REGIONE DEL VENETO

REGIONE TOSCANA

Mattoni SSN
Progetto Mattone Internazionale

reshospitals

Co-funded by the Intelligent Energy Europe Programme of the European Union

Lessons from a European Project:

The input of RES- Hospitals and its Guide for the challenge of "HOSPITALS AT ZERO CARBON"

Prof. Arch. Simona Ganassi Agger

IEE Project: SI2.593326/IEE/10/261
June 2011 – November 2013

Consortium Members & Associates

The partnership consists of 11 organisations from eight countries and three European centres:

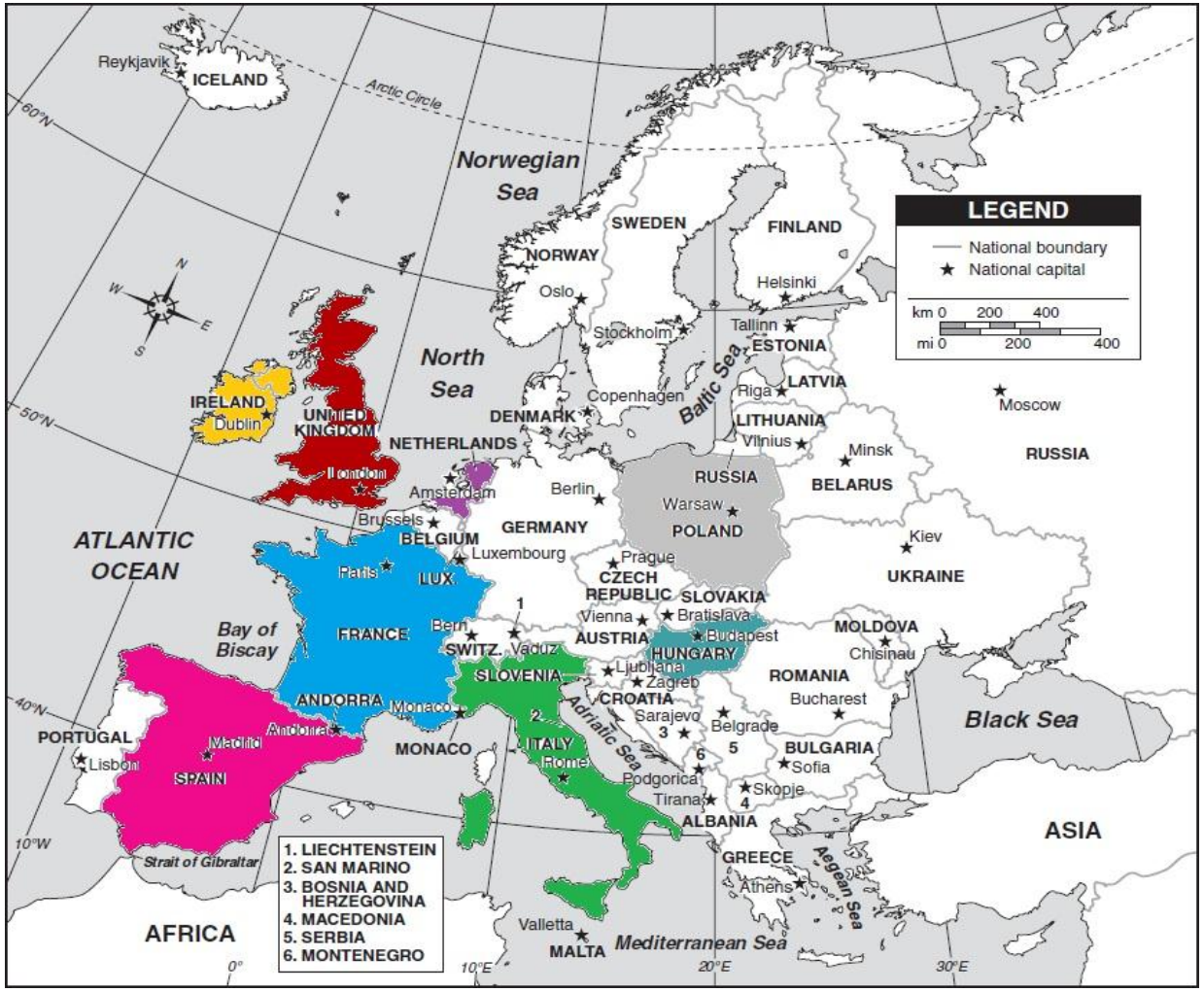
- **Italy - Asti Local Health Agency (coordinator)**
- **France - I'lle de France (Paris area) Regional Health Agency**
- **Hungary – Health Services Management Training Centre**
- **Ireland – National Directorate of Estates**
- **Netherlands - TNO**
- **Poland – Sucha Beskidzka Hospital**
- **Scotland - Health Facilities Scotland**
- **Spain - BIOEF**
- **ECHAA - European Centre for Health Assets and Architecture**
- **Optimat (UK)**
- **SIAIS – Italian Society for Architecture and Engineering of the Health Sector**

Coordinator

Prof. Arch. Simona Ganassi Agger, RES-Hospitals European Project Manager, ASL ASTI

Countries Involved

- FRANCE
- ITALY
- HOLAND
- IRELAND
- UNITED KINGDOM
- POLAND
- HUNGARY
- SPAIN



Rational Behind the Project

The Scientists Message

Climate change is one of the great challenges of the 21st century. Its most severe impacts may still be avoided if efforts are made to transform current energy systems. Renewable energy sources have a large potential to displace emissions of greenhouse gases from the combustion of fossil fuels and thereby to mitigate climate change. If implemented properly, **renewable energy sources** can contribute to social and economic development, to energy access, to a secure and sustainable energy supply, and to a reduction of negative impacts of energy provision on the **environment and human health**

From: Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN)

Intergovernmental Panel on Climate Change (IPCC)

Rational Behind the Project

Europe 2020 Energy Targets

- 20% lower than 1990 Greenhouse Gas Emissions (mainly CO_2)
- 20% of Energy produced from Renewable Sources
- 20% increase in Energy Efficiency (reduction of Energy consumption by 368 Mtoe)

Rational Behind the Project

The European Hospitals

26.000 hospitals in Europe that operate 24/7/365, collectively account for around 5% of EU CO_2 emissions.

The Health sector is facing:

Increasing demand for healthcare

Move towards community-based delivery

Increasing pressure to reduce unit cost of healthcare

Reducing energy consumption (cost) is a priority

Policy commitments to reduce CO_2 emissions

Regarded by most as an issue for the future

Rational Behind the Project

Hospitals as Strategic Institutions

RES-Hospital project, coherently with the objectives of IEE Program, is focused on identifying, and possibly proposing measures of reduction, of **non-technical barriers** to the exploitation of energy efficiency measures and renewable energy systems, with regard to the hospitals needs of thermal and electric energy.

Rational Behind the Project

Hospitals as Strategic Institutions

This is even more evident when

the total picture of the hospitals influence in the CO_2 emissions is considered.

The following slide illustrates the three "scopes" of hospitals related GHGs emission.

Two projects: **Low Carbon Buildings – Healthcare**, recently concluded and its continuation **EcoQUIP** have addressed the actions that can be taken for "Scope 2", with regard to getting better, cheaper and sustainable hospitals supplies and services, stimulating highly needed innovation in the health sector and new demand of health services.

