

SOLAR AND BIOMASS FOR MIRANDOLA and MONCHIO DELLE CORTI

As announced in the previous SRF newsletter, Italian SRF partners can now present the results of two promising Italian case studies in Emilia Romagna that show great potential for solar in combination with biomass: Mirandola and Monchio delle Corti. Both of the feasibility studies deal with the extension of existing DH networks in which the combination of these two renewable energy sources were found to be economically and technically feasible. From the environmental point of view, biomass can definitely decrease the CO₂ emissions but increases the pollutant emissions that can definitely be reduced by solar thermal.

The use of renewables, such as solar energy and biomass, implies significant land use, which is a controversial topic. It is thus fundamental to design these projects basing on heat planning and mapping, and to analyse every project with a comprehensive approach, looking at every impact involved.

FRAMEWORK

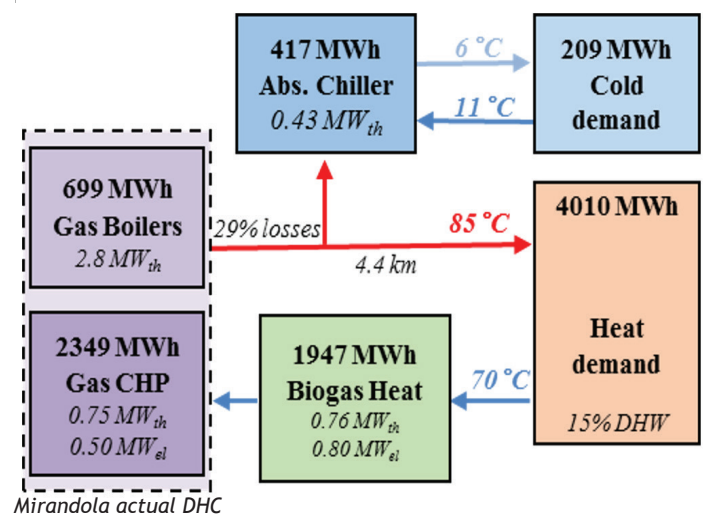
DH has been shown to be an efficient way to exploit different energy sources and among them renewables such as biomass and solar thermal. The region of the two analysed case studies lies in the Po valley, the largest plain area in Italy which is, due to its physical landscape and human aspects, experiencing several problems in maintaining air quality standards. That's why the Emilia Romagna region has elaborated an integrated air quality plan, PAIR 2020 (DGR 949/2013), to get back as soon as possible within the air quality limit values, in particular regarding particles emissions. In this framework, DH fed primarily by cleaner renewable energy sources, has certainly great potential in substituting individual polluting systems such as liquid fossil fuel boilers, and even biomass ones. Biomass is a renewable, local and CO₂ neutral source but despite these advantages, biomass burning can have negative impacts on air quality in particular in case of old inefficient technologies. Small scale DH can bring some benefits by centralizing and moving the polluting source away from residential areas allowing the use of higher stacks, high quality filtering systems and qualified employees to optimally manage

and operate biomass power systems. But most of all, the flexibility of DH systems can reduce the use of biomass by the integration of zero emission systems, such as solar thermal, a "zero emission technology" that has proven to be a perfect candidate to integrate biomass on flexible DH systems in particular in summer time.

The two cases analysed in this paper deal with the extension of existing networks: the main new source is biomass; solar thermal is integrated to reduce its use in summer and reduce the impact on air quality.

THE CASE STUDIES - MIRANDOLA

Mirandola (MO) is a small town with 20,000 inhabitants with an existing DH and small DC system fed mainly by a natural gas internal combustion engine, which recover heat on the return line, from a third party biogas power plant. (Figure 1)



A ruinous earthquake affected the area in 2012: the extension project aims to connect the reconstruction areas using DH as the new energy infrastructure of the city centre, doubling the current heat demand.

