans)
4. Involve solutions for non-building sectors:
   - Transportation
   - Waste (water) treatment
   - Economic developments
5. Calculate the carbon emissions reduced and remaining carbon footprint
Climate data

Conclusion: mean temperature 18°C → soil perfect for cooling/pre-heating
What is happening here?
MACRO SCALE
WATER IN THE CITY
Reconnect the city to the Guadalquivir and use flowing water to cool and humidify it.
MACRO SCALE
WATER IN THE CITY

Reconnect the city to the Guadalquivir and use flowing water to cool and humidify it.
Tiro de Línea
**MESO SCALE**

**CAPTURE & STORE**

A combination of rainwater collection, filtering, evaporative cooling and a playground.
Use of cisterns underneath the streets which link to the water squares.
MICRO SCALE
CAPTURE & REUSE
Condensate Irrigation from Heat Exchangers
Tiro de Línea
Water infra
Water – green – energy hubs
Urban Heat Island: Normalised Difference Vegetation Index
### Table 2

<table>
<thead>
<tr>
<th>Period</th>
<th>SERES climatic scenario</th>
<th>$T_{\text{CC}}^{\text{max}}$ ($^\circ\text{C}$)</th>
<th>$\Delta T_{\text{max}}$ ($^\circ\text{C}$)</th>
<th>Landsat 7 ETM+</th>
<th>$\text{NDVI}^{\text{CC}}$ (dim)</th>
<th>$S_{\text{CO}}^{\text{CC}}$ (ha)</th>
<th>$\Delta A_{\text{gr}}$ (ha)</th>
<th>Percentage of roofs to vegetate (%)</th>
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<tr>
<td>2011–2040 A2</td>
<td>a/35.5</td>
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<td>1414</td>
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<td>0.56</td>
<td>1519</td>
<td>629</td>
<td>34.5</td>
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</table>

Percentage of green roofs needed due to climate change.
Different green solutions for different street sections

Percentage of street shaded with different height/widths

Streets in danger of overheating

Tiro de Línea

PASSIVE ENERGY

RENOVATION STRATEGIES
INNER-CITY DENSITIES - SELF SHADING

INCREASED SHADING MEANS COOLER PATHS TO WALK ALONG AND COOLER BUILDINGS
PASSIVE ENERGY
RENOVATION STRATEGIES
INNER-CITY DENSITIES
New Stepped Strategy for energy-positive (re) design

1. **Reduce the demand**
   a) Smart bioclimatic design
   b) Energy-efficient appliances

2. **Reuse waste energy**
   a) Recover heat/cold from exhaust air and waste water (buildings)
   b) Attune urban functions programmatically (neighbourhoods)
   c) Exchange heat, cold and electricity (neighbourhoods)
   d) Store heat, cold and electricity (neighbourhoods-districts)
   e) Use industrial waste heat (city)

3. **Produce renewable energy**
   a) Solar
   b) Wind
   c) Water
   d) Air
   e) Geothermal
   f) Biomass
   g) Human
Typical facades and roofs

[Diagram showing typical facades and roofs with specifications and materials listed for each.]

[Government of Spain/IDAE; Energy Performance Scale – Existing Buildings; Madrid, 2011]
Energy renovation options

- **Minimal**
  - Simple & cheap
  - Saves most cooling needs

- **Wrap up**
  - More extensive & expensive
  - Saves a lot of cooling and heating needs

- **Solar skin**
  - Technical solution
  - Reduces most cooling needs
  - Produces a lot of electricity

- **Green veil**
  - Green solution
  - Reduces most cooling needs and saves heating
  - Combined with PV roof: produces electricity

- **Combination of all 4 possible**
PV porn

- **PV shell over the building, East to West**
  - Catches sun in the morning, afternoon, evening
  - Continuous production during the day
  - Estimated yield with a 20x10x12 m block: 64 MWh

- **Main issue: electricity storage**
  - Daytime domestic activities
  - Central battery storage
  - Electric vehicles
  - Heat pump charging the heat/cold storage
Soil energy options – from passive to active
ACTIVE ENERGY
RENOVATION STRATEGIES
INDIVIDUAL

Vertical soil collectors, individual heat pumps, PV panels and heat exchangers.
ACTIVE ENERGY RENOVATION STRATEGIES
COLLECTIVE

