Pirelli & C. Ambiente Renewable Energy S.p.A.

Information Material

Executive Summary

Pirelli Ambiente Renewable Energy (PARE) has a **proprietary and patented technology for the production of HQ-SRF (High-Quality Solid Recovered Fuel) out of Municipal Solid Waste (MSW)** with the following benefits:

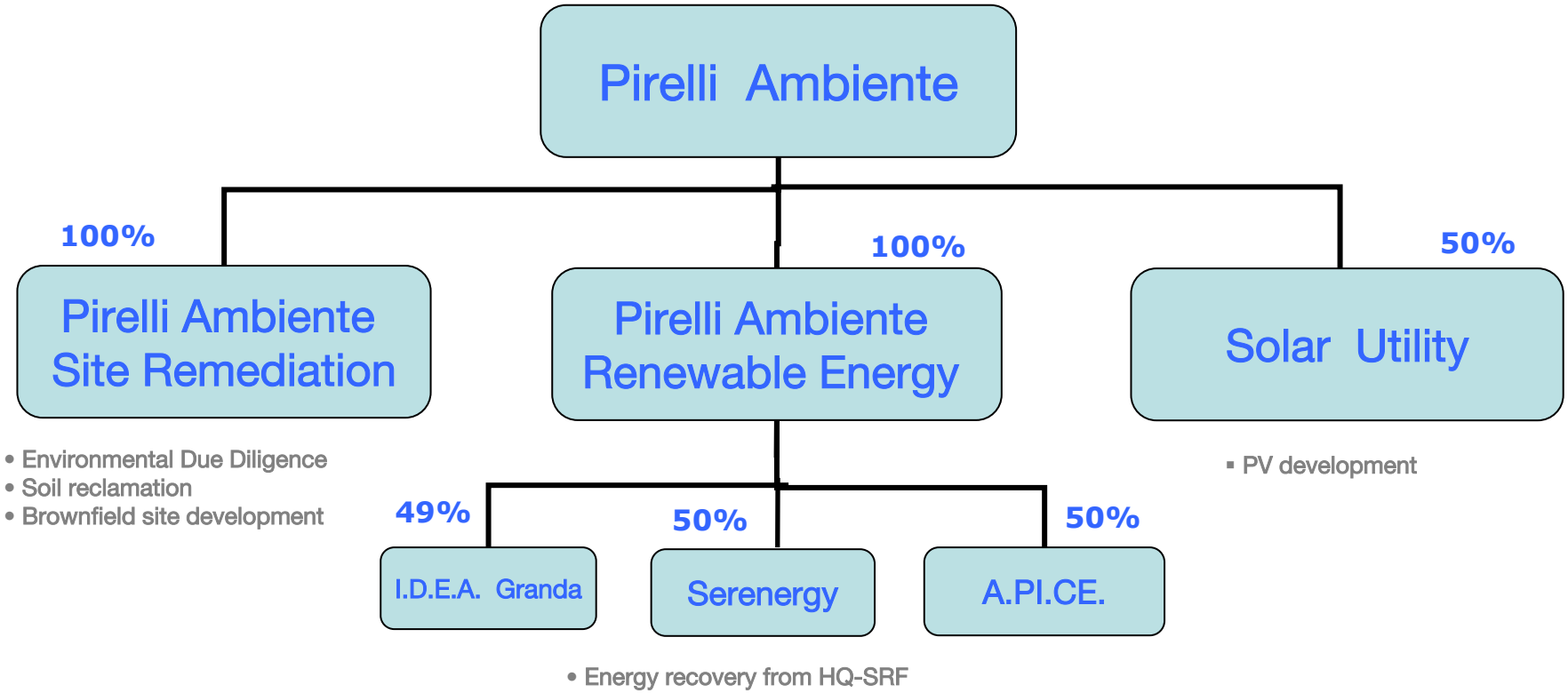
1. **Large SRF market potential worldwide** (i.e. EU 15 amounts to 57 mio t/y);
2. **Reduction of fossil fuel imports and related dependence** (SRF as a "domestic" fuel);
3. **Massive CO_2 reduction** (1 ton of SRF through its production from MSW and its co-firing reduces emissions of CO2 by 1,75 ton/CO_2) and improvement in NO_x and SO_2 emissions;
4. **Cost effective** alternative among Renewable Energy Sources (RES) and waste disposal solutions.