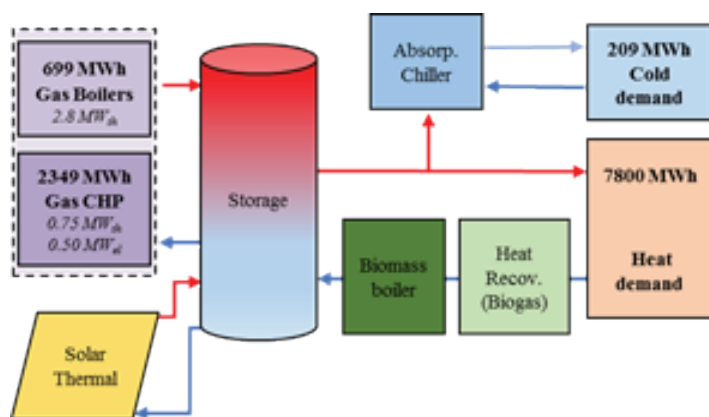
Together with the local authority and other local actors, the company is developing the recovery of local biomass before it becomes a waste. The main aim is to reduce dependency on fossil natural gas and on its price unpredictability and to exploit a local resource that is now wasted.

Four alternatives have been simulated (see table). The

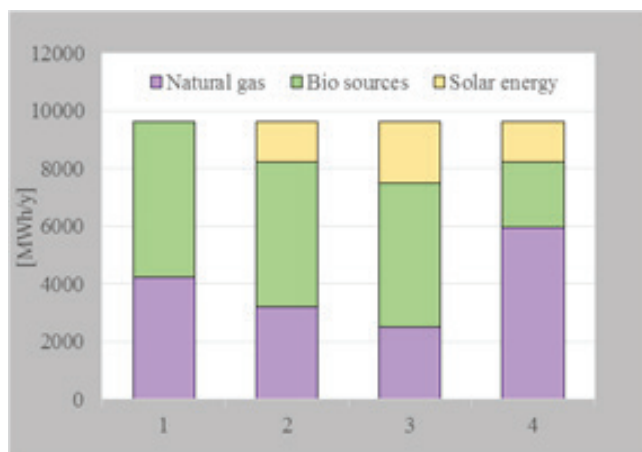
alternative integrations foresee additional smaller biomass boiler to increase efficiency at partial loads, storage tank and different sizes of solar thermal field sized in order to avoid stagnation.

Alternatives	Biomass	Solar thermal	Storage tank
	P_{th} boiler	Area	Volume
1	1 MW	-	200 m ³
2	1 MW	1600 m ²	160 m ³
3	1 MW	2500 m ²	1000 m ³
4	-	1600 m ²	160 m ³

Alternative solutions for Case 1 extended

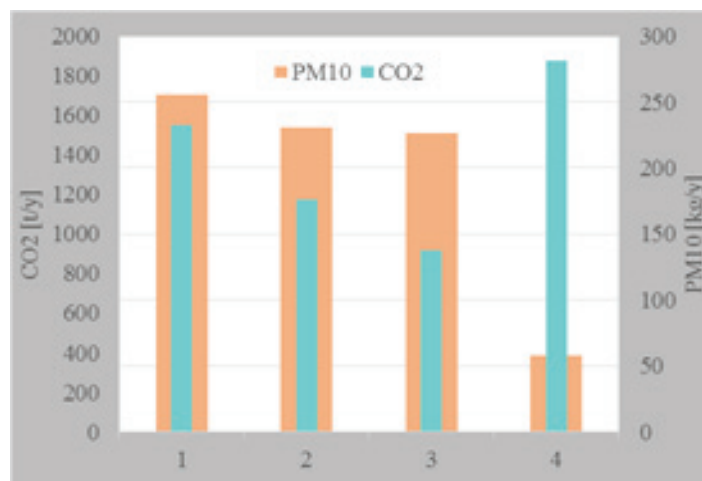


The solution with the highest solar fraction, n. 3, is also the one with the lower use of CHP plant, so lower operational costs



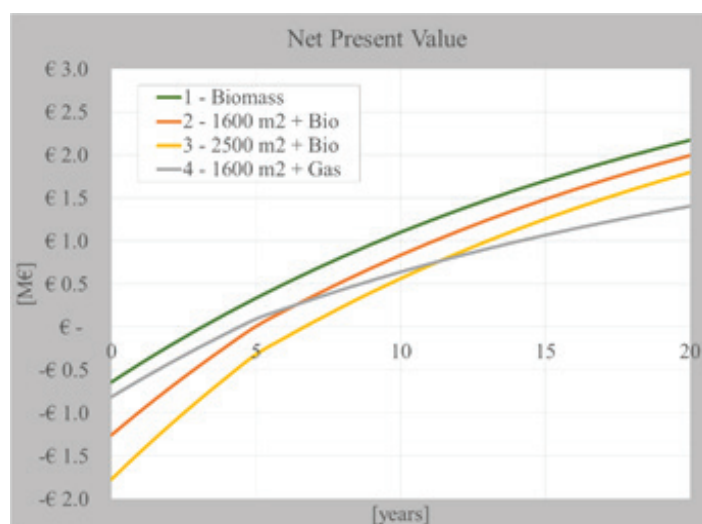
Energy results of Mirandaola DH extension

From the point of view of environmental impact, alternative 4 has a quite important solar fraction but also a higher use of natural gas, less environmental friendly (high values of CO₂), but with a lower impact on air quality (lower primary and secondary particulate emissions).