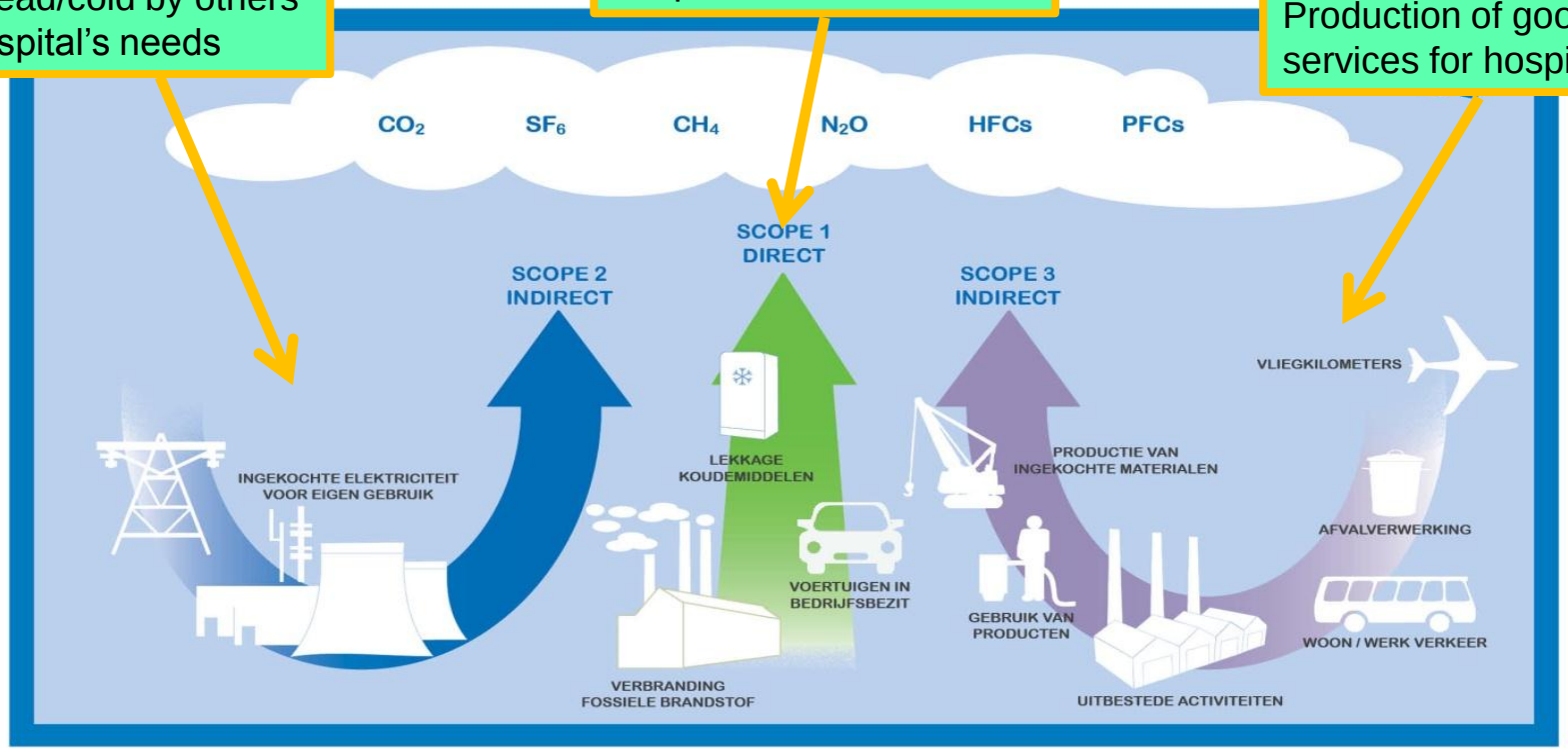
Rational Behind the Project

Hospital Related Greenhouse Emissions

Production of electricity and head/cold by others for hospital's needs

Emissions produced by hospitals activities

Production of good and services for hospitals



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General and strategic Objectives

RES-HOSPITALS GENERAL OBJECTIVE:

Accelerate exploitation of renewable energy opportunities in European hospitals, supporting EU20-20 Strategy for climate change and energy targets.

and

TWO MAIN STRATEGIC OBJECTIVES:

Facilitate the transformation of participating hospitals

At least 50% of energy from renewable sources by 2020

Give evidence and tools for the wider hospital sector

At least 20% of energy from renewable sources by 2020

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Main Activities

Pilot projects in different European countries

Aimed at exploring the barriers and how they can be overcome in different situations and producing

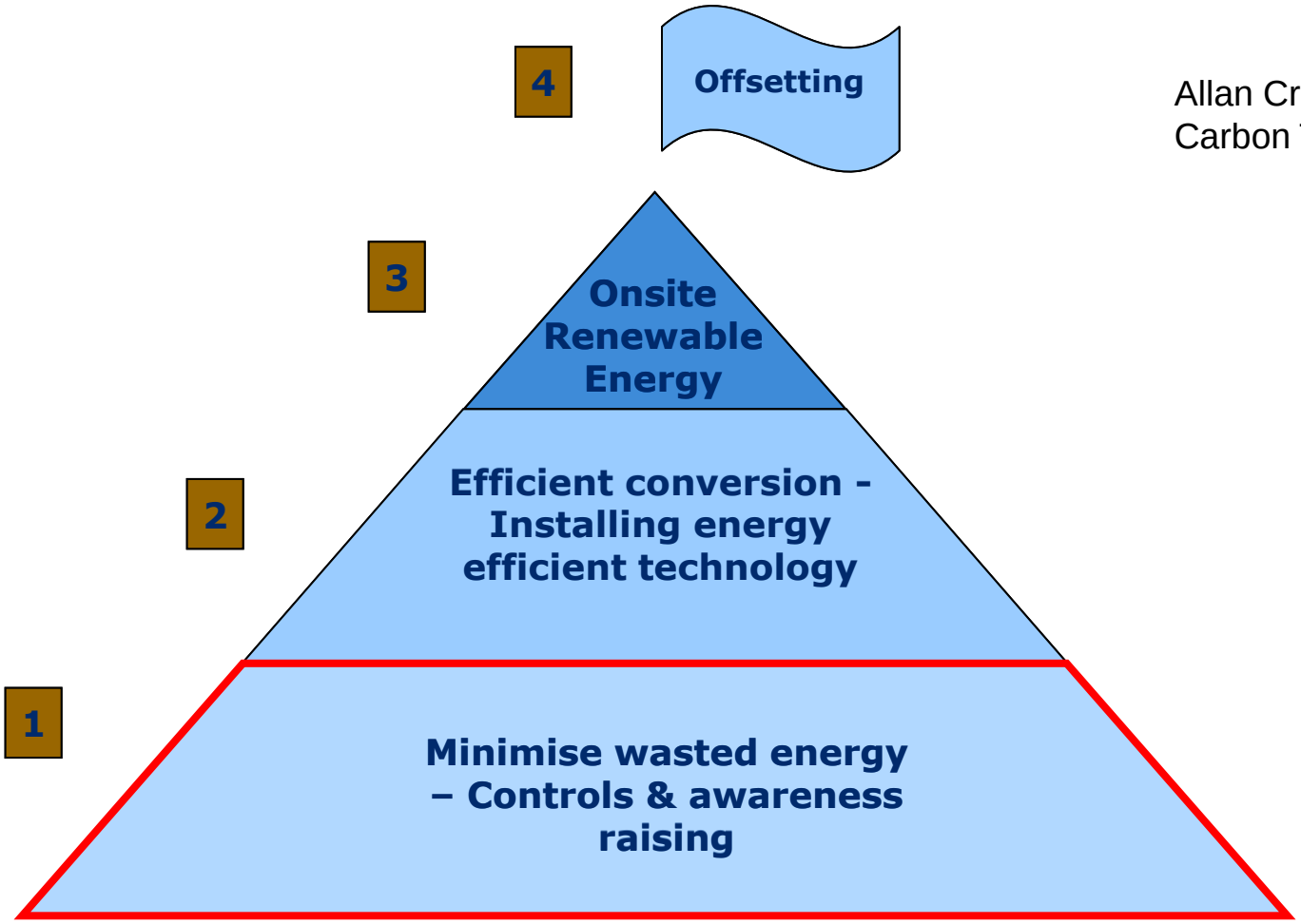
- **Investment plans to reach 50% RES by 2020**
- **Roadmap for Zero carbon possibilities**

Renewable Energy Guide for European Hospitals

Aimed at management and policy stakeholders and dealing in:

- **Influencing factors**
- **Non-technical barriers**
- **Feasible RES options**
- **Making the business case for investment**

Carbon Management Hierarchy



Allan Crooks –
Carbon Trust -Scotland

Carbon Management Hierarchy- step 1.

Minimise Wasted Energy
Control &
Awarness Raising

A Canadian project of 2003

This Project was produced by Natural Resources Canada (NRCan)
with support from the Canadian College of Health Service Executives (CCHSE)

Energy Innovators Initiative

Turn Energy Dollars into Health Care Dollars

A Guide to Implementing an Energy Efficiency Awareness Program in a Health Care Facility

Carbon Management Hierarchy- step 1.

