Eco-Friendly Sustainable Campus

Action 5 | Online projects presentation:

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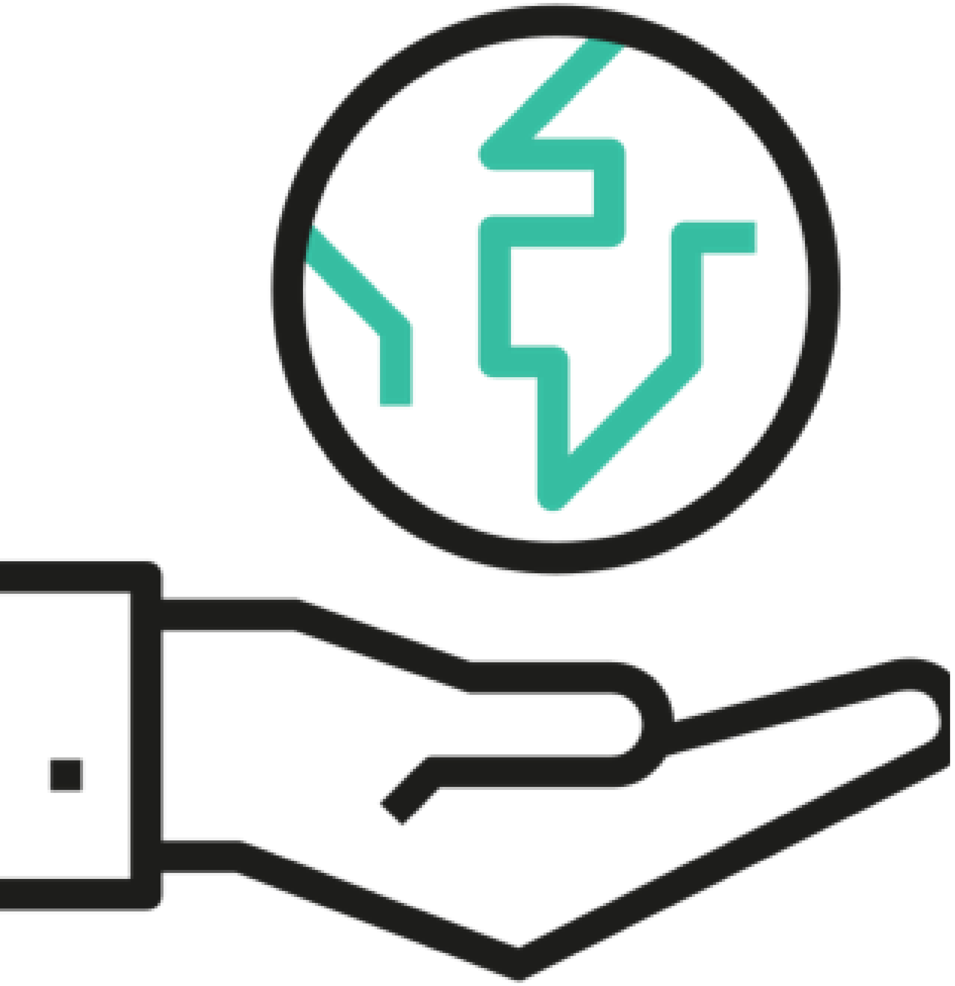
EULIST



Definition of sustainability

01 Sustainability has three dimensions: Economic efficiency, social justice and environmental sustainability.

02 Sustainability means meeting the needs of the present without compromising the opportunities of future generations.

Environmental aspects

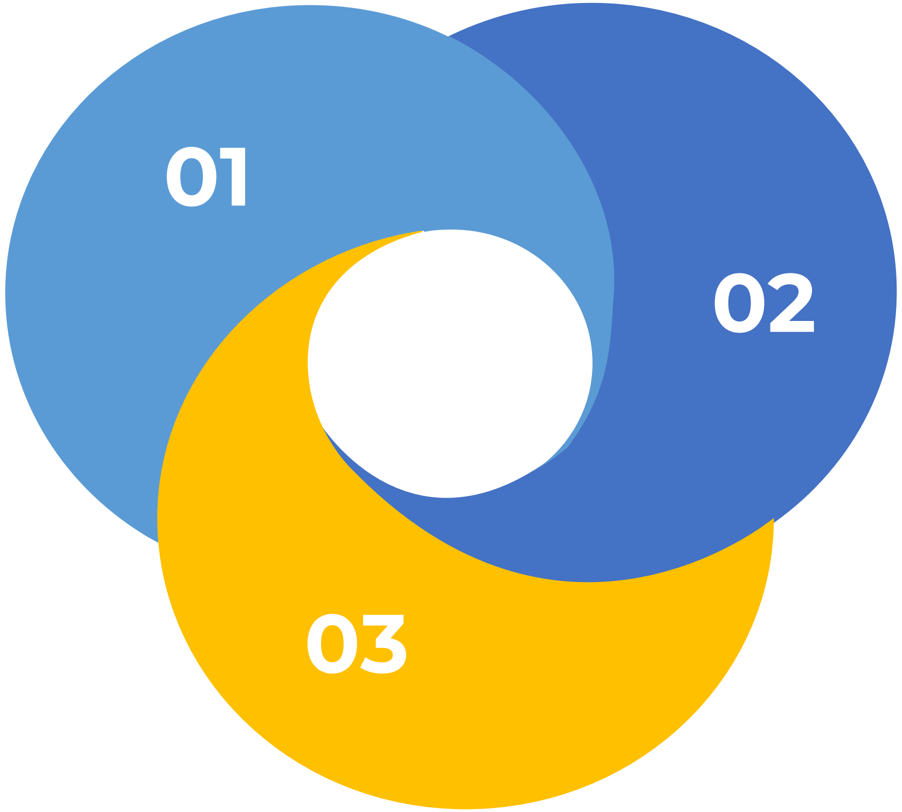
Importance of sustainability

- Protection and conservation of natural resources and ecosystems.
- Reducing pollution, saving water resources and reducing CO_2 emissions.
- Develop sustainable buildings and energy saving measures.

social aspects

Importance of sustainability

Emphasis on justice, social inclusion and equal opportunities in society.