Emissions results of Mirandaola DH extension

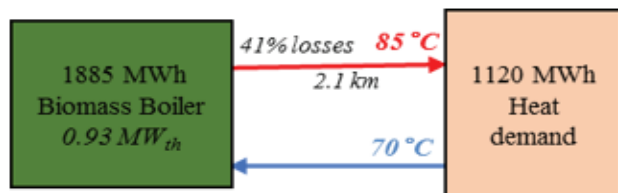
Considering investment costs, operational costs and revenues and incentives schemes for solar thermal, the economic figures that come out are presented in the picture.



All payback times are much lower than systems life time and economic figures are very positive. For a higher investment cost, solution with a higher SF, have very interesting values of NPV at 30 years with reasonable IRR.

THE CASE STUDIES - MONCHIO DELLE CORTI

Monchio delle Corti is a small mountain village with less than 1,000 inhabitants. The case deals with a very small DH network with a single biomass boiler in a mountain village that is not reached by natural gas network.



Monchio delle Corti actual DH

The purpose of the analysis is the evaluation of the extension and also the optimization of the existing plant, which is directly operated by the municipality. Improper design (piping size and insulation, oversizing of biomass boiler), low heat density and bad operational strategies (temperatures and flow) are causing a very high level of loss (41%).

The current situation can thus benefit from densification of the heat demand and introduction of clean solar thermal system.

Two alternative configurations for plant extension have been assessed: the first with an additional smaller biomass boiler to enhance efficiency at partial loads, and the other one with solar thermal.

Alternatives	Biomass P ₀ boiler	Solar thermal Area	Storage tank Volume
1	200 kW	-	-
2	200 kW	280 m ²	10 m ³

Alternative solutions for case 2 extension

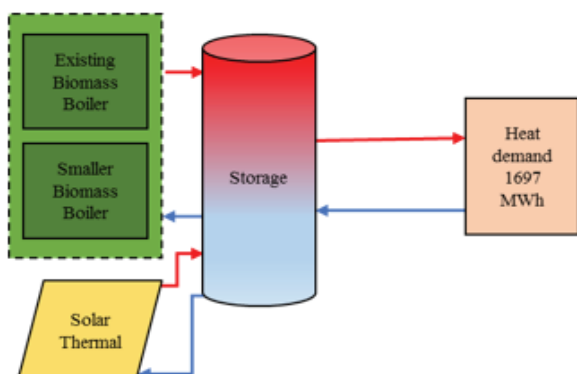
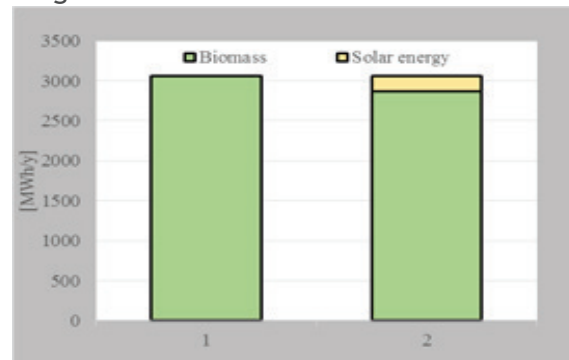


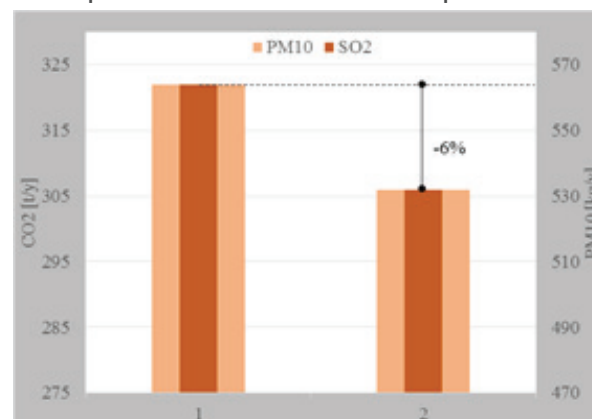
Figure 9: Monchio delle Corti DH extension

