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Innovation, Sustainability, and Renewable Energy: Food in Italy's dilemma

A teaching case in two parts

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This Case was used at the First Sustainability in Agribusiness Case Competition held by the College of Management and Economics, at the University of Guelph on March 16-17, 2012. Other than for the 2012 competition the case has remained confidential. Part 1 was used in the eliminatory round; Part 1 and Part 2 were used for the final round of the competition.

This submission to the 2014 Igls Forum is the first formal submission of the complete case.

The author wants to acknowledge the contribution of colleagues who discussed a much earlier version at the 5th International European Forum (Igls Forum) on System Dynamics and Innovation in Food Networks, Feb. 14-18, 2011, Innsbruck-Igls, Austria.

PART 1

On a foggy November afternoon, Carlo Rossi, president of Food in Italy (FI), a fully owned subsidiary of a large food multinational group, was on his way to an executive meeting called by the newly appointed CEO of the multinational group. The meeting was the first called by the new executive, who wanted to become better acquainted with FI activities, its recent and projected future profitability, and its plans for the future, with a special emphasis on innovation.

Rossi was focused and motivated: this meeting was going to be an excellent opportunity to table a proposal he had recently reviewed regarding the installation of a leading solar technology at FI's headquarters. He was sold on the merits and broad potential of this world-class technology which -he reasoned- had multiple applications for FI and -much more relevant- the multinational group. It only had to be tested once, and it would then fly throughout the group. In a sense, then, the smaller investment by FI was in reality a pilot for a potentially much larger adoption by the entire group. Rossi wanted to receive approval to invest in this Canadian solar technology which would significantly reduce net energy consumption at the corporate head office, significantly increasing the building's energy self- sufficiency, reduce its CO_2e emissions and become a show case opportunity to further enhance FI's image as sector leader in terms of product quality, business and environmental innovations, and commitment to overall triple bottom line sustainability .

As president of Food in Italy for the last 8 years, Rossi had nursed the growth of the company along three main product lines. First and foremost the export of top quality Italian typical foods. FI was selling its "Italian Excellence" products only through carefully selected retail stores; its portfolio included important cheeses like Parmigiano Reggiano "Masterpieces of Tradition", Prosciutto di Parma DOP aged 18 months, several regional Extra Virgin Italian Olive Oil "Every region in Italy has its own flavor", Balsamic Vinegars "The precious gift of time", Artisanal Compotes "a creative approach to traditional ingredients", and Italian Appetizers and First Courses "Authentic Italian flavors". These products were carefully sourced by FI, produced under precise contractual obligations focused on quality and tradition, and exported throughout the world, the main market was the US, followed by Northern Europe, and Japan. China was starting to emerge. Second, a small specialized food media operation, publishing high quality recipes books specializing on regional Italian foods. Most of the publications were aimed at English speaking clients, mostly living North America. Third, culinary training courses and culinary tourism in Italy; this was the most profitable segment of the company, attracting to the head office of the company (housed in a Renzo Piano designed building with superior facilities including 4 large teaching kitchens and an architecturally stunning auditorium with a removable complete show kitchen and advanced multimedia support) an ever growing flow of high net worth tourists from the US and increasingly from China and other Far East countries. Clients ranged from well off professionals to eccentric high net worth individuals who expected to move around Italy by private helicopter. Rossi was delighted to accommodate even the most expensive tastes and needs. Not surprisingly, this was the most profitable product line for FI.

Rossi had always pushed FI to be the top quality player in all they did. Particular care had been devoted to promoting the image of FI as champion of Italian food tradition, intended as the sharing of a multi-sensorial cultural experience of the highest quality level, a sustainable tradition based on the simplest and purest of ingredients and excellence of Italian typical food tradition. Indeed, he had grown the company into its industry-recognized leadership position. FI was recognized as the innovator in this segment of food business, but could not ignore the reality of an increasingly crowded market, with several challengers broadly arising from the same traditions and commitment to excellence that constituted FI's own foundations.

Rossi was reasonably satisfied by FI's recent sales milestones: in 2011 revenues were expected to exceed 30 million Euros, with food exports reaching 24 million Euros; revenue from the publishing operations reaching 1.5 million Euros; and the advanced kitchen training and organized regional food tours revenue expected to surpass 6.5 million Euros. As noted, FI was a fully owned subsidiary of a family-owned large multinational food processor, world leader in their own product market. Consolidated sales for the entire group were in excess of 6 billion Euros in fiscal 2011. Rossi was very well connected and had earned full trust by key members of the family, and as such, the early years of FI were quite positive. The company was growing, much like in an incubator which nourished and protected it. This provided much needed longer term breadth of planning and leadership decision making.

The executive meeting started on time and the atmosphere was quite friendly. The senior spokesperson for the controlling family told Rossi that the family felt Food in Italy had reached age of majority and that it was time FI learned to walk with its own legs. True, FI was a key star in the multinational stable of fully owned subsidiaries, fulfilling a strategic function of promoting traditional Italian foods internationally, but also it was time that FI started to contribute more in terms of its own profitability. The controlling shareholders were committed to FI and told him that the company would be able to rely on basic services (management of accounts payable and accounts receivable, as well as warehousing and transportation in Italy) that would be provided at cost by the mother company. The multinational would remain as lender to FI's and satisfy its financial needs, provided it qualified under the standard commercial requirements the family expected of all subsidiaries. These standards were defined by precise ratios and other quantifiable, objective indicators, that Rossi knew well, and in fact he had been a key person in the executive committee which had defined them. The standards were valid for all companies, world-wide, and more than a few executives had been held accountable for failing to meet them; some had been terminated once the family had concluded that a leadership replacement was necessary to rectify the situation.