"I shut off waste"

- Starting in 2008
- Campaign of Emilia-Romagna Region
- All the people operating in Hospitals were called to give their contribution for awarness on energy use.
- Distribution in the health le strutture of posters, lieflets, notices aimed to diffuse
- 10 "good habits" for energy saving

The Carbon Trust Initiative - 2010

CARBON TRUST
Making business sense of climate change

Hospitals

Healthy budgets through energy efficiency

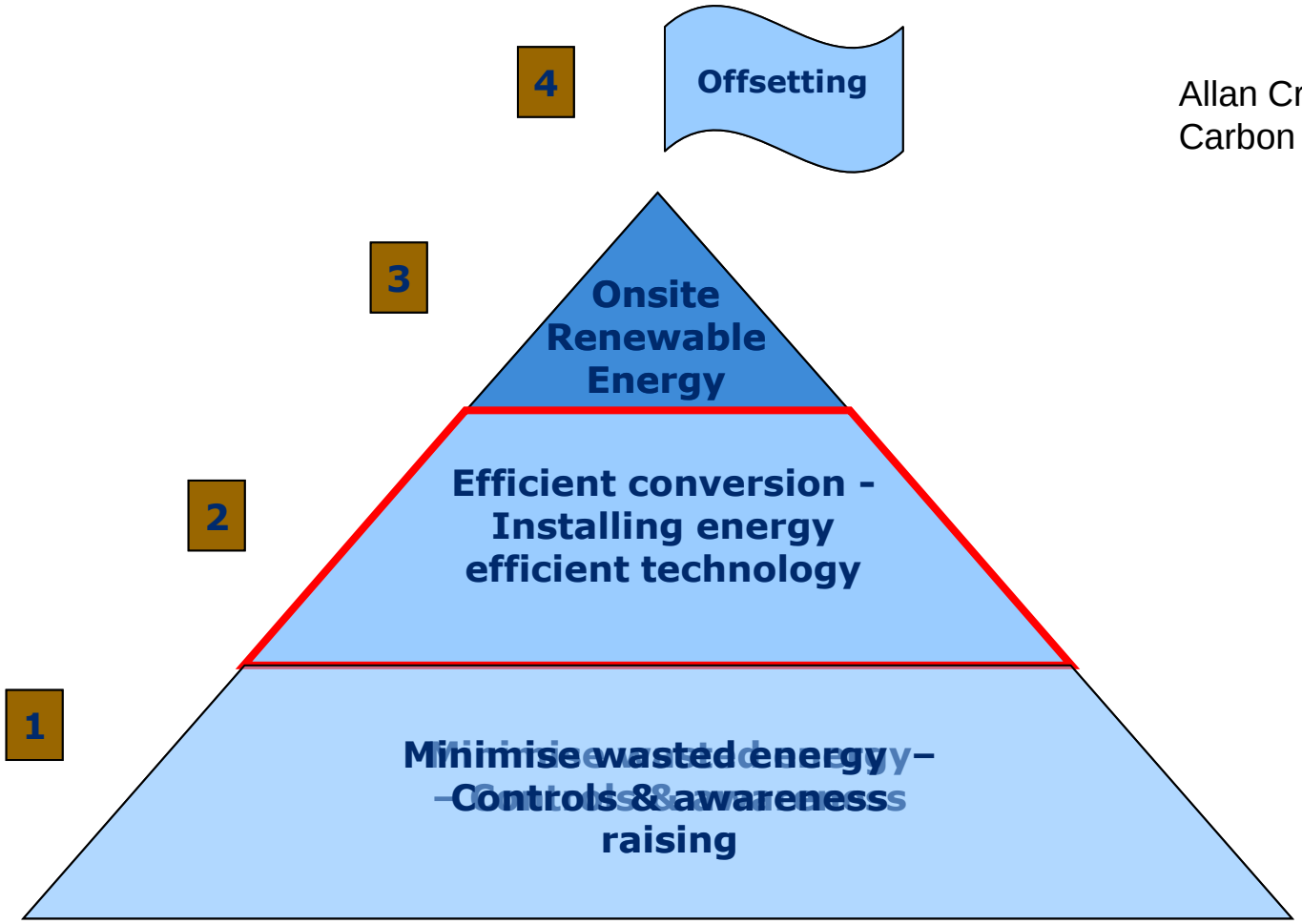
Res-Hospitals: Key activities

Survey about non-technical Barriers

The main non-technical barriers:

- Related to Financial aspects
  - **lack of capitals** for investments
  - **too long** to reach beak even
  - **lack of focused** incentives for the public sector
- Related to the hospital's managers vision
  - **lack of attention** to energy consumption and costs
  - **lack of awareness** of EU and national objectives on Energy and on GHGs reduction
  - **no interest** or even refusal of the hospital role as energy self producers and even less as supplier
  - **diffidence** towards innovation generally and RES produced energy specifically
  - **perceived weak support** and maturity of RES supply chain

Carbon Management Hierarchy- step 2.



Allan Crooks –
Carbon Trust -Scotland

Carbon Management Hierarchy- step 1.

Efficient conversion –

Installing energy efficient technology

CAREGGI UNIVERSITY HOSPITAL – FLORENCE

74 ha – 1,650 beds – 6,000 employees – 15,000 persons present daily

New Trigeneration Plant

Energy efficiency and Environmental Benefits

EVALUATION OF THE CO2 AVOIDED

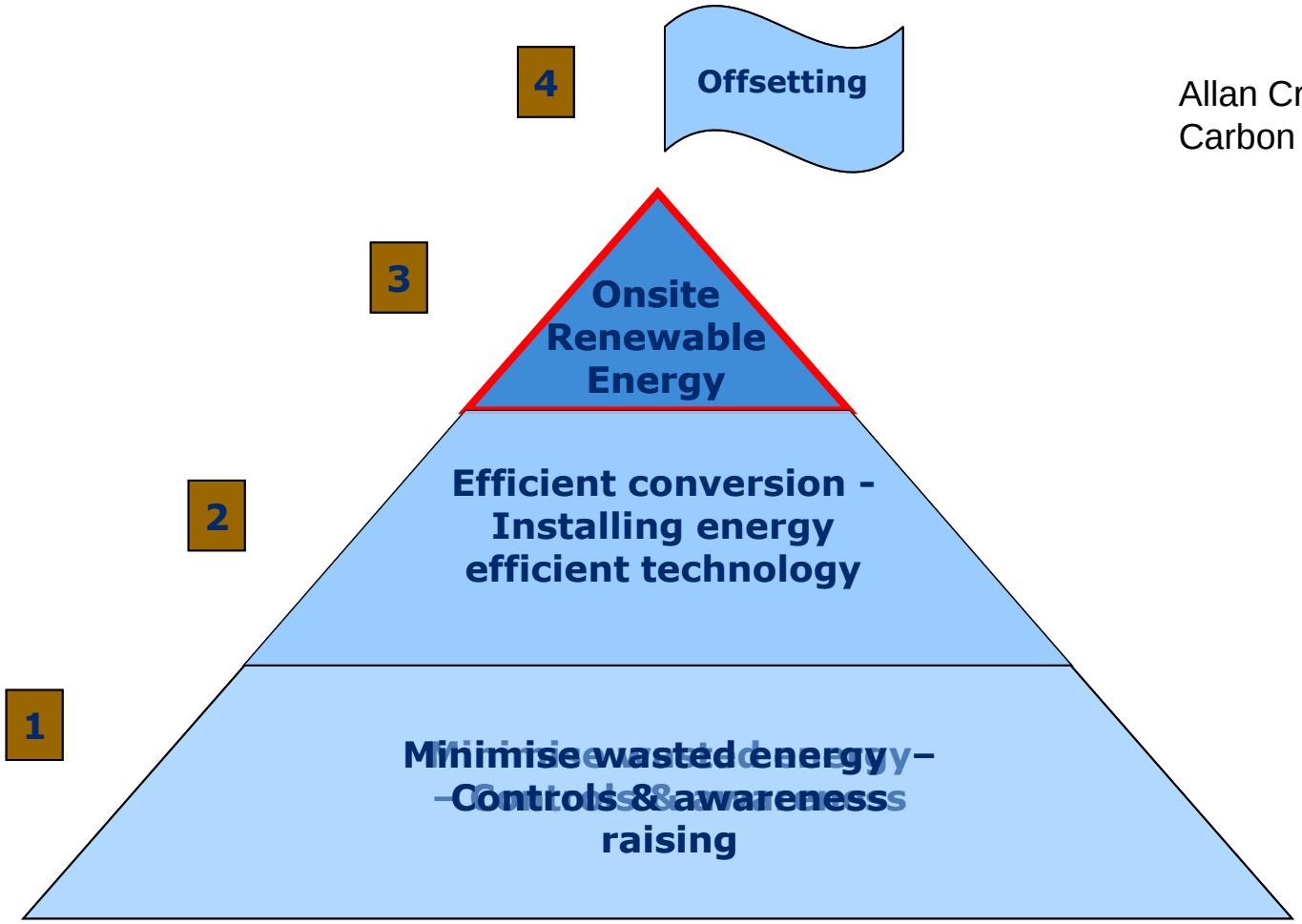
To evaluate the reduction of emissions on an annual basis, reference was made to the energy balance of the PO planned to 2008, comparing the following assumptions in supply:
from traditional sources (electricity and heat from boilers ENEL – National Energy Supllier)
with cogeneration (electricity and heat produced in-house, with partial use of traditional sources for additions)
For homogeneous comparison it was assumed that the fuel used is always the methane hypothesis using other fuels in the solution "traditional“ for boilers, would be further penalized for this situation.
The framework for comparison, prepared on the basis of the coverage efficiency of PO Relative to the above situations, is reported in the following table:

QUADRO DI RAFFRONTO EMISSIONI DI CO2 IN ATMOSFERA (CON EMISSIONI DA RETE ENEL 522 gCO2/kWhe				
		TRADIZIONALE	CON TRIGENERAZIONE	DIFFERENZA
PRODUZIONE CO2 DA COMBUSTIONE TURBINA	(t/anno)	0	34.395	34.395
PRODUZIONE CO2 DA COMBUSTIONE CALDAIE	(t/anno)	21.015	7.684	-13.331
PRODUZIONE CO2 DA RETE ENEL	(t/anno)	20.589	-7.707	-28.296
PRODUZIONE DI CO2 TOTALE	(t/anno)	41.604	34.372	-7.232 -17,4%

DATI DI RIFERIMENTO APPLICATI:
Produzione CO2 da combustione metano *1,898 kg/Smc*
Produzione CO2 da rete ENEL *0,522 kg/kWhe*

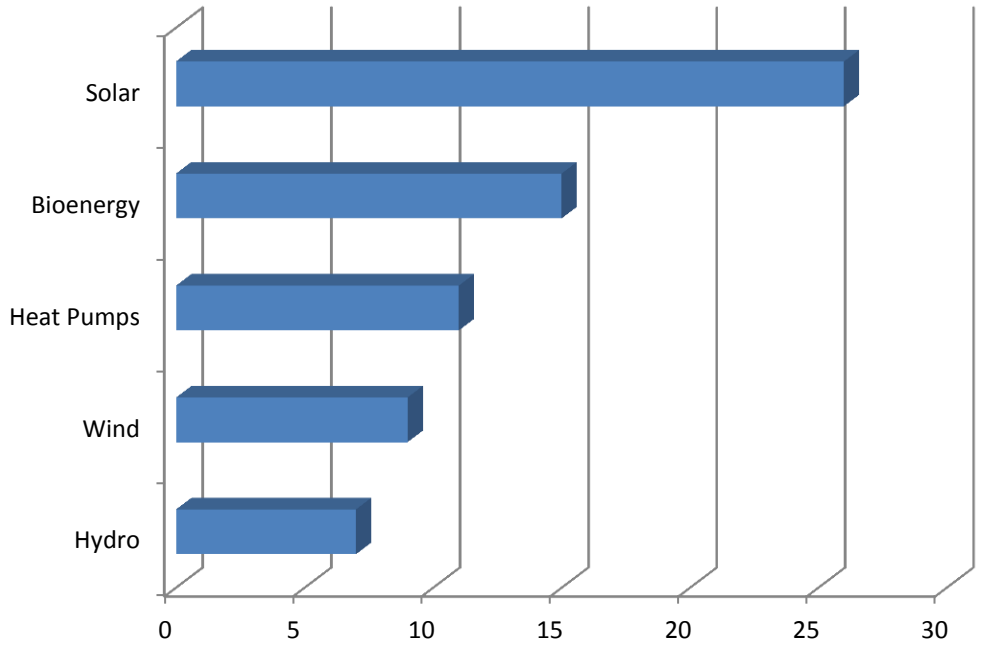
In the calculation of comparison, in addition to the thermal recovery, it is also considered the lack of production of CO2 by ENEL, the proportion of electricity sold in the network.
From the above it should be noted, therefore, a quantity of CO2 avoided equal to 7232 t / year, corresponding to a percentage reduction of 17.4%.

Carbon Management Hierarchy- step 3.



Allan Crooks –
Carbon Trust -Scotland

CURRENT POSITION/OPTIONS FOR HOSPITALS



See www.res-hospitals.eu for summary of examples (v1)

AVICENNE HOSPITAL - FRANCE

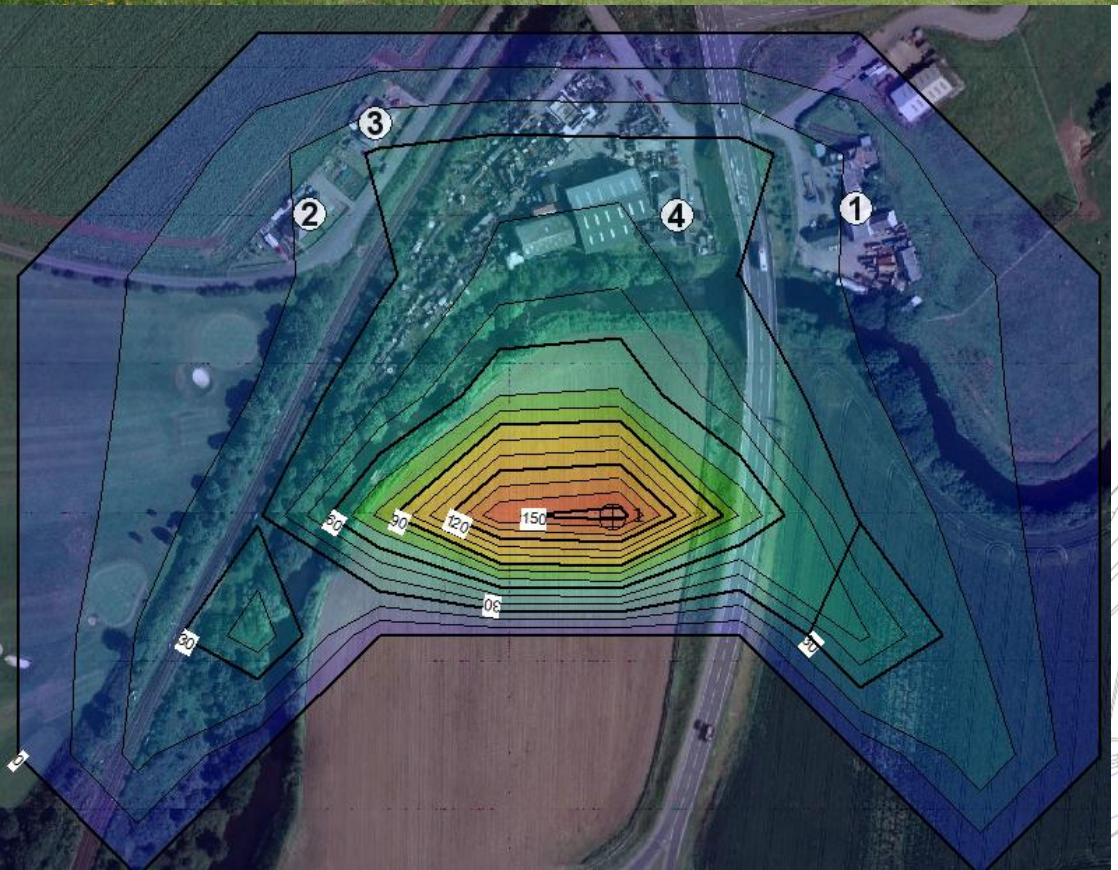
THE NEW PROJECT

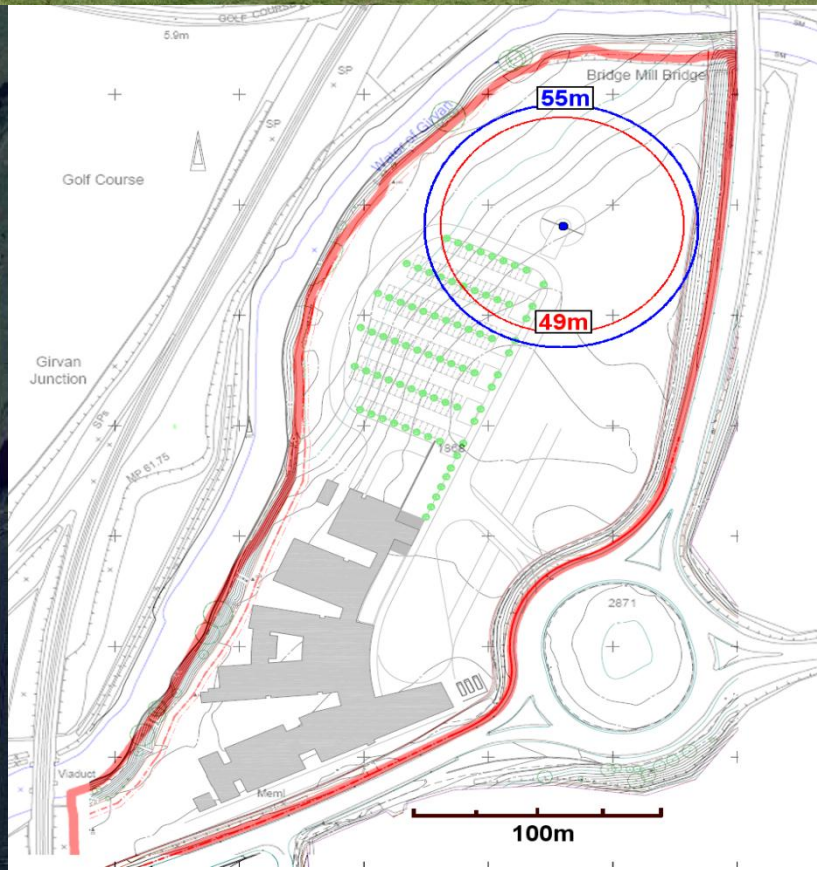
ENVIRONMENTAL RESULTS

- **Emissions of CO2 :**
- **Gas : 205 g CO2 eq / kWh pci**
- **Gasolin : 270 g CO2 eq / kWh pci => Trucks PL : 500 g CO2 eq / km**
- **Biomasse : 0**