Ensure affordable and accessible energy-saving homes.

Promoting the use of sustainable energy.

Importance of sustainability

Economic aspects

- Creating a stable and balanced economic system.
- Focus on long-term economic sustainability.
- Eco-systemical approach for feasible solutions.
- Vital target to diminish the exploitation of the natural capital.

Dimension integration

Importance of sustainability

01 The balance between these dimensions is crucial to meet the needs of the present without compromising the future.

02 All three aspects of sustainability are intertwined and must be considered together for truly sustainable development.

Problems environmental pollution

Pollution is any unwanted introduction of pollutants, fumes, effluents, emissions, waste, nuclear radiation, and noise and light into the environment that disrupts and impairs the natural processes and resources of our planet

EFFECTS

- extreme weather events
- sea level rise
- health impacts
- ecosystems can be damaged
- habitats reduced and inanimate made

Need to reduce the use of non-renewable resources

Non-renewable resources are natural resources that cannot be restored in a human time frame. These resources are formed over millions of years and are limited in their availability. They primarily include fossil fuels such as oil, coal and natural gas, but also mineral resources such as metals.

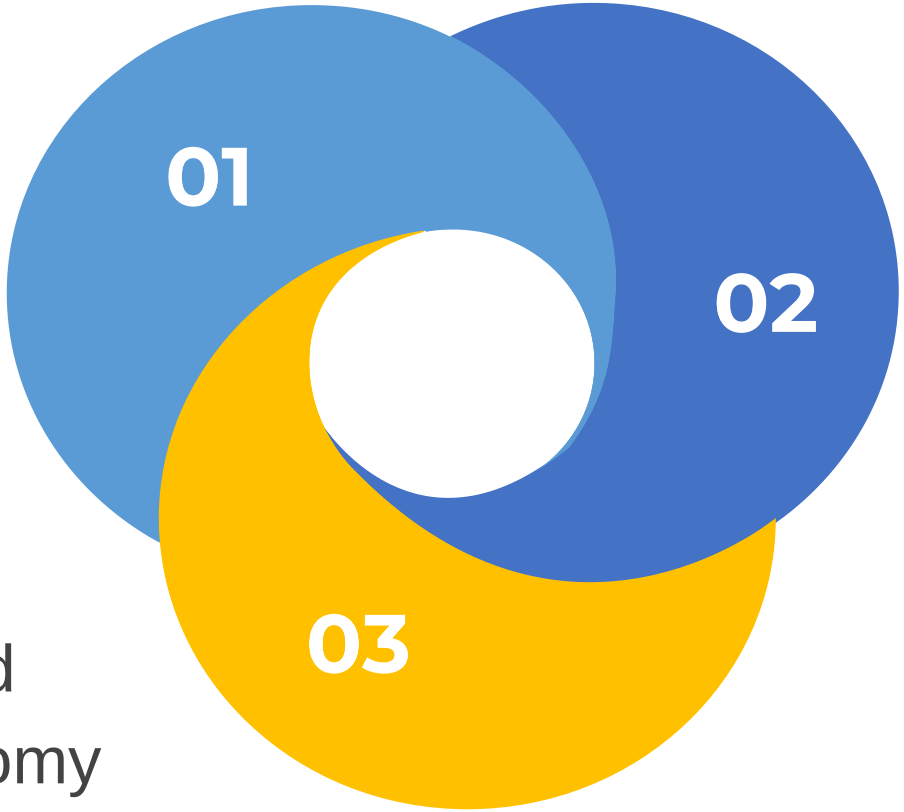
Problems

- depletion and scarcity
- sea enviromental impacts of extraction and refining
- dependence on improvised resources

Importance of sustainability

Strategies to reduce the use of non-renewable resources

Focus on renewable energies



Energy efficiency improvements

Recycling and circular economy

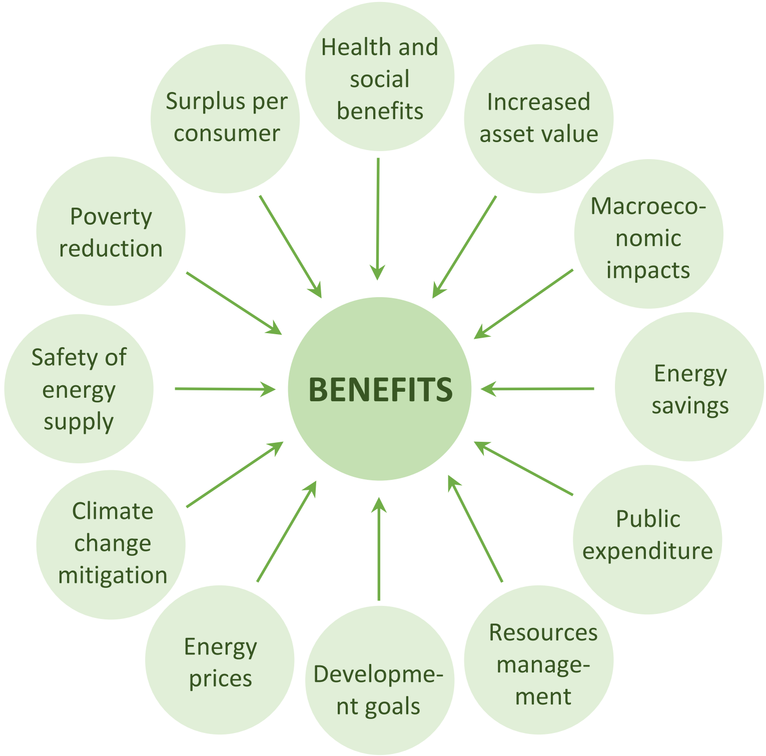
construction industry

- most energy-intensive industries in the world
  - extensive energy requirements during the construction process
- most of the energy consumption is not due to construction, but to the use and operation of the buildings
  - → It is important that the buildings are constructed sustainably so that this does not happen

What can I do if I want to make the building more sustainable?