The meeting progressed well. There was general agreement on all issues discussed.

Rossi, prudently optimistic, felt good about the opportunity to present his proposal in what he felt was a truly remarkable innovation. In preparation for this part of the executive meeting, Rossi had already shared with his colleagues the original proposal received by the Canadian companies, here presented in Appendix A, and had prepared a few slides to "pre-sell" his innovative ideas, presented in Appendix B.

Rossi was now thinking of what hot buttons to push in his own presentation. He had many thoughts in his mind:

a- How to bet present the many key advantages arising to FI with the proposed adoption of the technology?

b- Was there any value for FI to pursue the reduction of its CO2e footprint? And if so, should FI maximize cost reduction, energy production, brand visibility?

c- To what extent could this technology be valuable for others corporate uses within the group?

d- What PR advantages -if any- could be expected in leading export markets from the installation of this technology on FI's headquarters?

e- Would the proposed technology meet the group's stringent financial requirements? Could the innovation be justified, given the general financial constraints currently set by the group?

f- Finally how best to argue vigorously for adoption of the proposed innovation, providing sound considerations for his recommendation?

APPENDIX A
ORIGINAL OFFER

SolarDuct.Offering This Leading Canadian Technology

to Food in Italy

A Business Proposal

Prepared by Conserval Engineering and Alpi Marketing and Consulting Services

Toronto, November 2010

Executive Summary

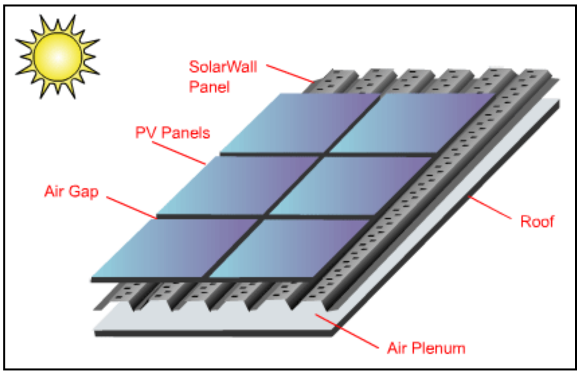
Objective:
Reduced energy cost and improved energy self sufficiency and environmental sustainability via reduced CO2e emissions at FI. A brilliant, high profile, world-class technology.
Recommended Solution:
Install 157 SolarDuct PV/T® panels on the roof of the building, to produce a mix of thermal energy and electricity.

Significant Benefits of the SolarDuct PV/T®

- Annual production of 172.7 MWh of free energy, 126 MWh thermal and 46.7 MWh electric.
- This solution supplies up to 50% of thermal energy required by FI and offsets the cost of 35% of FI's electricity needs thanks to existing governmental financial incentives to photovoltaic.
- A maintenance free installation, for the next 25+ years (thermal), 20+ years (photovoltaic).
- An IRR of 18.8% assuming an energy price inflation of 6%, consistent with current market conditions.
- Significant environmental sustainability improvement, significant reduction of CO2e emissions.
- Innovative technology, very timely, will attract significant interest from clients and media.
- Will impress FI visitors for its serendipity and simplicity.
- First in Italy, one of the first installations in food industry in Europe.
- A certified, award winning, established technology, rated by US government as having the highest known solar conversion efficiency, world-wide.
- An outstanding IRR of 40.8% if installed in locations where thermal energy is required year round.

The Technology

SolarDuct® is a modular rooftop solar air heating system based on the highly efficient and award-winning SolarWall® system. The technology has been specifically engineered for roof settings and for applications in which a traditional wall mounted system is not feasible. **SolarDuct®** can convert to usable energy more than 95% of solar radiation, about 6 to 9 times more than the 10-15% converted by conventional Photovoltaic installations.



SolarDuct PV/T® product is an optimally designed Photovoltaic/thermal cogeneration system, with improved Photovoltaic (PV) efficiency versus typical PV mounting. **SolarDuct PV/T®** can convert to usable energy more than 50% of solar radiation, about 3 to 4 times more than the 10-15% converted by conventional Photovoltaic installations.

Figure 1. Solar Wall scheme

With a SolarDuct PV/T system, the all-metal SolarWall® panels double as the PV racking system, while also removing the heat from the back of the PV modules and using it to offset the building's heating load. The SolarWall® PV/T technology solves the overheating problems found in most building integrated PV (BIPV) systems by removing the heat from the back of the PV modules. PV modules are mounted on top of the SolarWall® panels, which act as the PV racking system. The heat is drawn off the back of the PV modules and is ducted into the building's conventional HVAC system where it offsets the heating load. The SolarWall system keeps the air circulating evenly around the PV modules, which can cool the PV modules by as much as 20 degrees C. This can increase the electrical output by 5-10%.

Figure 2 illustrates how PV modules are mounted on top of the SolarDuct® units, and the heat is drawn off the back of the PV modules and then ducted to the nearest rooftop air handler. Since the SolarWall® air heating panels serve as the racking system needed to mount the PV modules, that also contributes to the cost-effectiveness of the cogeneration system. The modular units are easy to install and are angled at an ideal orientation for maximum solar gain.