- **Actual needs « all gas »** (21.900 MWh pcs/an) **4.038 tonnes CO2 eq/y**
- **Futur needs «all gas »** (33 900 MWh pcs/an) **6.252 tonnes CO2 eq/y**
- **Futur needs « mix Biomasse/gas** (66 % biomasse) **1.750 tonnes CO2 eq/y**

PLANNING AND IMPLEMENTING RES AT GIRVAN COMMUNITY HOSPITAL


3
2
4
1
150
120
90
60
30
30
30


55m
49m
Bridge Mill Bridge
Golf Course
Girvan
Junction
100m

PROJECT RETURNS

✓**100kW**	✓£7,500
✓**500kW**	✓£46,500
✓**1.5MW**	✓£90,000
✓Capital costs	✓Operating profit
✓£400,000	✓£52,500
✓£1,360,000	✓£383,500
✓£2,245,000	✓£526,000
✓**Energy yield**	✓**Payback period**
✓219,850kWh	✓6.9 years
✓1,768,400kWh	✓3.5 years
✓3,973,450kWh	✓4.0 years
✓Income	✓Rate of return
✓£ 60,000	✓15%
✓£ 430,000	✓30%
✓£ 616,000	✓27%
✓Operational costs	

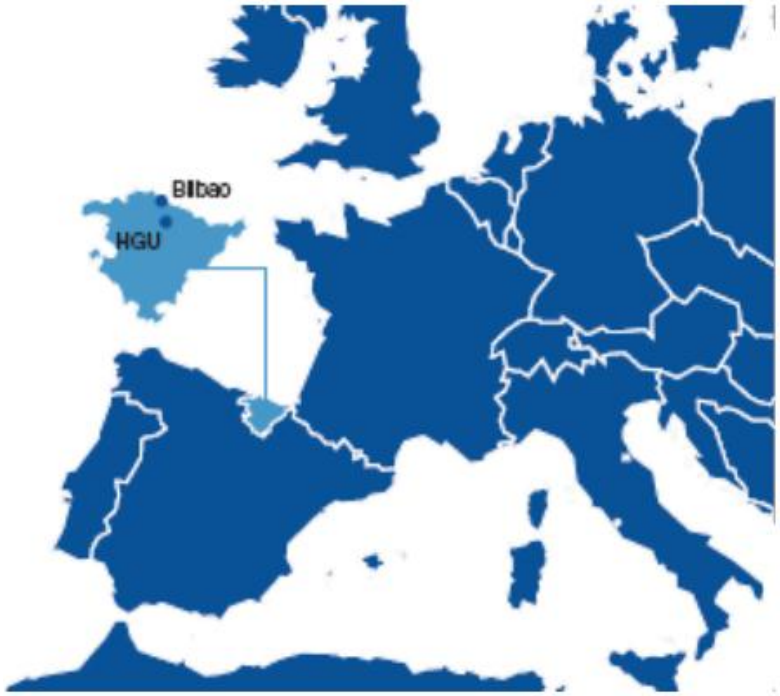
Res-Hospitals : Key Activities

Pilot Studies: the Scope

- Review existing energy demand and supply (level, source and application)
- Review historical and planned actions (energy efficiency and RES)
- Identify further energy efficiency measures (type, cost, finance, impacts)
- Identify renewable energy options (type, barriers, cost, finance, impacts)
- Develop an investment plan to achieve 50% RES by 2020
- Gain commitment and funding from at least one hospital per country
- Develop a Zero Carbon Roadmap

Galdakao- Usansolo Spain

Medium size Hospital



Galdakao- Usansolo Spain

Galdakao- Usansolo Spain

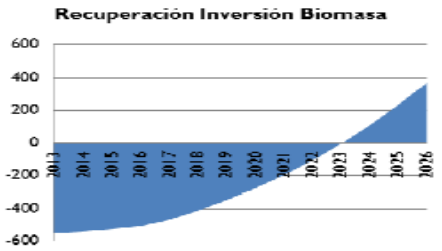
Acute General Hospital – medium size

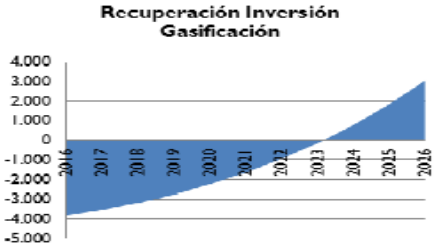
Public Health facility belonging to the Osakidetza network (regional integral health care organisation financed by public funds).
Built area 70,000 m^2
10 floors above ground and two basements;
26 years old.
440 inpatient beds (56 emergencies beds).
The Galdakao hospital can be considered a leader in the hospital sector in the fight against climate change. In the working framework of the oligopsony environmental team (consisting of 12 national hospitals), it is leading the search for common air emissions indicators.
In 2008 it has installed 460 PV panels for 100 kW and an annual production of 100MWh/year.
Installation of solar water heater for rehabilitation swimming pool in 2012 (20 kW). Both examples of the example of the environmental line to which the hospital is committed.

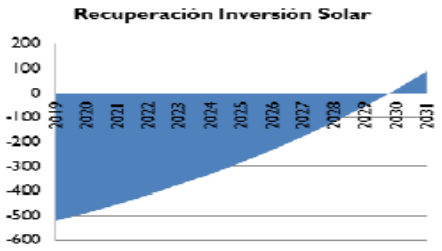
Galdakao- Usansolo Spain

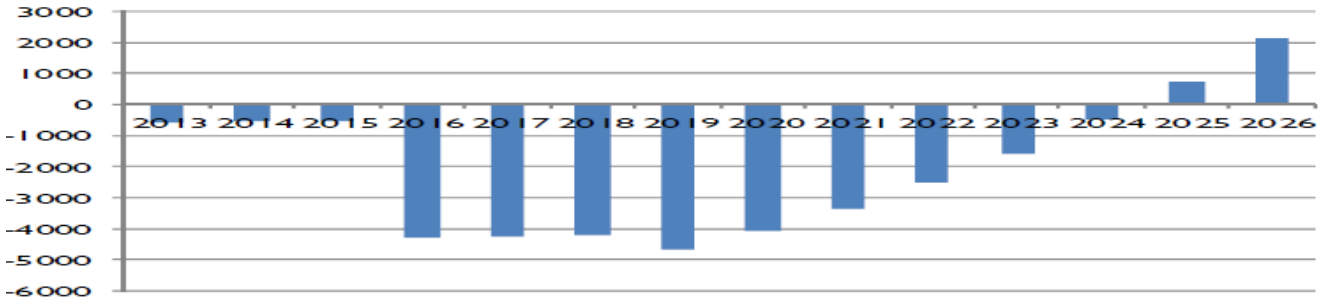
Financial Investment Proposted for RES by 2020

	2013	2014	2015	2016	2017	2018	2019	2020
Calderas Biomasa	550.000 €							
Sistema Gasificación				3.800.000 €				
Solar Fotovoltaica							520.000 €	



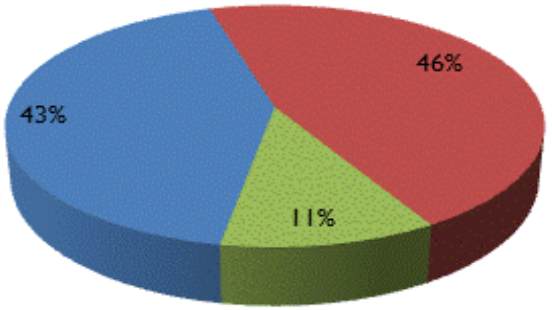


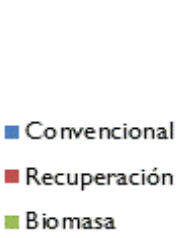


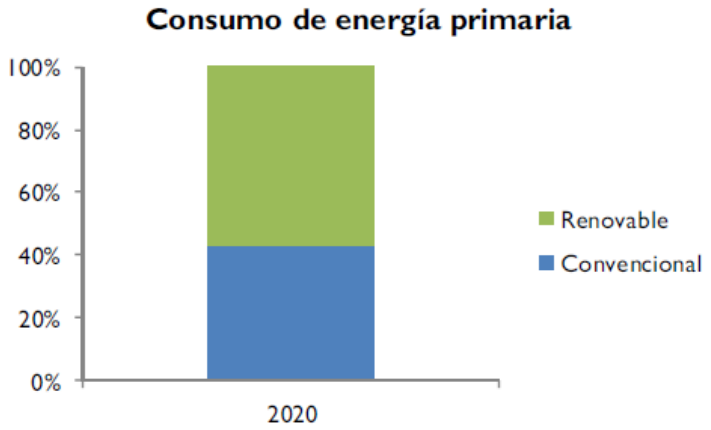


Galdakao- Usansolo Spain

The total investment proposed for RES by 2020 is € 4,870,000 and ends in the year 2019.