Energy and environmental results are shown in following images:



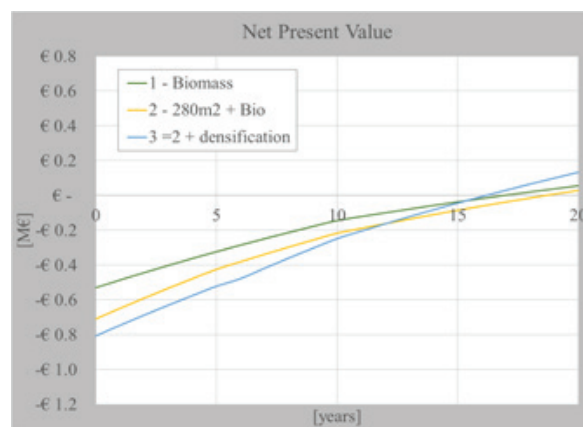
Energy results of case 2 extension

The solar energy is demonstrated to be the only emission-free technology: the solar energy production has a direct impact on the reduction in air pollutants.



Emissions results of case 2 extension

Economic results show that, even if the two solutions with solar thermal increase the PBT, the values are similar and all are still lower than lifetime.



The reason for the high PBT values of the extension lies mainly in the big amount of losses and general inefficiency of the system due to oversizing.

CONCLUSIONS

Results show that biomass can definitely decrease the CO₂ emissions but as a drawback it causes an increase in the pollutant emissions that can definitely be reduced by solar thermal. The economic figures show that integration of biomass and solar thermal is definitely feasible and sustainable and it can have a beneficial social impact with the use of local resources. Nevertheless, a better management and more accurate design

are needed in the DH owned and operated by the local authority. Since the alternative solutions all have advantages and disadvantages, it is important to evaluate all the different aspects e.g. environmental, financial and also social to assess the best solution. In any case all the calculated figures will support the decision-making managers in choosing the best configuration..

Update from SmartReFlex on Kerry District Heating Deployment

The heat planning study undertaken by XD Sustainable Energy Consulting (XDC) for the town of Tralee in Kerry in the framework of SmartReFlex shows that district heating could attract a 90% share of Tralee's heat market. The next step was to analyse the heat density map to plan spatially 3 scenarios for the deployment of district heating in Tralee, from the high heat density areas in the town centre to the lower density areas in the suburbs. For each scenario, a technico-economic feasibility study based on a preliminary design of the associated heat distribution network and modelling of 100% RES-heat generation systems. XDC is also working closely with its partners Kerry County Council to integrate spatial planning considerations (zoning, environmental impacts, traffic, etc.) and define a district heating deployment strategy which will inform the future Tralee

Town Development Plan. In parallel, the heat density mapping of the whole of county Kerry has started and will enable identifying other urban areas where district heating deployment might be feasible. This second study will support the integration of a County Heat Plan in the future review of Kerry's County Development Plan and its Renewable Energy Strategy.

XDC is also working with the Kerry Sustainable Energy Co-operative (KSEC) on a pilot project which will support the deployment of district heating in Killorglin, a rural town with a population of 2,000 in the centre of Kerry. KSEC is a community-based cooperative business which aims to encourage the creation of sustainable energy communities in towns and villages throughout Kerry. The initial focus is on investigating the potential for district heating to service a neighbourhood with a



Members from the Kerry Sustainable Energy Co-operative completing their survey of Killorglin residents to assess heat demand in the town.

mix of private and public housing, as a means to tackle fuel poverty and improve well-being for the residents. Having completed a survey of heat demand in the neighbourhood and the potential for thermal retrofit measures, KSEC's members are now engaging with large heat users in the wider community to identify large anchor loads which would underpin the deployment of a town-scale district heating system. XDC will help KSEC with producing a heat map for the town and appraising the technical and financial feasibility of 100% RES-heat district heating in Killorglin. Moreover, the study will provide a unique opportunity to explore business models for community participation in district heating development in Ireland and the associated organisational management. KSEC's initiative is also exemplary of community engagement during the planning phase of district

heating and the response to their heat survey and associated activities has been excellent. As part of this pilot project, James Clifford will attend the workshop and study in Kolding (24-25 November) on behalf of the KSEC where he will learn from all SmartReflex partners and will then be able to share this knowledge with other members of his group.