Figure2. : A SolarDuct® PV/T™

Outstanding Energy Efficiency

Consider this possible installation alternatives:

1. **A stand alone Photovoltaic installation converts 10-15% of the solar radiation into electricity,** the rest is lost. 10% is lost due to reflection by the PV glass and 75-80% is converted into heat energy which is dissipated. The hotter the PV module becomes, the less electricity it produces. (~0.5% loss per degree above the PV Nominal Operating Cell Temperature of 25°C).
2. **A SolarDuct® installation alone converts 50-80% of the solar radiation into usable heat energy.**

A SolarDuct PV/T® installation, converts 10-15% of the solar radiation into electricity and 35-50% of the solar radiation into usable heat energy. FI will be the first to install it in Italy

Our proposal

The FI building

Technical data received by FI staff indicate 2700 m2 of a high quality, highly specialized office building, with annual average consumption (2007-2009) of 252.5 MWh of thermal energy to heat the facility, 55.3 MWh of thermal energy to produce sanitary hot water, and 299.2 MWh of grid purchased electricity. Thermal energy is purchased from the existing district heating system. Due to the specialized nature of the building, fresh air requirements are high, between 15,000 and 45,000 cubic meters per hour. Most recent thermal energy cost is 9.1 cents per kWh; electricity is 19.1 cents per kWh. No indication of an effective efficiency in converting energy from the district heating system was provided. A very conservative 90% was assumed in the analysis, normally this efficiency is 25-70%, depending on a number of parameters; if the actual efficiency were in fact lower than the used 90%, the economic results of SolarDuct installation would increase accordingly. The FI building roof is flat and extends for 1300 m2 (a front of 32.5m and depth of 40m) with a central mechanical room 4.5 m from the front of the building. Limited shading is experienced by the roof due to the presence of the mechanical room and nearby buildings. This building is suitable for installation of either a standalone **SolarDuct®** or a **SolarDuct PV/T®**, a joint Solar Duct® and PV installation. Thermal energy captured can be fed through the fresh air intake located in the North-West corner (top left) of the building.

Analysis

We conducted a preliminary engineering and economic analysis to determine the preferred installation for AB. Given the much higher efficiency of the **SolarDuct®** compared with that of conventional photovoltaic systems, our proposal reports only on the comparison of a **SolarDuct PV/T®** and a **SolarDuct®** installation. In the analysis it was verified that IRR of a PV installation, despite the large government incentives currently available, is inferior to the IRR available from **SolarDuct®** in situ.

We have short listed these two proposals:

- **Proposal A is a SolarDuct PV/T® installation, joint SolarDuct® and photovoltaic,** producing 126 MWh of thermal energy during the period Sep 15-May 15, and 46.7 MWh electric throughout the year. Payback is 7.3 years.
- **Proposal B is a SolarDuct® installation without photovoltaic,** producing annually 214.3 MWh of thermal energy during the period Sep 15-May 15. Payback is 5.9 years.

The economic life is a minimum of 25 years for **SolarDuct®**, with essentially no maintenance, and a minimum of 20 years for the PV component, with a new inverter installed in year 10 to 12. Current market prices and incentives levels were used in the calculation.

The empirical results are presented in three tables:

- Table 1.a presents the environmental performance results, in terms of energy produced per year and corresponding reduction in CO2e emissions calculated at the average Italian grid rate of kg 0.443 per kWh.
- Table 1.b presents the economic metrics results, in terms of annual savings from the proposal at current market prices (inclusive of existing government incentives for PV electricity production), cost of the proposal, pay back, benefit cost ratio, and NPV (all at constant energy prices, a prudent assumption).
- Table 2: presents the IRR of each proposal, over 25 years for the SD and 20 years for the PV, for different projected energy inflation rates. As a reference, during 2007-10 FI experienced an annual inflation of 3.7% for electric kWh and 5.9% for thermal kWh purchased from the grid.

Table 1.a.

Environmental performance of the two proposals.

		MWh Produced			Emission reduction, CO2e tons
		Thermal	Electric	Total	
A	157 SolarDuct panels, used 8 months/year, with 157 photovoltaic panels (36.11 kW inst.), used full year	126.0	46.7	172.7	84.9
B	157 SolarDuct panels, used 8 months/year	214.3	na	214.3	105.5

Table 1.b.

Economic metrics of the two proposals.

		Annual Savings, 1000 Euro	Installed Cost, 1000 Euro	Pay Back, years	Benefit Cost Ratio	NPV, 1000 Euro
A	157 SolarDuct panels, used 8 months/year, with 157 photovoltaic panels (36.11 kW inst.), used full year	€ 40.0	€ 290.8	7.3	3.0	€ 576.4
B	157 SolarDuct panels, used 8 months/year	€ 23.3	€ 137.0	5.9	4.2	€ 444.8

Table 2.
nternal Rate of Return of the two proposals.

Energy Cost Inflation Forecast (*)	Internal Rate of Return	
	Proposal A	Proposal B
0	12.90%	16.60%
2%	14.90%	18.60%
4%	16.80%	20.60%
6%	18.80%	22.50%

(*) the energy cost inflation in 2007-10 experienced by FI was 3.7% per annum, compounded, for electrical and 5.9% per annum, compounded, thermal.