Energy requalification is based on the need to reduce energy consumption with the same:

- COMFORT INDOOR
- COMFORT OUTDOOR
- SAFETY REQUIREMENTS



What can I do to make a building more efficient?

Energy efficiency measures can be carried out in two ways:

"SPOT" INTERVENTION

Intervention on a single building component without an overall energy assessment of the building-plant system.

PLANNED AND INTEGRATED INTERVENTION

Intervention on several building components with an overall energy assessment of the building-plant system.

BUILDING ENVELOPE

- Opaque
- Transparent

PLANTS

- Heating
- Air conditioning
- Ventilation
- Electrical system
- …

A planned and integrated intervention need for energy simulation!

ENERGY SIMULATION

Dynamic energy simulation is a valuable technical tool that can guide the designer in choosing between alternative solutions. It allows to simulate in a very realistic and detailed way the real behavior of the building, hour after hour in all days of the year.

CRITICAL ISSUES

Through energy simulation it is possible to have a greater awareness of energy phenomena and critical issues in the building.

OPTIMIZATION STRATEGIES

Once the critical issues are known, it is possible to intervene with efficiency strategies. The energy simulation allows us to optimize the choices saving on consumption, construction and maintenance costs.

What could be the optimization strategies?

We can take **action on**:

BUILDING ENVELOPE

Acting on the stratigraphy of the wall to reduce the high transmittance value.

Reduce thermal bridges with more insulation and better insulation.

Replacing glass with better performing glass to reduce the solar factor.

Reducing the thermal transmittance value of window frames by introducing a better performing one.

Acting on the stratigraphy of the floor to reduce the high transmittance value.

Replacing building components with photovoltaics (Building Integrated Photovoltaic - BIPV).

PLANTS

Introduction of more efficient HVAC systems with low-consumption components (e.g., heat pumps, etc.)

Use of energy-saving light bulbs for the lighting system (e.g., replacing incandescent bulbs with LEDs)

Introduction of renewable sources such as photovoltaic panels and wind turbines for electricity production and solar thermal panels for hot water production.

Installation of automation, control and monitoring systems for energy saving in buildings (BACS)

EXTERNAL DEVICES

Installation of shading systems (horizontal/vertical, internal/external, fixed/orientable sunshades, Venetian blinds, roller blinds, slats in double glazing, etc.)

Replacing external solar shading devices of building with photovoltaics (Building Integrated Photovoltaic - BIPV). Integration is possible in parapets, balustrades, canopies, sunshades and blinds.