Very importantly, the Sustainable Energy Authority of Ireland is supporting the three studies discussed above in the framework of its Sustainable Energy Communities programme and the Local Authority Renewable Energy Strategies programme, in order to provide a template for other local authorities and community groups to develop their heat plans and district heating strategies.

Upcoming Events

The last SmartReFlex Webinar 2016

Tuesday 06.12.2016

14.00 - 15.30 CET (Berlin time zone)

The free webinar "Think big - Design rules and monitoring results of solar district heating systems", organised in cooperation with solarthermalworld.org will take place as part of the project. It will report on the use and performance of seasonal heat storage units, distributed SDH plants connected to specific points of the district heating grids and the large, centralized SDH plants used in Denmark.

Speakers and presentation:

Thomas Schmidt, Member of the Management at the German research institute - Solites, "Monitoring results and performance of seasonal heat storage"

Robert Söll, Head of Project Development at the Austrian SHC turn-key system supplier S.O.L.I.D., "Distributed solar district heating: Built examples in Austria"

Jan Erik Nielsen, Project Manager at Danish consultancy PlanEnergi and Manager of the Solar Keymark Network and the Global Solar Certification Network, "Monitoring and simulation of large solar district heating fields: An example from Denmark"

Free Registration and further information are available here: <http://solarthermalworld.newsweaver.co.uk/WebinarDesignrulesandmonitoringresultsofsolardistrictheatingsystems-11g7c2lybu0/15n6r6y0728>

The first SmartReFlex Webinar 2017

Tuesday 25.01.2017

16.00 - 17.30 CET (Berlin time zone)

Topic: "Renewable district heating and local heat planning"

More information will be available soon under: <http://www.smartreflex.eu/en/news/>

Technical Design and Planning of RES District Heating and Cooling (DHC) Training Course

This 2 day course is part of a series of training opportunities that will bring some of the best international experience in district heating to Ireland. It is organised as part of the European SmartReFlex project, which includes Irish partners Tipperary Energy Agency, Kerry County Council and XD Consulting. Smart Reflex aims to support the development of district heating based on renewable energy sources (RES) through know-how transfer and exchange of experience. This training will focus on the planning and technical design aspect of developing and operating a RES district heating project. It will be a unique opportunity for participants to gain an insight into the Danish experience of designing and deploying successfully district heating with renewable energy.

When: January 24th and 25th 2017

Where: Woodquay Venue, Dublin City Council Civic Offices, Woodquay, Dublin 8

Fee: €295 per person

Full agenda: Coming Soon

Trainers: Per Alex Sørensen, PlanEnergi, Morten Hofmeister, PlanEnergi, Xavier Dubuisson, XD Consulting, Paul Kenny, Tipperary Energy Agency, Donna Gartland, CODEMA

Course Content:

Urban heat planning, DHC vs. individual heat supply, cooperative ownership, real examples of project development:

Mapping of present and future heat and cooling demand
Mapping of resources

Mapping of costs and competitiveness

Case-studies - examples from Europe and SmartReflex local project participants

Concepts on how to stepwise reach 100 % RES, e.g. utilisation of excess heat from industry

How to come from case studies to municipal and regional plans, addressing the necessary framework for development of DHC (e.g. risk analysis)

How to optimize technical solutions in 100% RES project implementation.

Design of substations and lay-out of DHC grid with low temperatures

Design of house installation - heating controls, efficient use of DH

Design of transmission and distribution networks - pipe sizing, branch sizing

The internet based calculation program isoCalc (from the manufacture of pre-insulated pipe systems isoplus) will be used for the hydraulic pipe dimensioning.

Production Technologies - excess heat from industry, Solar thermal, Biomass boiler, Biomass CHP, Biogas CHP, heat pumps, storage technologies.

RES production plants and how to calculate production price:

Calculation of district heating production plant

Calculation in EnergyPro of production cost

A 30 day licence for EnergyPro, energy project modelling software package, will be issued to all participants in the training course

More details are available here:

<http://tippenergy.ie/event/technical-design-planning-res-district-heating-cooling-dhc-training-course-2/>

Workshop “Renewable DH” during the SmartReFlex - Final Event

On the 24th to 25th of November the final event of the project „SmartReFlex“ took place in Kolding (DK). As part of this the workshop “Renewable district heating and cooling” took place. Everybody who missed this event with a large number of interesting presentations can find the slides on our website (right on the bottom of the start-page www.smartreflex.eu)