Discussion

As expected given the superior efficiency of the **SolarDuct®** technology compared to photovoltaic, the installation of a pure **SolarDuct®** system (proposal B in table 1.a and 1.b) maximizes conversion of solar energy into usable heat energy, and therefore maximizes the total energy produced, and reduction in CO2e emissions.

A **SolarDuct PV/T®** installation, **proposal A in table 1**, has a marginally lower environmental and economic performance than a pure **SolarDuct®**.

This is expected as the environmental efficiency of **SolarDuct®** is a multiple of that of PV, and this objective advantage remains even once the economic assessment includes the existing government incentives to the PV sector. Table 1.a and 1.b confirm that **SolarDuct® is without hesitation the best technical option if maximizing energy production is the objective.**

That recognized, however, one needs to focus on the specific requirements of FI, in particular its specific energy mix needs. Whereas FI could use all the thermal energy of proposal B in a cold day when its ventilation needs are high due to specific in-house activities, part of the energy produced would be in excess in a lukewarm day, perhaps a week end day, when ventilation volumes are lower.

Proposal A, provides 16% of FI's average annual electricity needs (remunerated at the inflated level provided for by the government incentive), and this is 100% usable for sure, and up to 50% of FI's average thermal energy requirements. Because of the current government incentives are almost double the current cost, 45.8 vs. 19.1 Euro per kWh, once the incentive is considered the production of 16% of electricity actually offsets 35% of FI annual electrical energy costs. **Proposal A, then, would offset the cost of 35% of electrical energy consumption and provide up to 50% of FI's current thermal energy needs.**

Proposal B would provide up to an average of 85% of FI's thermal energy needs, but one must realize the possible timing mismatch of production and requirements of thermal energy, so that it is possible that a percentage of this energy would remain unutilized (for example: a day when ventilation volumes required are low, and/or in an unusually warm day).

Accordingly, and despite its lower overall performance due to the trade-off between PV and SD, we believe that proposal A, **SolarDuct PV/T® installation with its mix of heat and electric energy which may be best suited to match FI's comprehensive needs during the entire year**: high heat energy during the cold months, and a constant supply of electric energy during the entire year.

Recommendation

Our professional opinion is that in this installation it is preferable to diversify the mix of energy produced as this best matches FI's energy requirements, rather than focussing on maximizing thermal energy production, which may not find a full use, year-round, at FI. The installation of a Heat Pump, not considered here, could modify this picture, by allowing the production of sanitary hot water with any excess thermal energy available. It should be noted, however, that the demand of sanitary hot water is reasonably limited (approx 1/5) when compared to FI's thermal requirements.

For illustration purposes only, in an industrial setting where the thermal energy could be used year round to pre-heat a given volume of air required by an industrial process, for example in a product drying process, the payback of **SolarDuct®**, using current market conditions and assumptions, would be an exceptional 2.7 year, with a benefit / cost ratio (with no energy price inflation assumed) of 9.3.

In conclusion, it is our professional opinion that **SolarDuct® is truly an outstanding technology with impressive returns for users who need the thermal energy so efficiently produced.**

Based on the economic and managerial considerations of a better match between FI's need and Proposal A's energy mix of thermal and electric energy over what would be provided by Proposal B, producing a larger amount of thermal energy, we **recommend the installation of proposal A, the SolarDuct PV/T® system**.

APPENDIX A.1

About Conserval Engineering Inc.

Conserval Engineering Inc. is 33-year old Canadian company headquartered in Toronto-Canada with offices in Buffalo NY, Paris, and Tokyo and dealers in 25-countries.

Conserval Engineering is the inventor of the "transpired-plate" solar air heating technology branded as SolarWall. SolarDuct is a modular rooftop version of the SolarWall technology. SolarWall and more recently SolarDuct have been used by clients on 6-continents and 33-countries for over 20-years.

Clients include government and private sector organizations such as US Army, Canadian Government, NASA, Ford, Federal Express, Wal-Mart, 3M, Auchan, Toyota, Bombardier, Boeing, and thousands more. With over 3 million sqf installed in over 33 countries, every year this technology reduces CO2e emission by 50,000 tons.

The National Renewable Energy Laboratory, US Department of Energy, has recognized the technology as having "the highest known efficiency of any active solar collector in existence".

About Alpi Marketing and Consulting Services Inc.

Alpi Marketing and Consulting Services Inc., founded in 1991, is a Canadian company headquartered in Guelph, ON, specialized in providing trade, financial and business analysis services to the agribusiness sector, with a particular emphasis on solving marketing and energy, commodity and financial risk management problems. Clients include government and private sector organizations such as the Agriculture and Agrifood Canada, the Italian Ministry of Agriculture, Barilla, Nestle', Better Beef, the City of Parma, the Consorzio Tutela Provolone Valpadana, the Universita' Cattolica del Sacro Cuore, the University of Buenos Aires to mention a few

APPENDIX A.2

FAQ

Q. Why should I buy SolarWall®?

Many reasons:

• SolarWall heats air for free providing thirty or more years of free heating

SolarWall can improve indoor air quality since more fresh air can be brought into the building without increasing heating costs. New ventilation codes require more air to solve sick building syndrome and SolarWall heats this air for free.

• SolarWall can displace large amounts of energy, and therefore it has a high contribution value to reducing CO2 emissions.