Each HQ-SRF production plant is structured as an **SPV, with interesting risk-return profile (moderate risk, IRR levered post-tax above 20%).**

PARE is now targeting international development for HQ-SRF and the entry in the photovoltaic business in Italy, looking for **partnership opportunities with strategic investors interested in both fields.**

Pirelli Ambiente Renewable Energy and the Pirelli Group

Pirelli Ambiente consists of 3 operating Companies, one of which being Pirelli Ambiente Renewable Energy (PARE).



The core business of PARE is the Building Owning and Operating (BOO) of plants for the production of High-Quality Solid Recovered Fuel (HQ- SRF), fostering the energy recovery from MSW.

Fuel Produced from Municipal Solid Waste: High Quality – Solid Recovered Fuel (HQ-SRF)

High-Quality Solid Recovered Fuel (HQ-SRF)

Derived from
- dry fraction from Municipal Solid Waste (MSW)
- chlorine-free plastic waste and rubber

- high qualitative stability
- calorific value close to coal levels (more than 5.000 kcal/kg, i.e. 22.000 kjoule/kg)

Potential uses

DIRECT USE OF HQ-SRF

BIOMASS

Using in conjunction with biomass in:
- Fluidized beds for power generation or high efficiency CHP (Combinated Heat and Power)

- COAL
- PETCOKE
- LIGNITE

Using in conjunction with coal and petcoke in:
- Coal-fuelled power plants (10%)
- Cement kilns (over 40%) *

* main burners

PARE's HQ-SRF: unique fuel process

The only SRF that is

- protected by patents on its methods of production and use
- certified by leading industrial boilermakers (ANSALDO and ABB) and by the Italian Agency for Energy and Environment (*ENEA),* for its environment-friendly and chemical-physical properties

PARE filed three relevant patent applications:

Patent **PA 001**
Priority Dec. 97
granted in USA - 2001
granted in UE - 2004

Concerning the composition of HQ-SRF and its chemical-physical characteristics

Patent **PA 002**
Priority Apr. 98
granted in USA - 2002
granted in UE - 2004

Concerning a combustible composition comprising a fossil fuel and HQ-SRF, and the process and the method for instantaneous combustion

Patent **PA 003**
Priority Mar. 2004

Concerning how to handle and combine municipal solid waste and the other components to obtain a homogeneous solid fuel of controlled composition, without using complex mixing devices. The process substantially corresponds to that carried out in the IDEA Granda plant.

ITALY: the first PARE plant, I.D.E.A. Granda

I.D.E.A. GRANDA (Integrazione dell'Energia nell'Ambiente) is the first industrial application of the technology for energy recovery from Municipal Solid Waste. The plant was built in 6 months (within an existing building) and has been working since 2003, producing more than 60.000 tons of HQ-SRF delivered to the second largets cement kiln in Europe, owned by Buzzi Unicem.

It is a company in which A.C.S.R. (a Consortium of 54 Municipalities in the Cuneo area, comprising 154.000 inhabitants) holds 51% and Pirelli Ambiente holds 49%.

