

# A flexible methodology to analyse 100 % renewable energy cities

Andrea Menapace – *Free University of Bolzano*

In collaboration with:

Henrik Lund & Jakob Zinck Thellufsen – *Aalborg University*

Giovanni Pernigotto, Andrea Gasparella, Maurizio Righetti & Marco Baratieri – *Free University of Bolzano*



Powered by



# How to design 100% renewable energy cities?

## Principles:

✓ Renewability

✓ Smart

✓ Sustainability

## Holistic smart energy approach:

- Local energy generation and energy recovery
- Smart grids and smart flexibility
- Energy system in balance: “connected island mode”

Powered by



## Methodology features:

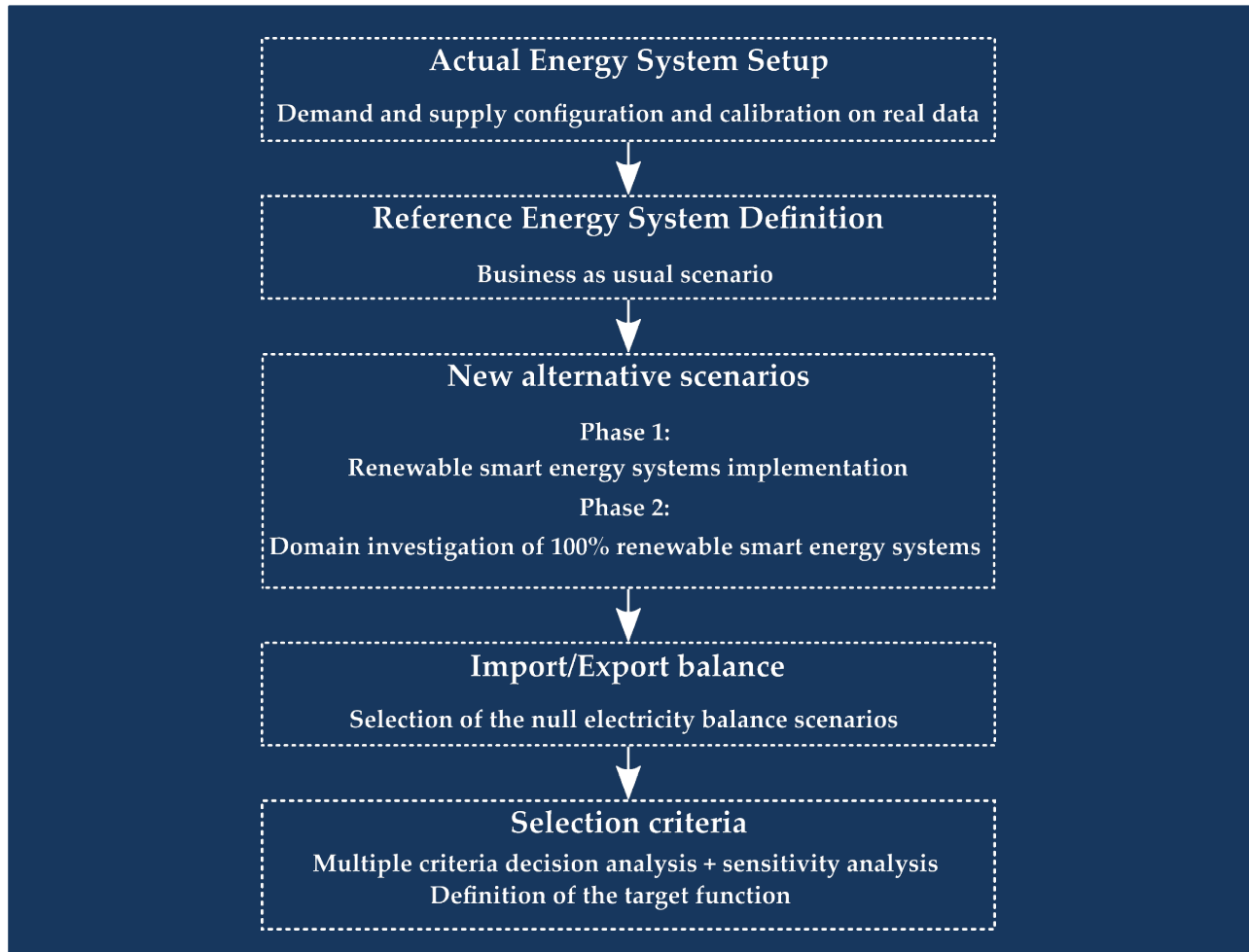
### Framework:

- ❖ EnergyPLAN
- ❖ Multiple-criteria analysis

- ❖ **Hourly energy system simulations**
- ❖ **Complex smart energy systems modelling**
- ❖ **Cutting-edge technologies implementation**
- ❖ **Deep multi-parameter analysis**
- ❖ **Multi criteria decision analysis with sensitivity analysis**
- ❖ **Best alternatives selection without priori setting of target function**

Powered by





Powered by



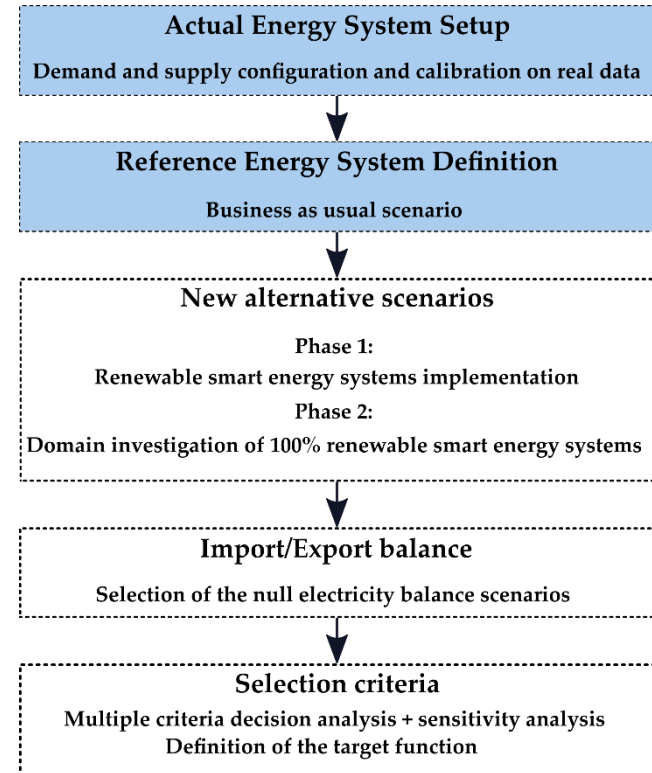
## Step 1-2: energy model setup

### Step 1:

- Delimitation of the urban system
- Data collection
- Model of the system in the reference year
- Model calibration