• SolarWall is maintenance free and has no moving parts

• SolarWall is non polluting and uses renewable energy.

• Solar heating could become mandatory for some government departments, which are committed to lowering greenhouse gases or solving energy shortage issues.

• SolarWall is one of the lowest cost solar energy systems available on the market

• Solar energy offers clients positive public image and shows leadership with renewable energy.

Q. What is the SolarWall® technology?

The SolarWall technology is an unglazed solar air heating system that is usually installed on a wall. The solar panels heat the fresh air that is required in commercial, industrial and institutional buildings. The panels are all-metal and available in a variety of colors. For a detailed introduction to the SolarWall technology view our flash presentation. Also find out more information in our SolarWall products section.

Q. What is the payback?

The payback can be immediate to a few years. SolarWall has one of the best returns on investment of any renewable energy product and a better payback than many other building products such as high efficiency windows, photovoltaic panels and heat recovery devices.

Q. How much heat will it produce?

Each square meter of SolarWall surface can generate 500-600 watts (160 Btu/hr) of thermal energy. A 100m2 SolarWall heater will provide 50kW (160,000 Btu/hr) of thermal energy on a sunny day.

Q. Has the SolarWall technology been tested?

The SolarWall system has probably had more testing and monitoring by governments than any other solar heating product. USA, Canada, Germany, UK, Austria, Japan and others have already spent millions on testing and field monitoring of numerous installations around the world. The independent monitoring has allowed Canada and USA to support the technology. The United States Department of Energy, a strong advocate of SolarWall technology, calls it a transpired collector.

Q. Is there any maintenance?

No! The SolarWall cladding is similar to other metal walls which require no maintenance and is designed to last as long as other metal cladding materials. Any fans or dampers attached to the SolarWall system are required in any event and would have the same maintenance as any other fan.

Q. Is there any cooling benefit?

Yes, the SolarWall cladding stops sunlight from reaching the main wall or roof and acts as a shade for that surface. In fact, in warmer climates, applying the SolarWall cladding to roof as well as the south wall can significantly lower the cooling load of a building. New research is currently underway to allow SolarWall panels to provide night time cooling and day time desiccant cooling.

Q. What is the unique feature of the SolarWall heater?

SolarWall is all metal, a building material and also an efficient heater. It does not need a glass cover which is typical of other solar designs. For the price of a wall, an owner gets thirty or more years of free heat and better indoor air quality.

Q. Does it work with PV panels?

Yes, in fact, SolarWall panels can be designed to cool PV modules and recover heat that would be otherwise lost in building integrated PV arrays. This co-generation (solar thermal air heating and PV electricity) system is referred to as SolarWall PV/T.

Q. I want to install PV panels to produce electricity and have no extra room for solar thermal panels.

Not a problem with SolarWall PV/T. Just mount the PV panels onto the SolarWall panels and the same surface area will now produce both heat and electricity. If fact, for roof mount systems, use SolarWall as the PV racking system and connect the heated air to the nearest roof top HVAC unit. Best of all, much of the heat from the building integrated PV panels is now removed, improving the PV efficiency, extending the roof life and saving more energy and money.

Q. Can you cool the air in the summer?

Yes. We are currently evaluating drying of desiccants necessary for desiccant cooling. In addition, our roof mounted panels will radiate heat to the clear night sky and a properly designed night cooling system is expected to provide up to 40 watts of cool air per square meter of panel from sunset to sunrise. If you have a potential night cooling project, please contact us at info@solarwall.com or at our contact info site and provide us with details of the project.

Q. How much CO2 can be displaced with the SolarWall technology?

Every 5 square meters of SolarWall panels displace approximately 1 ton of CO2 emissions every year.

APPENDIX A.3

Assumptions made, second half of 2010.

Price paid in Q4 10, 1 kWh thermal, Euro per kWh	€ 0.091	As provided by Food in Italy
Observed inflation 2007-2010	5.9%	
Price paid, Q4 10, 1 kWh electrical, Euro per kWh	€ 0.191	As provided by Food in Italy
Observed inflation, 2007-2010	3.7%	
Existing governmental PV incentive, Euro per kWh produced	€ 0.358	Gazzetta Ufficiale della Repubblica Italiana, for 20-200 kW installed, valid up to April 30 2011, guaranteed 20 years
Efficiency of AB heat exchanger from invoiced hot water grid (all inclusive) to actual hot air used in building	90%	Prudent estimate, needs to be verified in situ, could be 70% or even lower (which woudl improve SD results)
Reduction in CO2e emission, price, Euro per ton	€ 15	Current market price, European Climate Exchange.
Solar Ducts panels installed	157	Engineering estimate, needs to be confirmed with in site measurements
Photovoltaic panels, kW installed	36.11	Based on the number of SD installed.
CO2e equivalent electrical footprint kg/kWh, average value published by ENEL for the national grid.	0.443	Source: ENEL . Available at http://www.enel.it/it-IT/azienda/ambiente/enel_ambiente/zero_emissioni/
SD cost, 157 panels, installed 1000 Euro	€ 137	
PV cost, 157 panels, 36.11 kW installed) 1000 Euro	€ 154	
SD life , years	25	
PV life (replacing inverter in yr 10, included in NPV calculation at 5% of initial cost), years	20	
Azimuth of SD panels	45˚	Driven by building shape
Inclionation of SD panels	32˚	Optimal for year-round production
Shading, roof, front of building	0%	Estimate to be verified in loco
Shading, roof, sides of mechanical room,	20%	Estimate to be verified in loco
Shading, roof, mechanical room	0%	Estimate to be verified in loco
Shading, roof, back fo building	10%	Estimate to be verified in loco

Note: the potential "30% contributo in conto capitale" (Capital Cost Contribution) described in the Gazzetta Ufficiale of the Italian Repubblic for innovative projects was not considered in the calculation as it is simply impossible to assess with certainty its applicability and availability. It is only mentioned here as something worth exploring.