By year 2020, the total primary energy consumption will be over 57% in RES systems.

Annual CO_2 savings as result of this investment will be over 2,803 tonn eq/y

The annual total emissions at the present time are 8.533 tons/year, the avoided tons represents therefore a saving of GHGs equale about 33%.

Versilia Hospital - Italy

General Information:

General Hospital - Part of National Public Service

Climate zone D

Degress/day 1485

Operating since 2002

Typology 4 floors - Single block

Area m^2 76,940

Volume m^3 270,828

Glass surface m^2 4,047

Beds 450+ 70 Day Hospital

Population served:

Residents 170,000

tourist present in the area in Summer season about 500,000

The complex has a Building & Plant Manger-Energy Manager present on Site and a General Technical Manager

Versilia Hospital - Italy

Photovoltaic panels generating 198,72 Kw, partially conveyed into the grid. A new plan photovoltaic panels up to the production of 500 Kwp, and mini-windmills are being planned.

Versilia Hospital - Italy

Initiatives in place

- Highly energy efficient building, monitored by a computerized Building Management System,
- Photovoltaic panels generating 198,72 Kw, partially conveyed into the grid,
- modern illumination energy-saving systems with fluorescent electronic ballasts, with internal automatic on and off systems (switches presence) and external (crepuscolar switches)
- recovery of the heat through reverse-flow heat exchangers.
- "free cooling“ using fresh air of the environment too cool down the water of the ventilation plant and cool down the building (passive cooling)
- variable frequency inverters for the regulation of the number of revolutions for machinery such as pumps, ventilators etc.
- Thermal insulation with mineral wool or polystyrene of the network distribution of hot fluids and hot/cold.

Versilia Hospital - Italy

Current Energy Consumption

Primary energy kWh	2,830,268	toe 651
methane mc	2,652,433	toe 2,175
Total		**toe 2,826**
CO_2 Emissions		
from methane		4,888.2 ton CO_2
from energy		2,085.9 ton CO_2
Total		**6,974.1 ton CO_2**
Total Hospital Carbon Foot Print (CFA)		**8,568 ton CO_2**

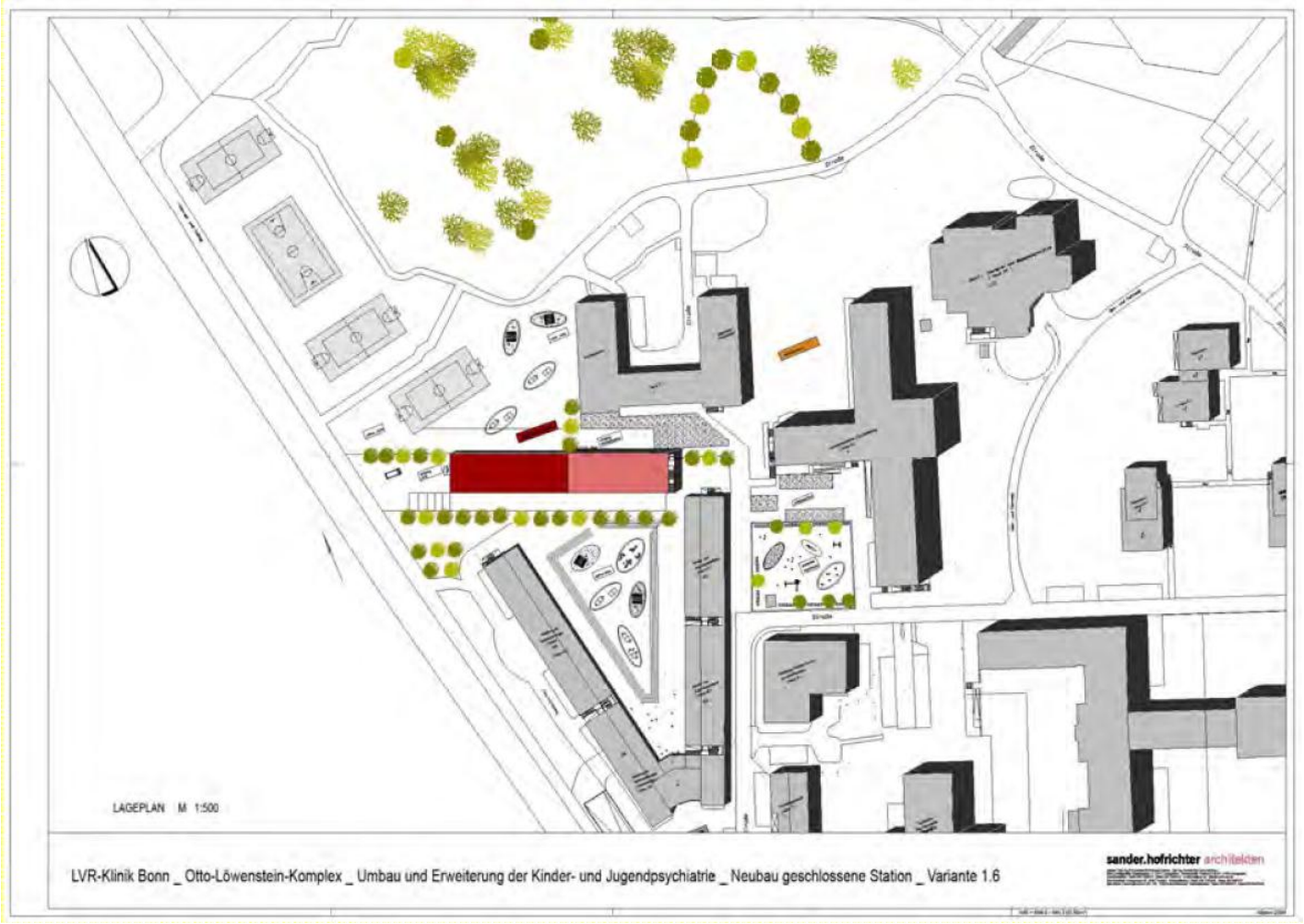
RES currently in use and assimilated (Italian law)

Small windmill – in use for outdoor lighting	1kW	kWh	1,300
Photovoltaic	198 kW	KWh	278,408
Trigeneration 1,003 kWe x 61,000 h/year	kWh 7,486,840		1,722 toe

Case Study: Zero-Energy-Houses

Psychiatric Hospital in Germany: Bonn

Qualität für Menschen



Case Study: Zero-Energy-Houses

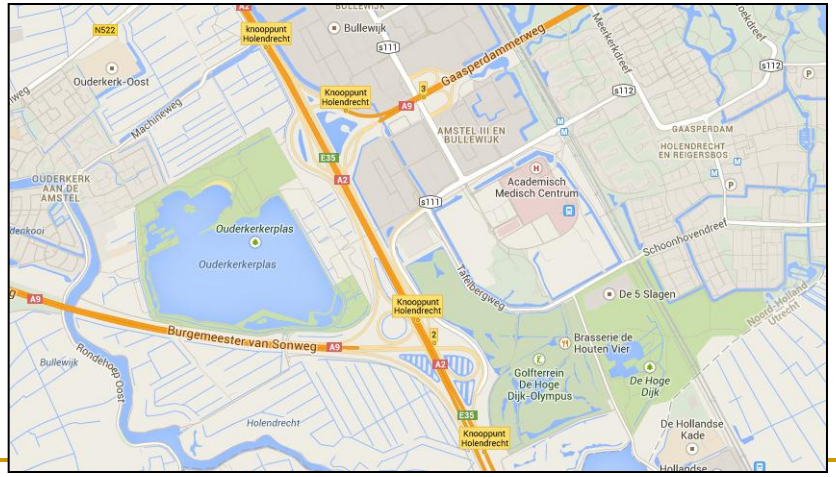
Psychiatric Hospital in Germany: Bonn

LVR
Qualität für Menschen

Case Study: Lake Water Cooling

University Hospital Amsterdam

Academisch Medisch Centrum
Universiteit van Amsterdam



Case Study: Lake Water Cooling

University Hospital Amsterdam

Academisch Medisch Centrum
Universiteit van Amsterdam

- The main building of the Amsterdam Medical University was completed in the beginning of the eighties
- Mayor rehabilitation programme on-going, including the existing power plant running on heavy fuel which will be replaced with
  - A combined heat and power plant running on natural gas.
  - The energy efficiency of the units will be increased from 55% to 82% while emissions will be significantly reduced due to the change from heavy fuel oil to natural gas (e.g. NOx emissions will be reduced by 96% and fine particles by around 80%).
  - The steadily increasing demand for cooling in summertime will be assured through the use of the cold water of a nearby 30 m deep artificial lake (Ouderkerkerplas).
  - In combination the expected overall energy consumption will be reduced by at least 23%, not considering the additional measurements for energy reduction within the existing buildings.