Energy modelling

Baseline construction set according 90.1 – 2019 standard

Optimization strategies

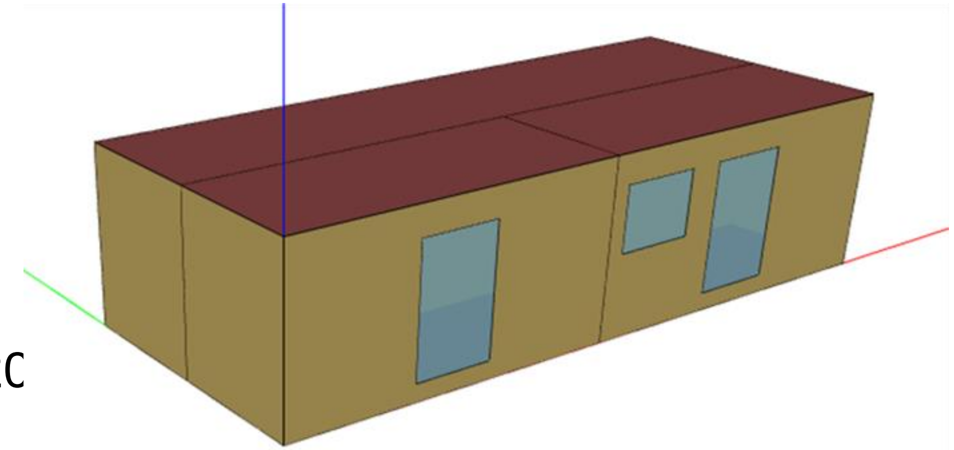
- Extra layer of wall insulation

  Athens: R = 2.1 $m^2\ K/W$

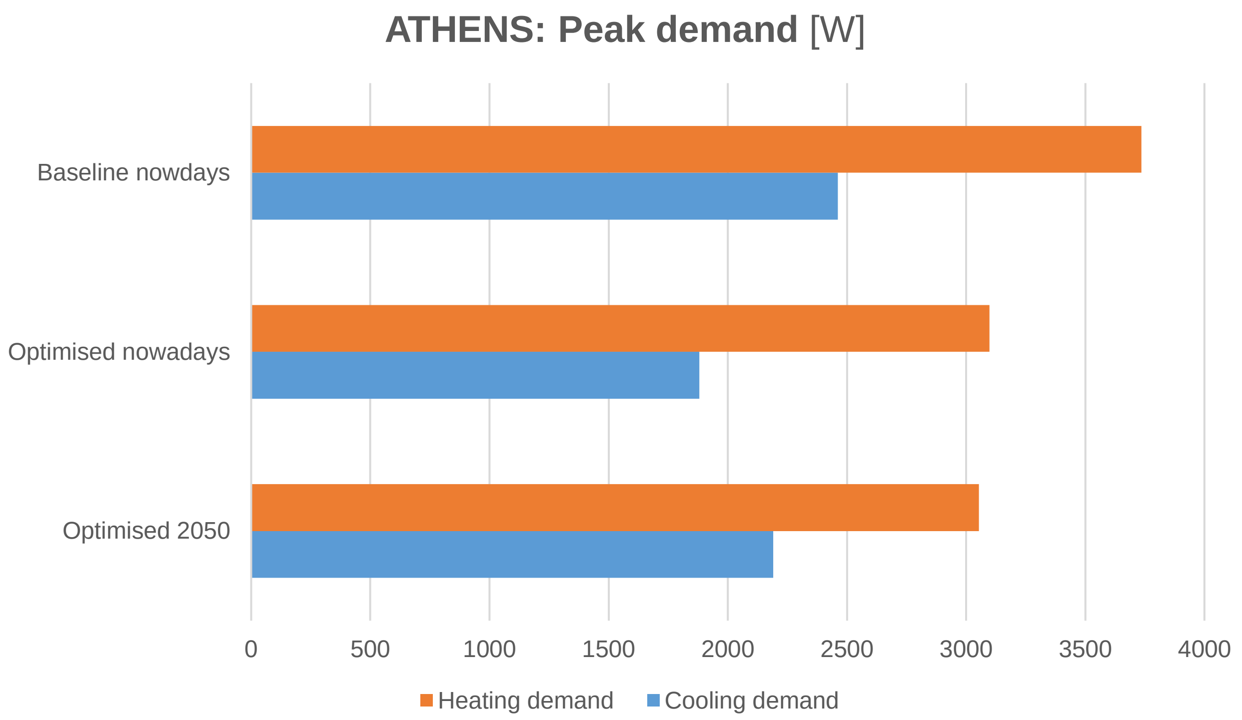