APPENDIX A.4

Proposed position of 157 Solar Duct® panels on the roof of the FI building

MODULAR PROPOSAL, FIVE ZONES

1- Orange (on roof at front of bldg, SW orientation): 32 Solar Ducts in two rows;, no shading.

2, 3- Green and Yellow (on roof at sides of bldg, W-NW and E-SE orientation): each 28 Solar Ducts in seven rows; 20% shading.

4- Blue (on roof of mechanical bldg): 30 Solar Ducts in 5 rows; no shading;

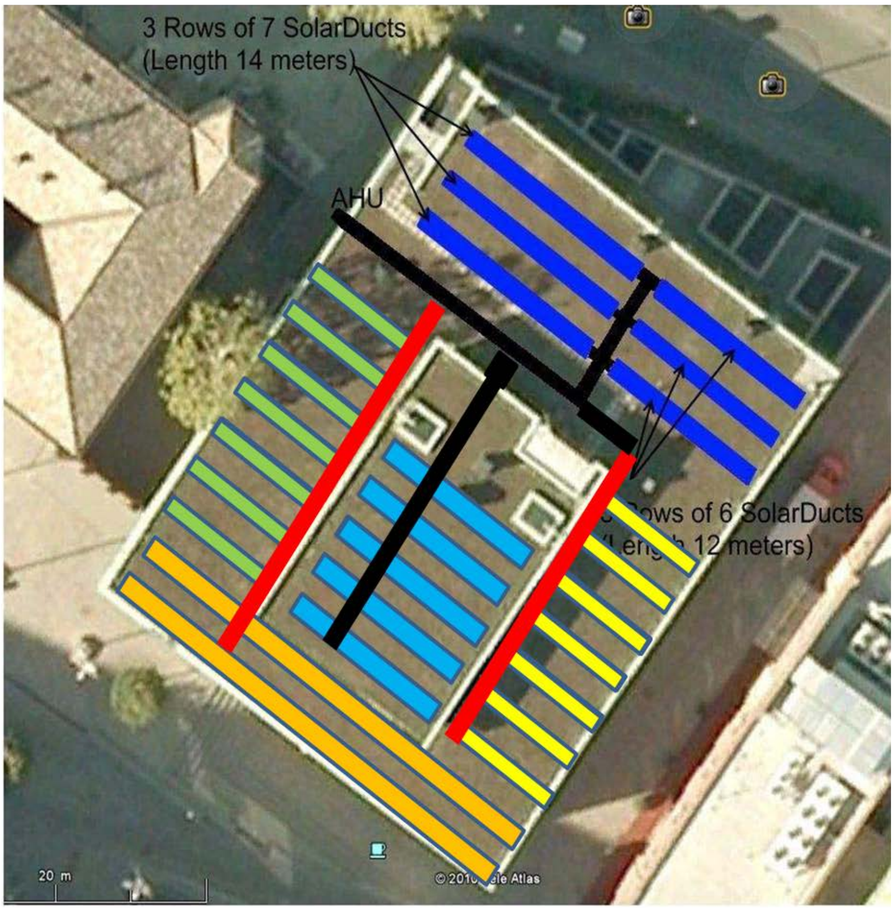
5- Dark blue (roof at back of bldg, NE orientation): 39 Solar Ducts in three rows, 10% shading.

Total for 5 zones: 157 Solar Ducts.

This is designed to provide a volume of pre-heated air of 15k to 50k m3 per hour, as per preliminary building specifications provided by client.

Solar Ducts are placed with a 32 degrees inclination, with minimal visual cluttering of bldg. Panels will be matte black.

Ducts will feed into the existing fresh air intake of the building.



APPENDIX
A.5

Essence of our proposal: to add a number of Solar Duct® panels and photovoltaic panels on the roof of AB, to produce both thermal and photovoltaic energy.