Case Study: High Energy Efficient Hospital

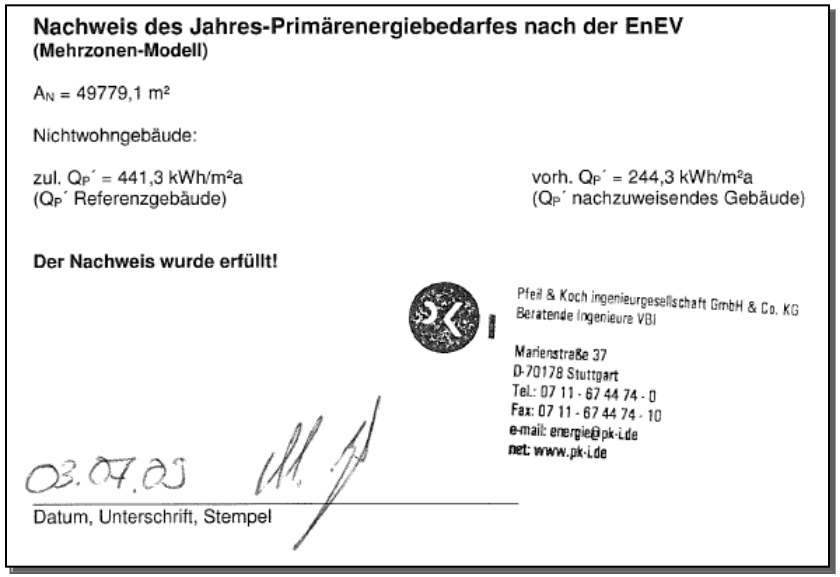
Klinikum Hannover

Case Study: High Energy Efficient Hospital

Klinikum Hannover

The following technologies are used:

- Geothermal power, 18 holes, 150 m
- Heat pump for cold and warm water
- Thermo Active Building Systems
  Winter: 27°/24°
  Summer: 18°/21°
- Controlled ventilation with heat recovery
- Improved insulation
- Integrated engineering of all components



Nachweis des Jahres-Primärenergiebedarfes nach der EnEV
(Mehrzonen-Modell)

A_N = 49779,1 m²

Nichtwohngebäude:

zul. Q_P' = 441,3 kWh/m²a
(Q_P' Referenzgebäude)

vorh. Q_P' = 244,3 kWh/m²a
(Q_P' nachzuweisendes Gebäude)

Der Nachweis wurde erfüllt!

Pfeil & Koch ingenieurgesellschaft GmbH & Co. KG
Beratende Ingenieure VBI

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03.07.09

Datum, Unterschrift, Stempel

Case Study: High Energy Efficient Hospital

Klinikum Hannover

- 20% of the energy in Winter is solely used to keep the helipad and a ramp to the logistical centre free from ice and snow
- Further reductions were possible by simply covering the ramp and the insolating of the platform for the helipad

Tabelle 2-2: Aktuelle Heiz- und Kühlarbeiten, Stand 11.02.10

	Heizfall	Kühlfall
BTA	230 MWh/a	84 MWh/a
FBH	56 MWh/a	-
Kühldecken	-	38 MWh/a
Hubschrauberlandeplatz	41 MWh/a	-
Rampe	31 MWh/a	-
Luftkühler Anlagen 3 + 4 (neu)	-	73,8 MWh/a
Gesamtarbeit	358 MWh/a	195,8 MWh/a

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?

Which inputs can come from the RES-Hospitals Guide For the challange of Zero Carbon Hospital

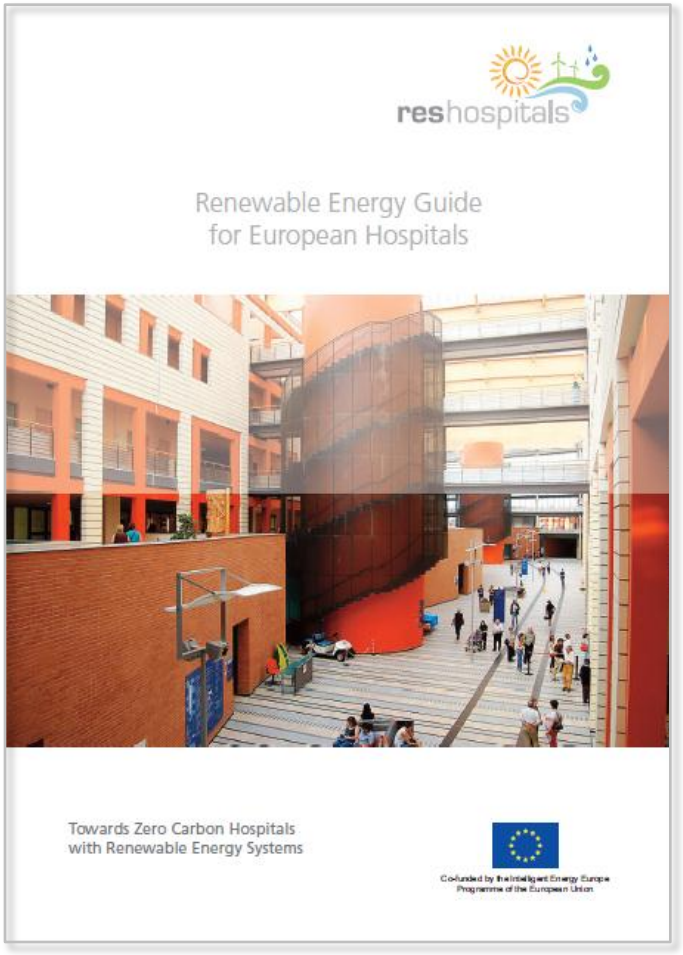
?

Guide Contents

1. Context
2. Research method
3. Factors influencing RES use in Hospitals
4. Non technical barriers to investments
5. Identifying feasible RES options
6. Making the business case for the renewable investment
7. Ten key messages grom the Guide

The Appendices include:

b. Case study examples
c. Synthesis of good practice guides
e. Economic of renewable energy



Target audience and objectives

reshospitals

- Support **Hospital Technical Managers** to identify options for renewable energy investment and make the business case to **Hospital Management**
- Provide **Hospital Management Boards** with evidence of the importance of renewable energy for the hospital(s) under their control
- Provide **Health Ministries and Agencies** with evidence of the importance of renewable energy in meeting national CO_2 and Europe 2020 energy targets and suggest actions they can take to help overcome barriers to investment
- Provide **other policy makers** with evidence of the important contribution hospitals can make to meeting EU CO_2 and renewable energy targets and suggest actions they can take to help overcome barriers to investment

NOT a technical guide!

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Key factors from Pilot Studies

Investment appears to be the main barrier declared by Policy Makers and Administrators

In effect other aspects have emerged:

Diffused diffidence for new technologies, especially RES related, Hospitals mainly focused on proven low risk technology

More concern for the other major items of cost for hospitals, such has staff and medicine costs

Low consideration of what can be achieved at basically no cost working with hospital staff to raise **awareness**

Limited consideration by hospitals of offsite and/or hospital led community options of RES

Substantially low consciousness of the importance directly for human health of the battle for reduction of CO2 and

The important role hospitals could and have to play in such a battle

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Key factors from Pilot Studies

From the type of investment made

No single RES **technology can** satisfy 100% of the energy needs of an hospital, excluding specific situations.

In most of the cases a mix of RES can satisfy over 50% of the needs at the present state of the art of the different RES technology

Renewable heat is, at the present time the main focus to achieve 50% RES by 2020.

Biomass and deep geothermal are the main contributors to % RES

Most technologies are in evolution towards higher performances and lower costs from PV to Windmills and bioenergy .

New renewable forms of producing energy are continously developped, some for specific situations other with wider possibilities, such as ocean energy.