  Stockholm: R = 3.7 $m^2\ K/W$

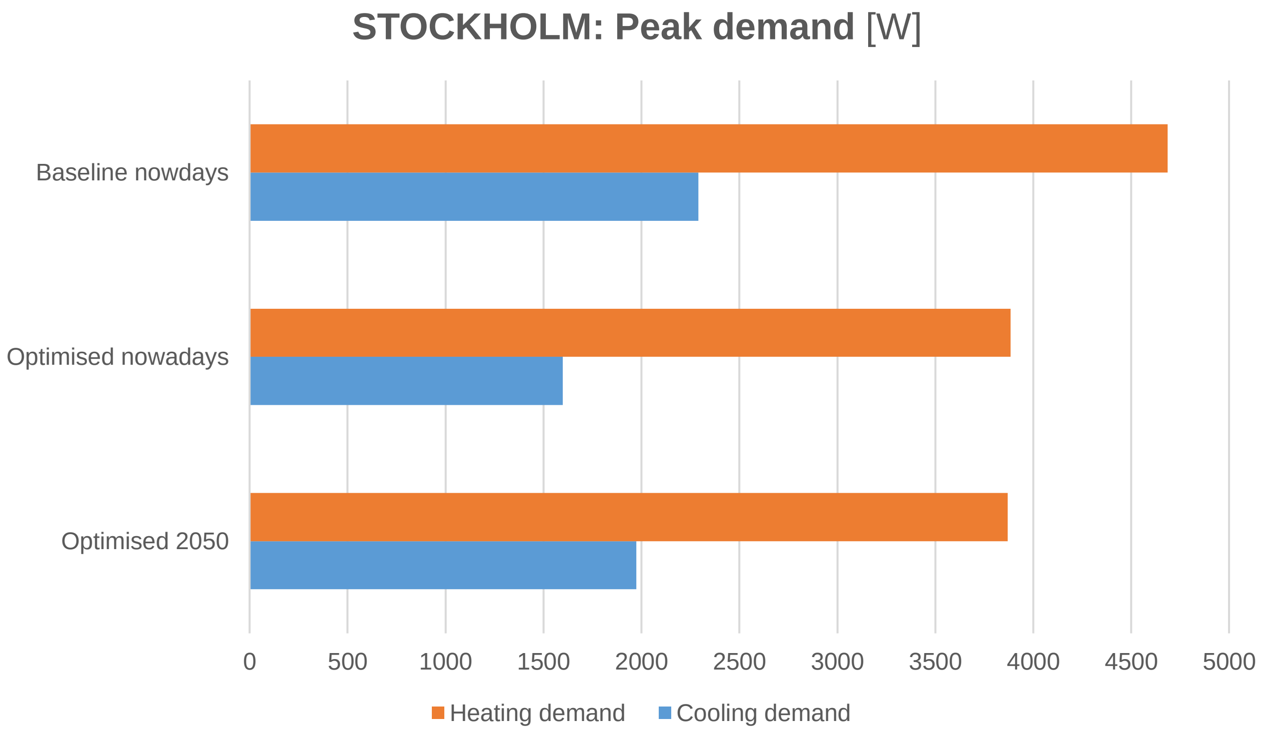
- Thermal mass increase

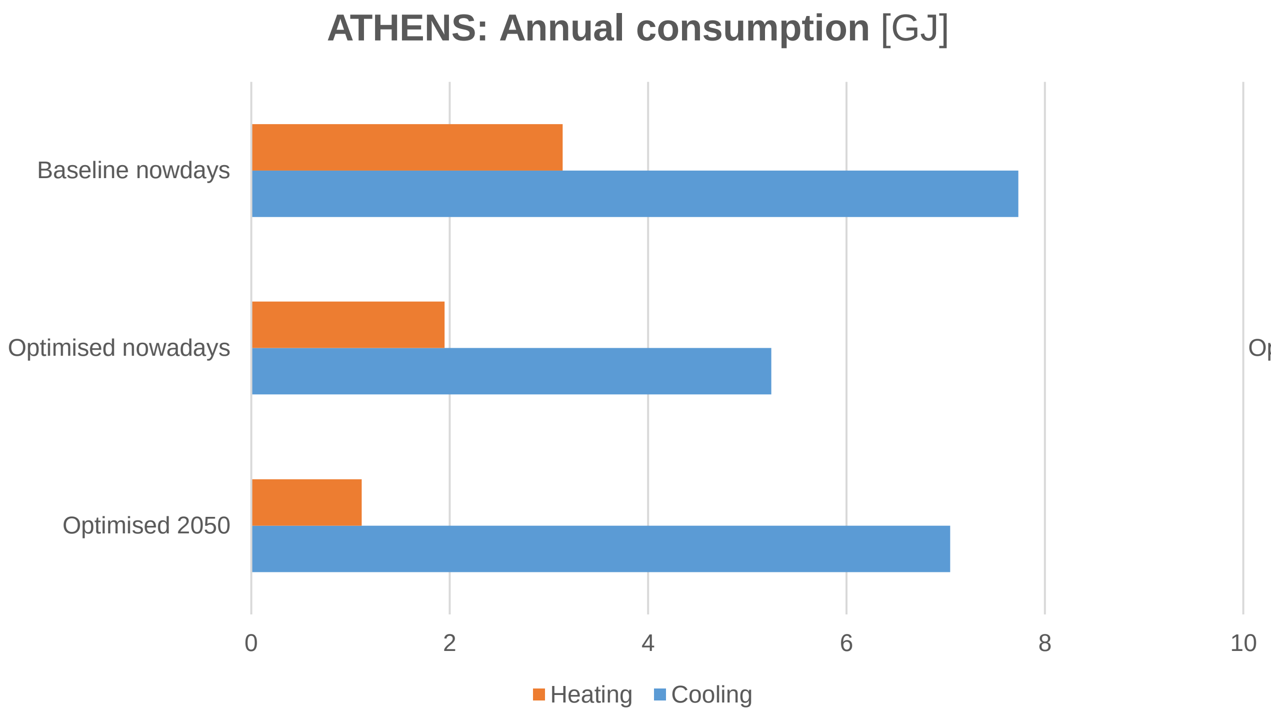
  Phase change material in the wall was assumed to be 20 cm of granite layer