### Step 2:

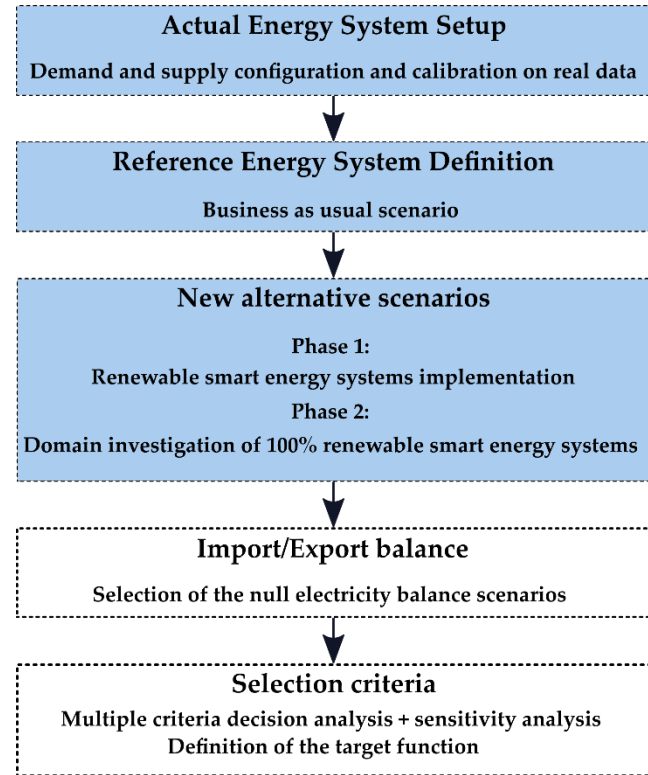
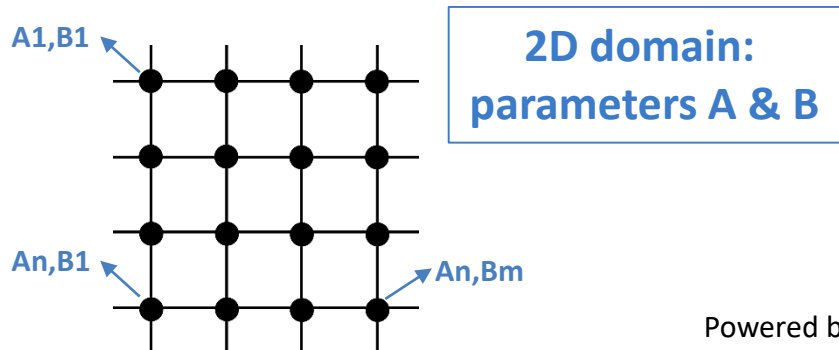
- Projection to business-as-usual-scenario



# Step 3: deep domain analysis

## Step 3:

- Implementation of smart grids and cutting-edge technologies – energy transition
- In-deep domain investigation: EnergyPLAN