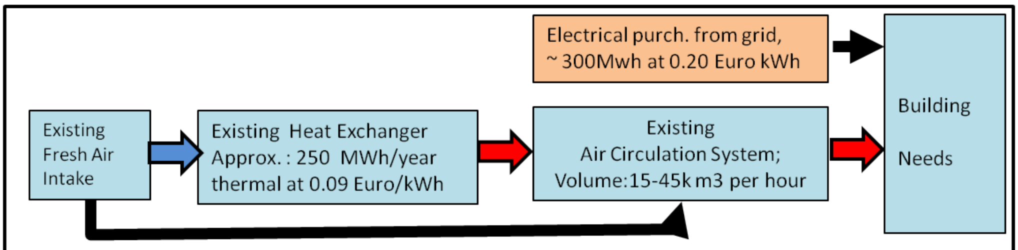


Figure 1: Existing system

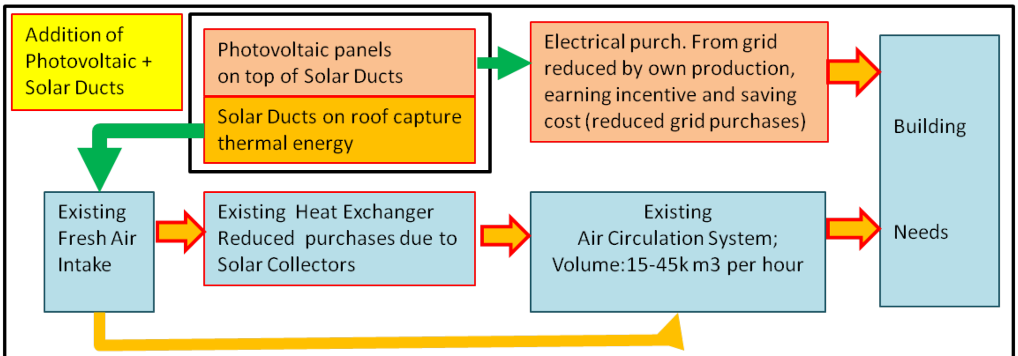


Figure 2: Addition of Solar Duct® feeding pre heated air to the building fresh air intake in the heating season, and photovoltaic panels feeding the building's own electrical consumption (year-round).

APPENDIX B

Slides prepared by Rossi for the Board Meeting

Executive Summary

Objective:

Reduced energy cost and improved energy self sufficiency and environmental sustainability via reduced CO2e emissions at Academia Barilla. A brilliant, high profile, world-class technology.

Recommended Solution:

Install 471 SolarDuct PV/T® panels on the roof of the building, to produce a mix of thermal energy and electricity.

Significant Benefits of the SolarDuct PV/T®

- Annual production of 518 MWh of free energy, 378 MWh thermal and 140 MWh electric.
- This solution supplies up to 50% of thermal energy required by AB and offsets the cost of 35% of AB's electricity needs thanks to existing governmental financial incentives to photovoltaic.
- A maintenance free installation, for the next 25+ years (thermal), 20+ years (photovoltaic).
- An IRR of 18.8% assuming an energy price inflation of 6%, comparable with current market conditions.
- Significant environmental sustainability improvement, significant reduction of CO2e emissions.
- Innovative technology, very timely, will attract significant interest from clients and media.
- Will impress AB visitors for its serendipity and simplicity.
- First in Italy.
- A certified, award winning, established technology, rated by US government as having the highest known solar conversion efficiency, world-wide.
- An outstanding IRR of 40.8% if installed in locations where thermal energy is required year round.

World-Class Innovation

- Will cut FI's thermal energy cost and relative CO2 footprint in half
- Will ut FI's electricity grid cost by 55%+, with a 16% net drop in footprint
- Is additional to any saving already in effect
- If thermal energy could be sold during the warm season to a nearby potential user, thermal cost would drop to zero, as its relative CO2 footprint

Mapping FI's Energy Opportunity Set

- National Grid
- Own gas powered boiler
- Pro rata large electric and thermal co-generation plant, gas powered
- Municipal utility distrct heating
- This new technology

Base Choice

- The national grid :
  - electricity at 20 euro cents per kWh
  - 3% annual inflation over the last 4 years
  - average CO_2 footprint of about 0.45 kg CO_2 per kWh produced.

Traditional choice: own gas boiler

- Generate thermal energy with a gas boiler
- significantly lower carbon footprint than otherwise obtainable from the national grid (40% saving), but only for its thermal energy requirements.
- The overall energy efficiency of this solution would likely be less than 50%.
- Natural gas prices relatively low now, but increasing at 4 to 5% per annum in the EU.

Prorated co-generation

- A large advanced gas powered co-generation plant, producing electricity and thermal energy (hot water) with overall energy efficiency of over 50%.
- This plant could offer a footprint closer to what could be found in Ontario,
- Likely determine a 40% reduction in emission when compared to national grid for electricity and 10-20% relative to a local boiler for thermal energy.

Municipal utility district heating system

- A municipal utility had recently launched a district heating system, which FI could join
- year round thermal energy and electricity
- The cost of thermal energy was less than 10 euro cent per kWh equivalent, and had experienced a 6% inflation over the last 4 years
- The cost of electricity was 10% lower than that from the national grid.
- No carbon footprint nor other emission measures were provided by the utility.
- Estimates: close but worse than with co-generation plant (co-generation is optimized, district has difficulty manage fluctuations in demand mix)

FI's own new technology

- Would provide an almost maintenance free (and therefore almost zero cost) solution,
  - with a zero footprint for up to 50% of thermal consumption by ICT, and
  - enough subsidized electricity to offsets the cost of 50% of FI's electricity needs, this thanks to existing incentives to photovoltaic.
- The ensured life of the installed technology exceeds 25 years for the proprietary component and 20 years for the PV installation.
- With sales to nearby user of excess thermal during warm months:
  - cut thermal cost and relative footprint to 0
  - still cut electricity cost by 46% and relative footprint by 16%.