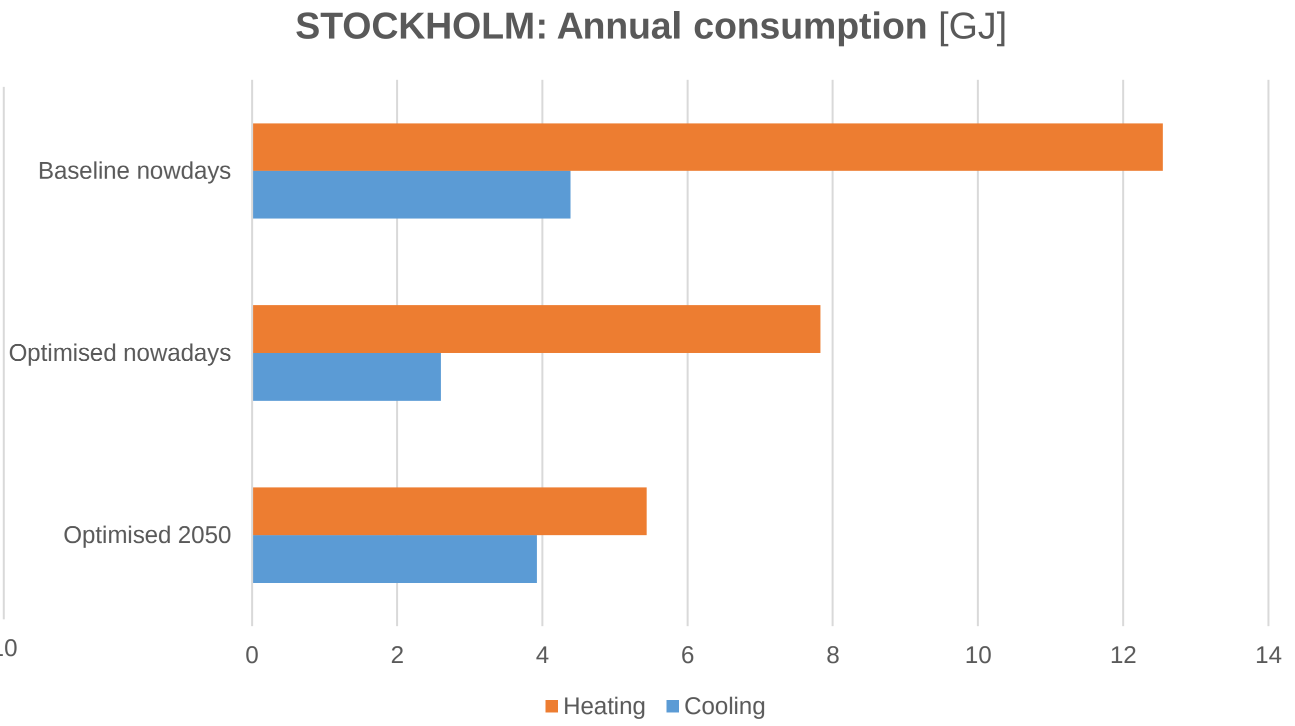


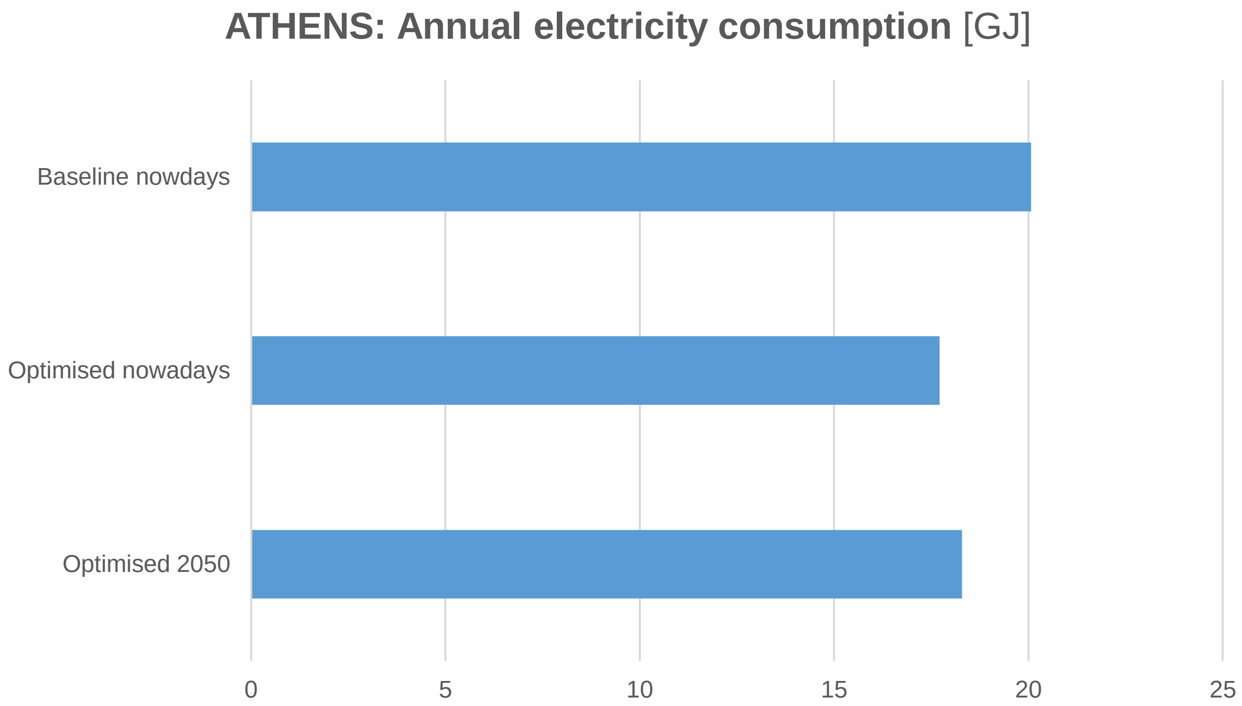
HadCM3 model was used for 2050 weather forecast