Powered by

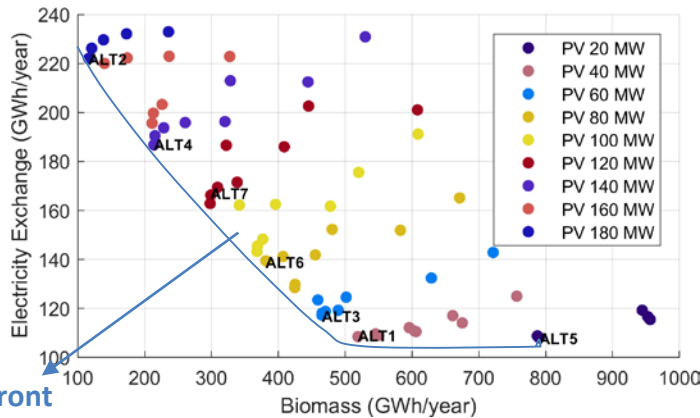
## Step 4-5: selection criteria

### Step 4:

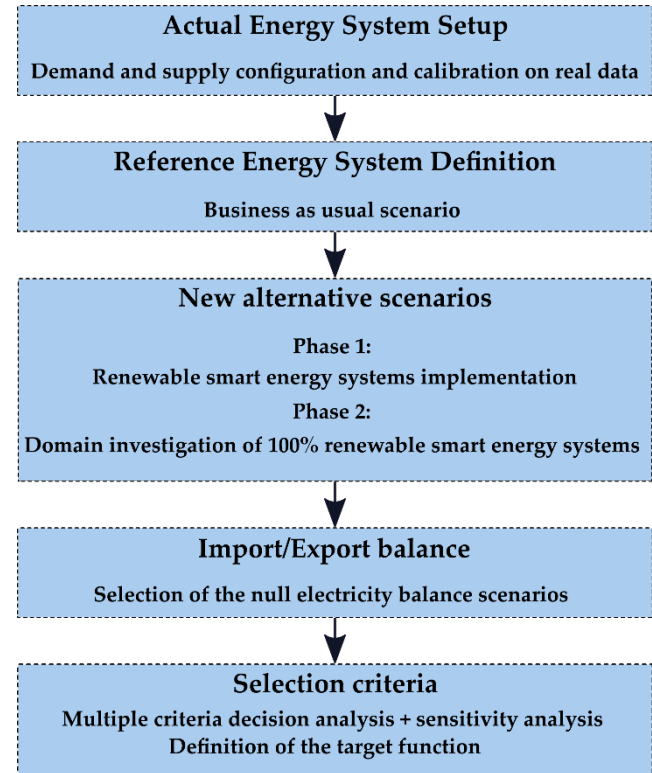
- Systems operating in island mode

### Step 5:

- Best scenarios identification



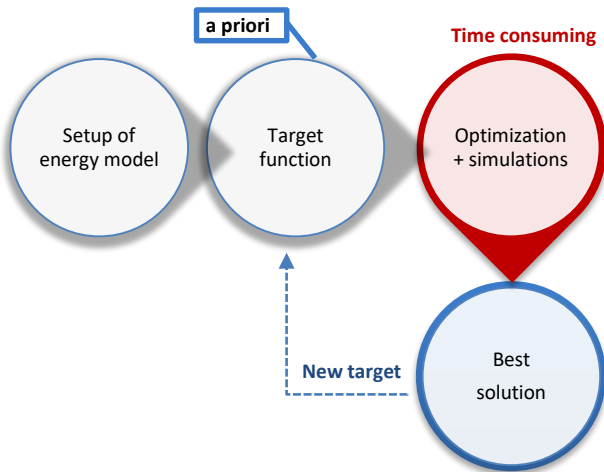
E.g.



Powered by

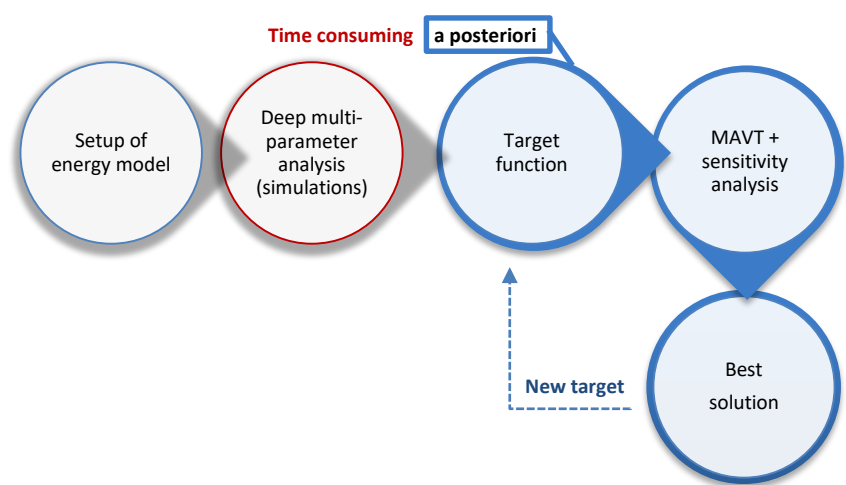
# Findings

## Traditional optimization



**Optimal solution / No flexibility**

## Proposed procedure



**Flexibility / Close to optimal**

Powered by





# Thanks for your attention!

**Andrea Menapace**

Free University of Bozen-Bolzano  
Faculty of Science and Technology

✉ andmenapace@unibz.it

 andrea-menapace



Presentation inspired by:

"Menapace A., Thellufsen J.Z., Pernigotto G., Roberti F., Gasparella A., Righetti M., Baratieri M., and Lund H. (2020).

**The design of 100% renewable smart urban energy systems: the case of Bozen-Bolzano.** *Energy*, 207, 118198

doi: <https://doi.org/10.1016/j.energy.2020.118198>"

Powered by