Bottom line

- Closed system, municipal district heating
  - Cut thermal footprint and cost by 50%
  - Cut electrical footprint to 84% of low grid footprint, cost to <50%
- Open system, municipal district heating, sale of thermal energy
  - Cut thermal footprint and cost to 0 (can't beat that)
  - Cut electrical footprint by 16%, its cost to less than 50%
- Open system relative to national grid and conventional boiler, replaced by new tech and district heating
  - Cut thermal footprint and cost to 0
  - Cut electrical footprint by > 55%, its cost by more than 50%

Simplified illustration of the proposed installation of SolarDuct® PV/T™ panels and photovoltaic panels on the roof of ICT, to produce both thermal and photovoltaic energy.

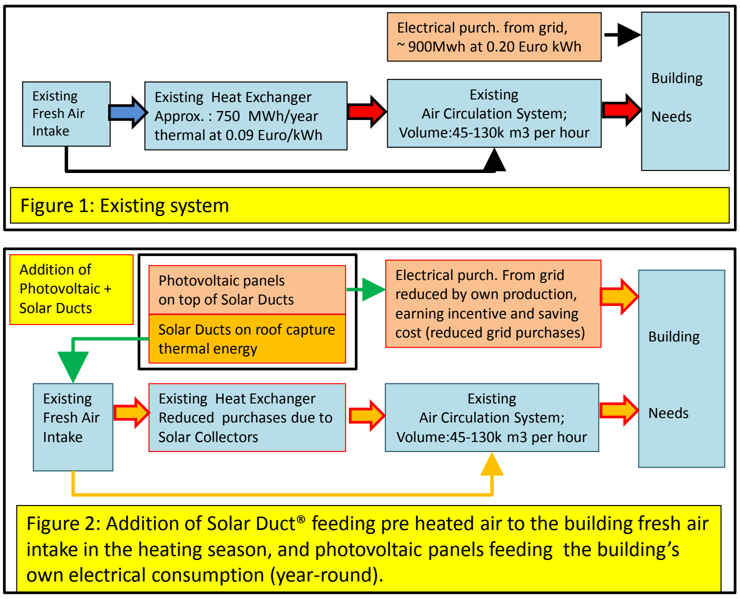


Figure 1: Existing system

Figure 2: Addition of Solar Duct® feeding pre heated air to the building fresh air intake in the heating season, and photovoltaic panels feeding the building's own electrical consumption (year-round).

PART 2

The Board meeting in November 2010 took a turn for the worst. The new CEO of the multinational group, a finance professional by training, insisted on his "finance-above-all" perspective: no investments with a payback longer than 3 years. Quite simply: the company had to save precious cash, which by the way was needed to face the unknown evolution of gloomy global economic conditions. True, the technology was outstanding, but no immediate adequate financial gains were to be had from its adoption. In addition, the group had embarked in a major energy strategic plan and was building their own gas-powered generation plants at all production locations, world-wide. Within the next 18 to 24 months, this would significantly reduce the group's CO2e footprint, a reduction well in excess of what was required by the new European Union directives, and a significant reduction in the average cost of hydro. In short: nice, but ... case closed.

Sic transit gloria mundi... one year later, in Q4 2011, the group had a new CEO.

Rossi seriously considered whether the entire issue should be revisited. True, the new gas-powered generation plants were feeding the group cheap and cleaner electricity. True, in regional markets such as North America the price of Natural Gas had dropped further in the last couple of years, courtesy of new technological developments that expanded production of this environmentally friendly, non renewable, fuel. That granted, the costs of electricity and energy in general had risen and were forecast to rise further in Italy, if anything due to newly increased taxes, and FI's head office complex was not fed by the new gas powered generation plant which was satisfying the needs of the local production facilities -the largest in Europe- just a few km away. In addition, sober budgetary considerations were calling for a significant reduction in the highly subsidized rates paid to PV production of electricity. Some were even calling for their outright termination.

Having taken notice that the market was strained by the overall poor economic conditions, Rossi's contrarian attitude felt that this could have been an even better time for true sustainable leadership. He was fully aware of (and quite uneasy about) the impact of higher discount rates and energy subsidies on long economic life investments such as Solar Duct. He knew that these practically meant a somewhat redundant, distorted, imperfect and incomplete "nothing after year 10 mattered" dry financial logic. But food was much more than numbers, food was traditions, deep emotions, food was culture... In short: he felt somewhat uneasy about this accurate but dry numerical conclusion. There was something attractive about getting a significant reduction of his headquarters net energy requirements... which somehow trumped the cold and almost too rational requirement of a three year payback. There was something attractive about becoming almost energy self-sufficient, in achieving an almost zero CO2e footprint.

But, at the end, would his high net worth clients in North America understand and appreciate this? Would they be willing to pay something extra for this, and if that were indeed the case, how much? And to cut to the chase, why just the headquarters, how about the rest of FI's entire supply chain? In fact, would the adoption of this technology at its corporate headquarters dangerously expose that the rest of its supply chain were still "traditional, non renewable energy - intensive"?

He was confused, and working on the new 2012 budget. He had little time to think of it, but deep in his heart he felt quite keen on the Canadian technology. Was this the right time to revisit it? Could the "corporation using the cleanest energy possible" be relevant, at the margin, for his high net worth clients? Could it become a valuable strategic resource, once a bit of economic recovery had cleared the current economic gloom and doom? Or would the relative glut in natural gas supplies further cool his lukewarm excitement for this courageous investment? Was there more to consider than just the crude, cold payback? And how convincing could that something sound to the new CEO?