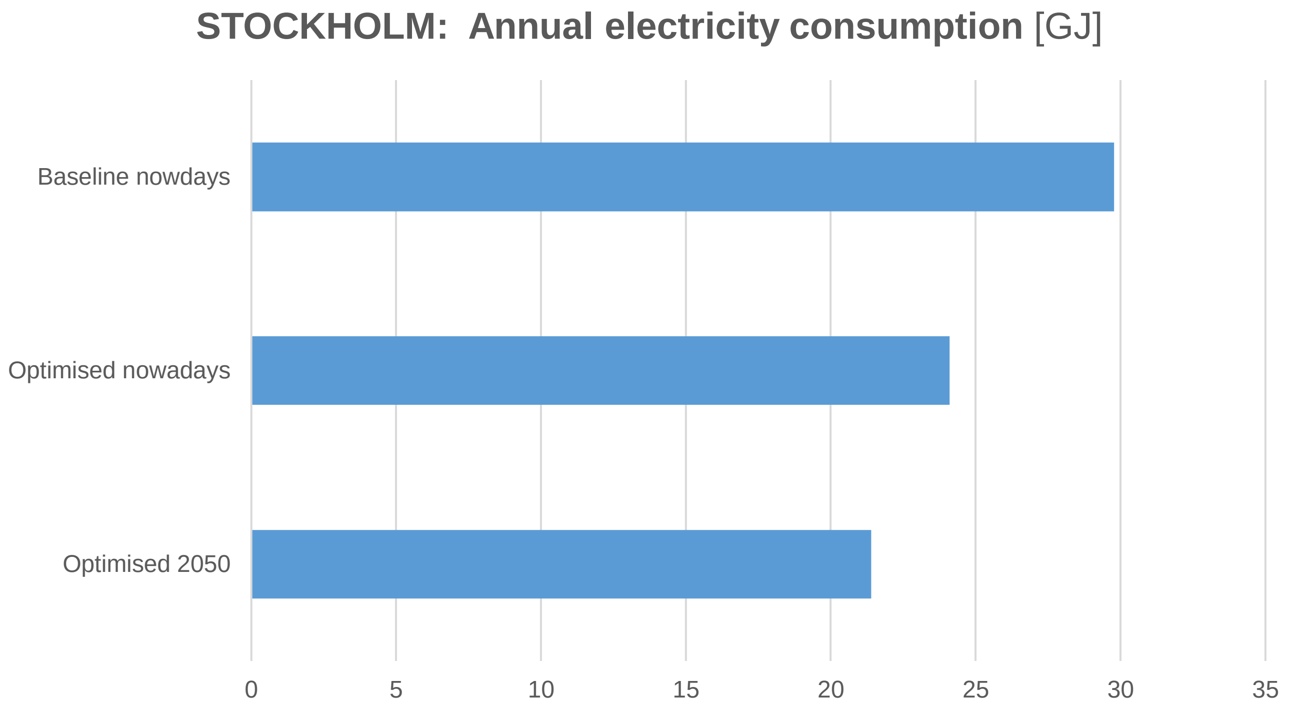

ATHENS: Peak demand [W]
Baseline nowdays
Optimised nowadays
Optimised 2050
0
500
1000
1500
2000
2500
3000
3500
4000
Heating demand
Cooling demand


STOCKHOLM: Peak demand [W]
Baseline nowdays
Optimised nowadays
Optimised 2050
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Heating demand
Cooling demand


ATHENS: Annual consumption [GJ]
Baseline nowdays
Optimised nowadays
Optimised 2050
0
2
4
6
8
10
Heating
Cooling


STOCKHOLM: Annual consumption [GJ]
Baseline nowdays
Optimised nowadays
Optimised 2050
0
2
4
6
8
10
12
14
Heating
Cooling


ATHENS: Annual electricity consumption [GJ]
Baseline nowdays
Optimised nowadays
Optimised 2050
0
5
10
15
20
25


STOCKHOLM: Annual electricity consumption [GJ]
Baseline nowdays
Optimised nowadays
Optimised 2050
0
5
10
15
20
25
30
35

Life cycle cost analysis - Initial Hypothesis

- Ceteris Paribus analysis with one analytical criteria (cost of energy consumption)
- Due to the abundant budget the hypothetical construction cost for both investments is 100.000$
- Interest rates for both cities is 0,03%
- The values are before taxation.
- The inflation is estimated to zero
- The life cycle is estimated to 25 years

Life cycle cost analysis - Athens (Tarrifs for utility Bills)

Report: **Economics Results Summary Report**

For: **Entire Facility**

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Annual Cost

	Electricity	Natural Gas	Other	Total
Cost [$]	360.09	0.00	0.00	360.09
Cost per Total Building Area [$/m2]	6.00	0.00	0.00	6.00
Cost per Net Conditioned Building Area [$/m2]	6.00	0.00	0.00	6.00

Tariff Summary

	Selected	Qualified	Meter	Buy or Sell	Group	Annual Cost ($)
ELECTRICITY TARIFF	Yes	Yes	ELECTRICITYPURCHASED:FACILITY	Buy	(none)	360.09
GAS TARIFF	Yes	Yes	NATURALGAS:FACILITY	Buy	(none)	0.00
WATER TARIFF	No	Yes	WATER:FACILITY	Buy	(none)	0.00
DISTRICTHEATING TARIFF	No	Yes	DISTRICTHEATING:FACILITY	Buy	(none)	0.00
DISTRICTCOOLING TARIFF	No	Yes	DISTRICTCOOLING:FACILITY	Buy	(none)	0.00

General

	Parameter
Meter	ELECTRICITYPURCHASED:FACILITY
Selected	Yes
Group	(none)
Qualified	Yes
Disqualifier	n/a
Computation	automatic
Units	kWh

Categories

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Max
EnergyCharges ($)	32.01	32.88	27.71	25.15	26.73	28.43	35.26	35.44	29.30	26.50	26.70	33.96	360.09	35.44
DemandCharges ($)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ServiceCharges ($)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Basis ($)	32.01	32.88	27.71	25.15	26.73	28.43	35.26	35.44	29.30	26.50	26.70	33.96	360.09	35.44
Adjustment ($)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surcharge ($)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal ($)	32.01	32.88	27.71	25.15	26.73	28.43	35.26	35.44	29.30	26.50	26.70	33.96	360.09	35.44
Taxes ($)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total ($)	32.01	32.88	27.71	25.15	26.73	28.43	35.26	35.44	29.30	26.50	26.70	33.96	360.09	35.44

Charges

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Max	Category
BLOCKENERGYCHARGE ($)	32.01	32.88	27.71	25.15	26.73	28.43	35.26	35.44	29.30	26.50	26.70	33.96	360.09	35.44	EnergyCharges

Life cycle cost analysis - Athens (Total energy costs)

Present Value by Year

	Total Cost (Without Escalation)	Total Cost (With Escalation)	Present Value of Costs
January 2011	360.09	360.09	349.60
January 2012	360.09	360.09	339.41
January 2013	360.09	360.09	329.53
January 2014	360.09	360.09	319.93
January 2015	360.09	360.09	310.61
January 2016	360.09	360.09	301.57
January 2017	360.09	360.09	292.78
January 2018	360.09	360.09	284.25
January 2019	360.09	360.09	275.98
January 2020	360.09	360.09	267.94
January 2021	360.09	360.09	260.13
January 2022	360.09	360.09	252.56
January 2023	360.09	360.09	245.20
January 2024	360.09	360.09	238.06
January 2025	360.09	360.09	231.12
January 2026	360.09	360.09	224.39
January 2027	360.09	360.09	217.86
January 2028	360.09	360.09	211.51
January 2029	360.09	360.09	205.35
January 2030	360.09	360.09	199.37
January 2031	360.09	360.09	193.56
January 2032	360.09	360.09	187.93
January 2033	360.09	360.09	182.45
January 2034	360.09	360.09	177.14
January 2035	360.09	360.09	171.98
TOTAL			6270.21

The ROI is measuring the profit. Which means that if someone has a ROI of 0,9 in 25 years, he will be profitable quite as much as the double of the initial investment.