Collective system with a cool/warm air supply and a professionally managed system.
ACTIVE ENERGY RENOVATION STRATEGIES
COMMUNAL

A hot and cold grid will supply energy to the neighbourhood on a communal scale.
PV: 4.2 kW/flat → 4200 €
PV: 4.2 kW/flat → 4200 €

Green: 4000 €/housing block
PV: 4.2 kW/flat → 4200 €

Borehole: 1250 €/flat
Heat pump & tubing: 4000 €/flat

Green: 4000 €/housing block
- PV: 4.2 kW/flat → 4200 €
- Borehole: 1250 €/flat
- Heat pump & tubing: 4000 €/flat
- Investment: 4200 € + (4000 €)/3 + 1250 € + 4000 € = 10 783 €
- Annual energy cost: 630 €
- Annual maintenance: 100 €
- 10 year balance: 18 083 €
PV: 4.2 kW/flat → 4200 €

Green: 4000 €/housing block

Borehole: 1250 €/flat
Heat pump & tubing: 4000 €/flat

ENERGY COOPERATIVE
→ Sells heat, cold and electricity @ 0.15 €/kWh
→ 10 year balance: 18 083 € → 120 553 kWh
PV:
4.2 kW/flat → 4200 €

ENERGY COOPERATIVE
Sells heat, cold and electricity @ 0.15 € /kWh
10 year balance: 18 083 € → 120 553 kWh > 20 years energy use > life-time of equipment

Green:
4000 €/ housing block

Borehole: 1250 € /flat
Heat pump & tubing: 4000 € /flat
Trash on the streets

Mierda...
An energy cooperative could involve waste processing

- Collection of waste
- Repair and reuse
- Recycling
- Digestion of organic waste
- Production of biogas for restaurants
Tiro de Línea sostenible

- Rainwater collection and usage
- Green infrastructure
- Energy renovation of buildings
- Energy cooperations that serve energy hubs
- Clean waste management
- Sustainable mobility: bikes and electric cars
El Corte Nuevo
El Corte Nuevo detail
Plaza de Aguas
Plaza de Aguas detail
Rambla verde
Tiro de Línea sostenible
'Dream no small dreams for they have no power to move the hearts of men...’  Von Goethe
Barrios urbanism
How big is big enough!
Hard edge
City desire line
Permeable/non-permeable space
Cars cars and more cars
Surveyed and non-surveyed space
Over-centralised space
Over-scaled external space
Correctly proportioned space
Seville Climate Projections. UK Met Office

<table>
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<tr>
<th>Year</th>
<th>Average Temp</th>
<th>Average High</th>
<th>Maximum Temp</th>
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<tbody>
<tr>
<td>2017</td>
<td>19.4</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>2070</td>
<td>24</td>
<td>45</td>
<td>55</td>
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</table>

Climate similar to Dubai by 2070

Correctly proportioned space
Perforated urbanism
Unpack the neighbourhood
Unpack the neighbourhood
Unpack the neighbourhood
Unpack the neighbourhood
UNPACK GREEN SPACE – MAKE OASES

UNDERGROUND PARKING

URBAN OASIS
Shading (trees)
Vertical farming/gardens
Rooftop gardens

SHADING (WATER STORAGE+PV)

FROM STREET TO SHARED PAVEMENT

Unpack green space – make oases
Unpack green space – make oases
Unpack green space – make oases
Densify urban space – create shade
Densify urban space – create shade
Make small green routes
Make small green routes
Unpack green space – make oases
Unpack green space – make oases
Reclaim the street – with car-share!
Reclaim the street – with car-share!
Reclaim the street – with car-share!
Reclaim the street – with car-share!
Reclaim the street – with car-share!
Bike-friendly routes go through the neighbourhood
Repack the neighbourhood
Unpacking the market makes new exciting public space
Unpacking the market makes new exciting public space
Unpacking the market makes new exciting public space
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NOW

To conclude
STEP 1: 25% GREEN

Unpacking the market makes new exciting public space.
STEP 2: 50% GREEN

MESO | ROOFTOP GARDEN, LARGER COURTYARD | RULES
Ability to sit comfortably and meet friends
More greenery
Shaded
STEP 3: 75% GREEN