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The learning experience

There are situations among the existing hospitals, in which the location or other constraints are objective barriers to the on-site RES use.

The Zero GHGs emissions hospitals have to be pursued and hopefully be reached with collective actions involving a greath variety of Stakeholders.

In Spain the hospital of Matarò, close to Barcelona, gets its heath from "Tubo verde" a pipe that distribute heath produced at community level with the use of local waste.

In Paris the production of centralised hot water reaches 23 public hospitals through an underground distribution system.

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… new approaches

To counteract the "agnosticism" underlined before, it is important to diffuse the knowledge of another form, of the hospitals as **pro-active agent** in the "battle" for energy efficiency and CO2 emissions reduction.

Hospitals becoming producers of energy for their Community

with the aim of increasing progressively the % of RES energy.

The hospital of Udine,

pioneer, but now no more the only one, has taken this proactive role.

the district heating network

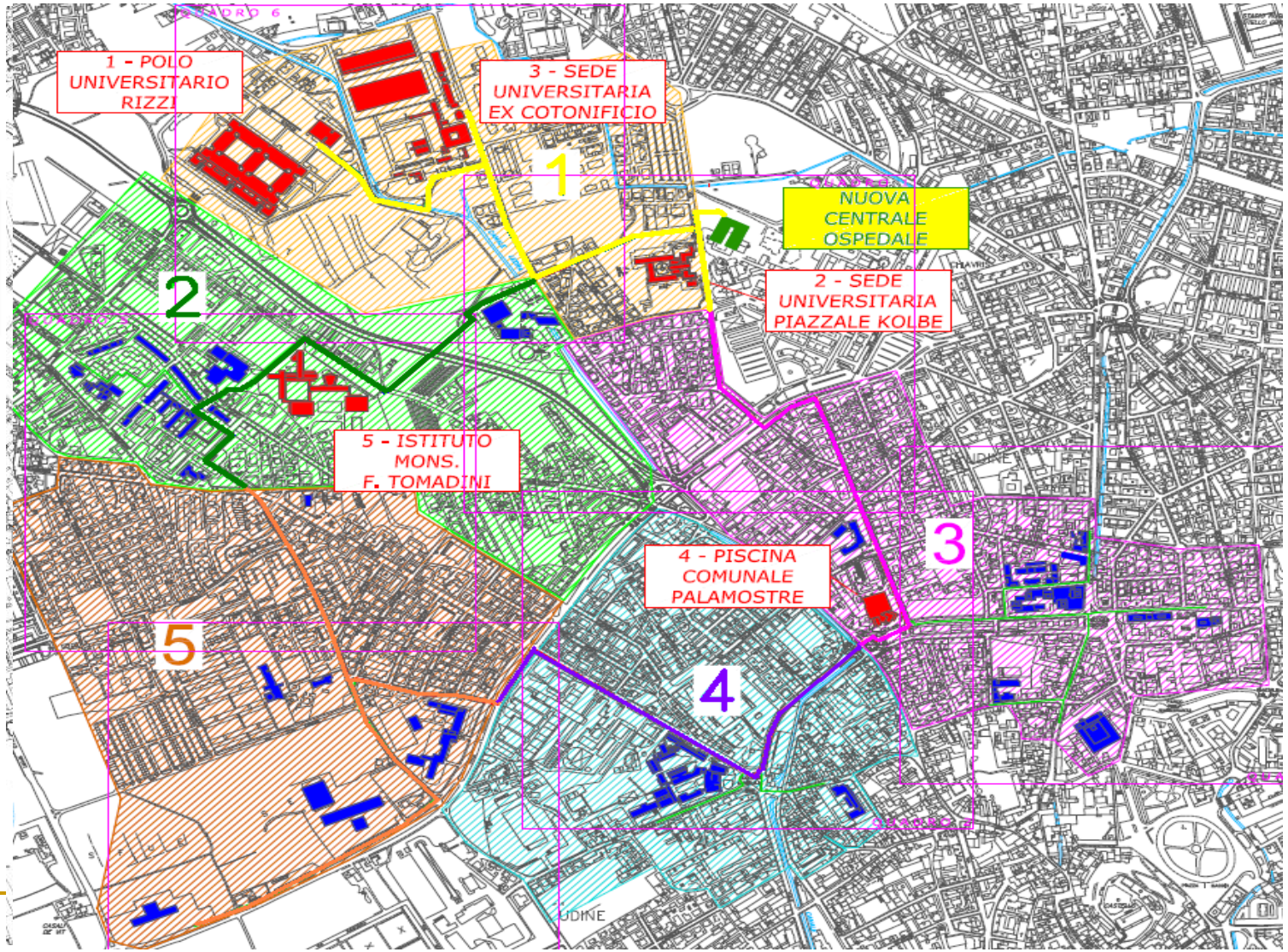
Riservata all'Ospedale 48.2 MW

POTENZA TERMICA INSTALLATA 85.9 MW

Disponibile alla Rete TLR 38 MW

Rete dimensionata per 45.7 MW

Obiettivo: SATURARE L'ATTUALE RISERVA DI POTENZA pari al 20%



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Germany too, with its several community examples, confirms that the most impacting interventions for the reduction of CO2 as well as energy saving are "System" interventions.

The need for those risults is high and urgent

This require new cultural awarness and maturity that the hospital, as one of the most important social institution, is in position to help in the development, with its own example and with the diffusion of this new consciousness.

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… and From the learning experience

The RES-Hospitals

Renevable Energy Guide for European Hospitals

represents the conclusive "tool" of the project for incouraging hospitals to be more strategic and sustainable about both energy reduction and production, including the wider exploitationof renewable energy opportunities at community level.

It evidence based methodology suggesting examples of how barriers were overcamed

will hopefully help for new as well for existing hospitals.

Res-Hospitals Objectives

Expected Impact

The potential impacts Include:

- **50% RES by 2020**
  - At least 10 of the participating hospitals
  - Indirect influence on another 100 hospitals in the participating countries
- **Zero carbon possibilities**
  - Highlight options in different cultural/economic/geographic situations
  - Encourage innovative and far sighted thinking
- **Multiplier effect on other hospitals in Europe**
  - Case-based evidence could influence another 1000 hospitals
  - *- 20% RES would reduce carbon footprint by 1 million tons of* CO_2 Potential wider influence on other public services

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Hospitals at zero impact

This objective

Must be considered part of the "core businnes" of the health systems based on the Vision of Hospitals as Instruments of Sustainability and Public Health

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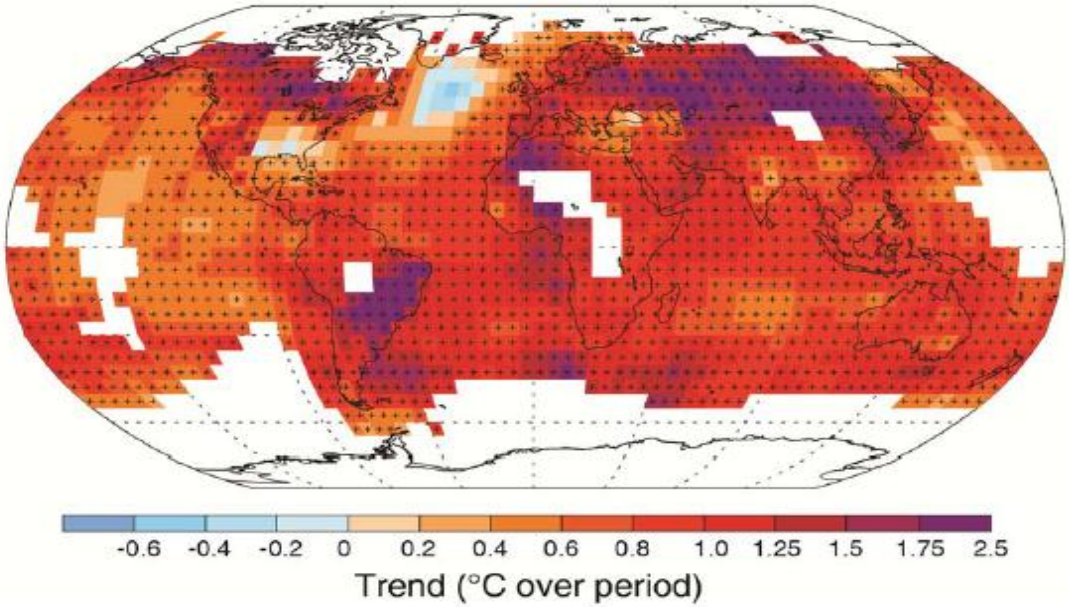
Here we are
we cannot go any further

(b) Observed change in average surface temperature 1901–2012



Thanks for your attention

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