Life cycle cost analysis - Stockholm (Tarrifs for utility Bills)

Report: **Economics Results Summary Report**

For: **Entire Facility**

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Annual Cost

	Electricity	Natural Gas	Other	Total
Cost [$]	381.52	0.00	0.00	381.52
Cost per Total Building Area [$/m2]	6.36	0.00	0.00	6.36
Cost per Net Conditioned Building Area [$/m2]	6.36	0.00	0.00	6.36

Tariff Summary

	Selected	Qualified	Meter	Buy or Sell	Group	Annual Cost ($)
ELECTRICITY TARIFF	Yes	Yes	ELECTRICITYPURCHASED:FACILITY	Buy	(none)	381.52
GAS TARIFF	Yes	Yes	NATURALGAS:FACILITY	Buy	(none)	0.00
WATER TARIFF	No	Yes	WATER:FACILITY	Buy	(none)	0.00
DISTRICTHEATING TARIFF	No	Yes	DISTRICTHEATING:FACILITY	Buy	(none)	0.00
DISTRICTCOOLING TARIFF	No	Yes	DISTRICTCOOLING:FACILITY	Buy	(none)	0.00
SECONDARY GENERAL	No	Yes	ELECTRICITYPURCHASED:FACILITY	Buy	(none)	874.03
LARGE CG	No	Yes	GAS:FACILITY	Buy	(none)	0.00

Charges

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Max	Category
BLOCKENERGYCHARGE ($)	51.87	37.39	37.06	27.71	23.43	23.62	26.50	26.85	21.57	24.47	35.28	45.77	381.52	51.87	EnergyCharges

- The maximum cost of energy is during January and the minimum, during September.

The focus should be on how to decrease the costs of energy during the winter period.

Life cycle cost analysis - Stockholm (Total energy costs)

Present Value by Year

	Total Cost (Without Escalation)	Total Cost (With Escalation)	Present Value of Costs
January 2011	381.52	381.52	370.41
January 2012	381.52	381.52	359.62
January 2013	381.52	381.52	349.15
January 2014	381.52	381.52	338.98
January 2015	381.52	381.52	329.10
January 2016	381.52	381.52	319.52
January 2017	381.52	381.52	310.21
January 2018	381.52	381.52	301.18
January 2019	381.52	381.52	292.40
January 2020	381.52	381.52	283.89
January 2021	381.52	381.52	275.62
January 2022	381.52	381.52	267.59
January 2023	381.52	381.52	259.80
January 2024	381.52	381.52	252.23
January 2025	381.52	381.52	244.88
January 2026	381.52	381.52	237.75
January 2027	381.52	381.52	230.83
January 2028	381.52	381.52	224.10
January 2029	381.52	381.52	217.58
January 2030	381.52	381.52	211.24
January 2031	381.52	381.52	205.09
January 2032	381.52	381.52	199.11
January 2033	381.52	381.52	193.31
January 2034	381.52	381.52	187.68
January 2035	381.52	381.52	182.22
TOTAL			6643.48

1. Total annual energy cost: 381,52$

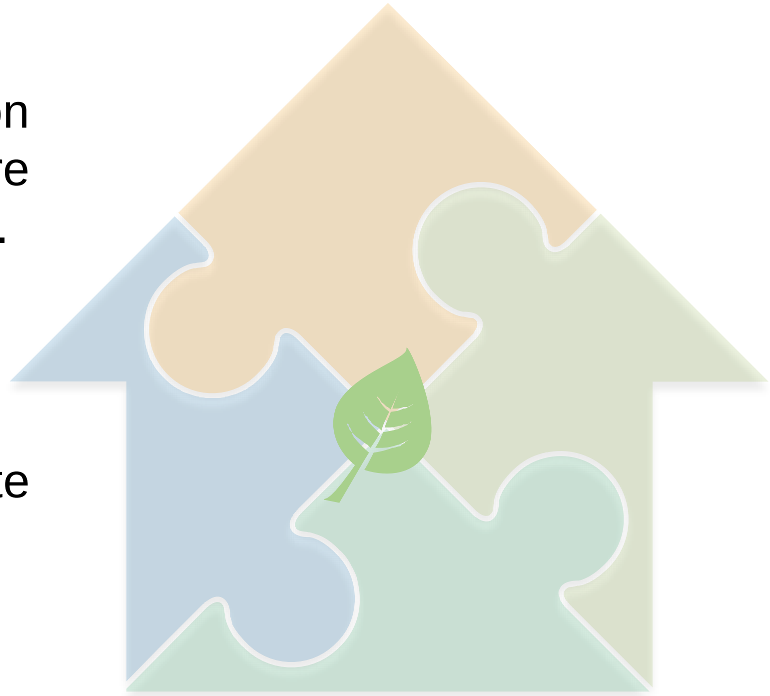
1. Total energy cost for 25 year-cycle-life: 6643,48$

1. ROI (Return of the investment) for 25 years = 0,933 or 93,3%

1. Projected Value of Cost in 2050: 134,22$ (without inflation and taxation interventions)

Final Conclusions - The road towards a sustainable strategy

- Multi-disciplined approaches needed.
- Extended use of Renewable Energy Resources and Construction Materials will decrease importantly the total costs of the future investments and will increase the environmental positive impact of them.
- Tailor-made and environmental oriented solutions.
- A sustainable project can absorb most of the external costs and climate discomforts within the construction in a deep-long-run analysis.
- Urgent need to establish a monitoring system of all the strategies.



Thank you for your attention