Unpacking the market makes new exciting public space.
STEP 4: 100% GREEN
CARBON FOOTPRINT MITIGATION MEASURES
BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

- ELECTRICITY: 12700 MWh
- HEAT ENERGY: 23000 MWh
- MOBILITY: 34400 km/house yr
- WASTE: 6240 t (1160 kg/house)
- WATER: 568,000 m3 (106 m3/house)

Pacman is coming...
ELECTRICITY 12700 MWh
HEAT ENERGY 23000 MWh
MOBILITY 34400 km/house yr
WASTE 6240 t (1160 kg/house)
WATER 568,000 m3 (106 m3/house)

BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

PASSIVE SYSTEMS
greening, shading, low emission paint
(20% houses)
-50% cooling (-1700MWh)
BARRIO TIRO DE LINEA
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THERMAL INSULATION
roof/facade retrofitting
(30% houses)
-50% cooling (-2500 MWh)
-75% heating (-1450 MWh)
ELECTRICITY 12700 MWh
HEAT ENERGY 23000 MWh
MOBILITY 34400 km/house yr
WASTE 6240 t (1160 kg/house)
WATER 568,000 m³ (106 m³/house)

BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

Behavioural changes
LED lights, air conditioning
(80% houses)
-50% electric lighting
(-2400 MWh)
BARRIO TIRO DE LINEA
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- **WATER**: 568,000 m³ (106 m³/house)

HEAT PUMP
(household scale)
(30% houses)
- 75% heating (-1500 MWh)
- 75% DHW (-1400 MWh)
+20% electricity (+360 MWh)
ELECTRICITY 12700 MWh
HEAT ENERGY 23000 MWh
MOBILITY 34400 km/house yr
WASTE 6240 t (1160 kg/house)
WATER 568,000 m³ (106 m³/house)

BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

HEAT PUMP
(neighbourhood scale)
(60% houses)
-75% heating (-3000 MWh)
-75% DHW (-2800 MWh)
+20% electricity (+720 MWh)
ELECTRICITY 12700 MWh
HEAT ENERGY 23000 MWh
MOBILITY 34400 km/house yr
WASTE 6240 t (1160 kg/house)
WATER 568,000 m³ (106 m³/house)

BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

PV panels (building block scale)
(30% houses)
-100% electricity (-7000 MWh)
BARRIO TIRO DE LINEA
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Electric bike sharing
(-15% private car use)
-100% fuel
+20% electricity for appliances
<table>
<thead>
<tr>
<th>Resource</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>12700 MWh</td>
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<tr>
<td>Heat Energy</td>
<td>23000 MWh</td>
</tr>
<tr>
<td>Mobility</td>
<td>34400 km/house yr</td>
</tr>
<tr>
<td>Waste</td>
<td>6240 t (1160 kg/house)</td>
</tr>
<tr>
<td>Water</td>
<td>568,000 m3 (106 m3/house)</td>
</tr>
</tbody>
</table>

**BARRIO TIRO DE LINEA**

14,000 inhabitants; 5364 households

- Bike to school/work (-30% private car use)
- 100% fuel
BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

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**Electric car recharger station**
(10% electric cars)
-100% fuel
+40% electricity for appliances
BARRIO TIRO DE LINEA
14,000 inhabitants; 5364 households

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- **MOBILITY**: 34400 km/house yr
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PV panels sharing (neighbourhood scale)
(40% houses)
-100% electricity (-10000 MWh)
BARRIO TIRO DE LINEA
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Tram line (district Sur scale)
(-40% private car use)
-100% fuels
BARRIO TIRO DE LINEA
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Differentiated waste
(100% house)
-70% waste-to-landfill
BARRIO TIRO DE LINEA
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Differentiated waste (avoided landfill) (100% house)
-100% waste-to-landfill
BARRIO TIRO DE LINEA
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Existing parks
New green assets
RE surplus (neighbourhood scale)
ELECTRICITY 12700 MWh
HEAT ENERGY 23000 MWh
MOBILITY 34400 km/house yr
WASTE 6240 t (1160 kg/house)
WATER 568,000 m³ (106 m³/house)

TENED CONFIANZA... GO TO ZERO!!!