The cement kiln **currently substitutes approx. 40% of coal-petcoke consumption by using HQ-SRF in its main burners.**

ITALY: IDEA Granda, unique and innovative properties

I.D.E.A. GRANDA implements an innovative and unique process in Europe based on:

- No need to build new chimneys;
- Partial substitution of fossil fuels with a renewable source: reducing CO2 so far by over 30.000 ton/year;
- Overall environmental benefits assessed at 90 times better than the alternatives (landfill and incineration plants) according to the Life Cycle Assessment Study validated by Milan-Bicocca University;
- Valorisation of municipal solid waste and end of life tyres: the energy recovery from waste in the Basin went from 0 to 32% (higher than the European average level);
- Reduction of the nitrogen and sulphur oxide emissions in the cement kiln;
- Dioxins and furans values are better;
- Short construction and start up time (6 months).

ITALY: IDEA Granda - synthesis opinion inquiry (2006)

The analysis conducted by FIELD SERVICE based on a sample of over 1000 interviews resulted in the following:

- 88,4% of the interviewed agreed with the Local Authority choice
- more than 84% gives a positive opinion on the social role carried out by Buzzi Unicem cement kiln following the choice to use this fuel
- more than 75% have a positive opinion about future expansion of the I.D.E.A. Granda capacity
- the inhabitants wants to be constantly informed on their MSW management

European overview: SRF market drivers*

INDUSTRY ISSUES	DRIVERS	SOLUTION PROVIDED BY SRF
Landfill Directive	Diversion biomass	MSW, with its biomass content, is not disposed in landfill, but recovered as energy
Renewable Energy Sources (RES) Directive	Biomass content	Energy production through SRF co-firing contributes to reach the Directive targets
Best Available Practice	Energy/climate change (Emission Trading Directive)	1 ton of SRF (through its production from MSW and its co-firing) reduces emissions of CO2 by 1,75 ton/CO2
Energy cost	Oil/gas/coal, CO2	SRF has the lowest production cost amongst RES and lowers electricity production costs

* Source ERFO – European Recovered Fuel Organisation: “SRF Markets”, March 2006.

European overview:
SRF market potential in the EU (15 members)

By assuming a 10% substitution rate in power plants, HQ-SRF market potential in the EU amounts to 57 mio t/y, with **avoided CO2 up 100 mio t/year.**

	EU 15 countries		Germany		Italy		UK	
Plant type	**fossil fuel substitution by HQ-SRF %**	**potential market EU15 (Mio ton SRF/year)**	**fossil fuel substitution by HQ-SRF %**	**potential market Germany (Mio ton SRF/year)**	**fossil fuel substitution by HQ-SRF %**	**potential market Italy (Mio ton SRF/year)**	**fossil fuel substitution by HQ-SRF %**	**potential market U.K. (Mio ton SRF/year)**
	ERFO SCENARIO *							
Cement kilns	15/30	3,5 - 7	40	1,4	40	2,4	20	0,5
Power plants	2/4	6,5 - 13	2/4	1,0 - 2,0	4	1,1	10	3,5
CHP ind. boilers		17		5	n.a.	n.a.	n.a.	n.a.
tot		**27 - 37**		**7,4 - 8,4**		**3,5**		**4,0**
	SCENARIO WITH POWER PLANTS @ 10%		**SCENARIO INCLUDING ALL POWER PLANTS @ 3/4%**		**SCENARIO WITH POWER PLANTS @ 10%**		**SCENARIO INCLUDING ALL POWER PLANTS**	
Power plants	10	33	3/4	10,0	10	2,6	10	8,7
tot		**54 - 57**		**16,4**		**5,0**		**9,2**
avoided emissions of CO2 (Mton/y)		**94 - 100**		**28,7**		**8,8**		**16,1**
saving of fossil fuels (Mtep/y)		**27 - 29**		**8,2**		**2,5**		**4,6**

- Source ERFO – European Recovered Fuel Organisation: "SRF: achieving environmental and energy-related goals markets", June 2006 (estimates refer to SRF derived from High Calorific Fraction of MSW, bulky waste, mixed commercial waste and from production specific wastes)

UK: HQ-SRF potential

HQ- SRF potential benefits in the UK are as follows:

- energy recovery of a minimum of 8 to a maximum* of 17,5 million ton/year of MSW (23% - 50% of yearly production in UK)
- production of a minimum of 3,9 to a maximum* of 9,6 TWh from a renewable energy source
- avoided CO2 emission** from a minimum of 7,4 to a maximum* of 16,2 million ton/year

* Assuming that all coal fired power plants will co-firing SRF under present European legislation

** Including avoided CO2 emissions from landfill

USA: Pirelli Ambiente and the Clinton Global Initiative Commitment 2006

The **Clinton Global Initiative** is a project of the William J. Clinton Foundation. It is a non-partisan catalyst for action, bringing together a community of global leaders to implement innovative solutions to some of the world's most pressing challenges, as efforts to combat global warming. The second annual meeting of the Clinton Global Initiative convened in September in New York, inspiring commitments valued at more than $7.3 billion over multiple years.

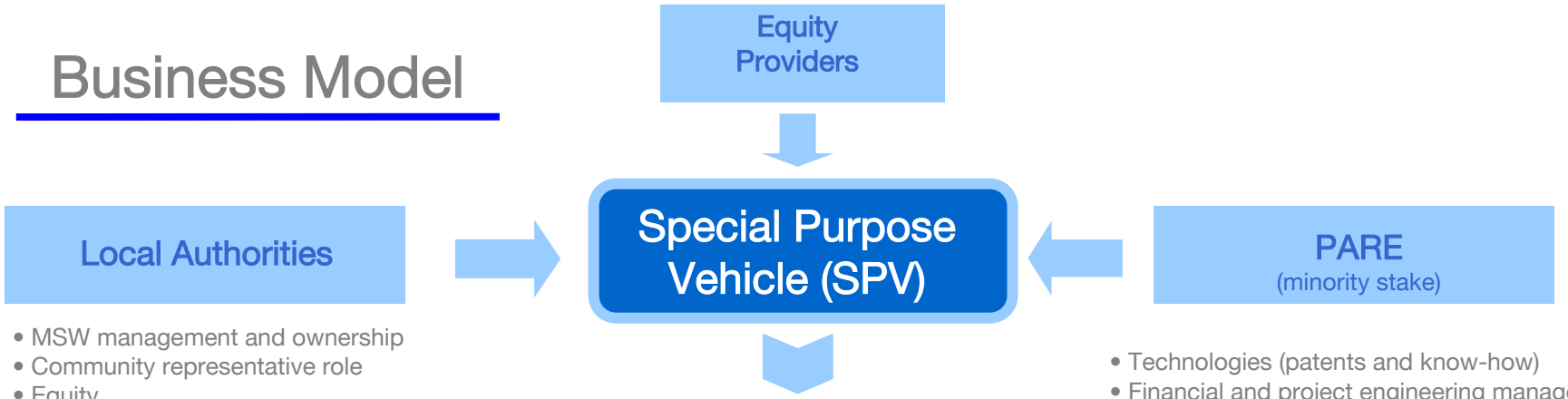
The commitment of Pirelli Ambiente Renewable Energy, selected and approved by CGI, is to reduce 5 million tons of CO_2 over 3-5 years: delivery will be made through the production and sale in Europe, North America and Asia of **HQ-SRF (High Quality Solid Recovered Fuel)**, a fuel capable to reduce massive amounts of CO2. Pirelli Ambiente Renewable Energy is the first Italian company to get its commitment approved by CGI.

Subject to the participation of local partners and equity providers, different SPVs will be structured by Pirelli Ambiente Renewable Energy on a non-recourse basis to guarantee the delivery of HQ-SRF to local industrial end-users, capable of recovering energy by co-firing HQ-SRF with fossil fuels and thus reducing CO_2 emissions from fossil fuels.

As part of the CGI network, the company will be in a position to establish contacts and to develop partnership opportunities instrumental to the project delivery.

Business Model and Revenue Streams

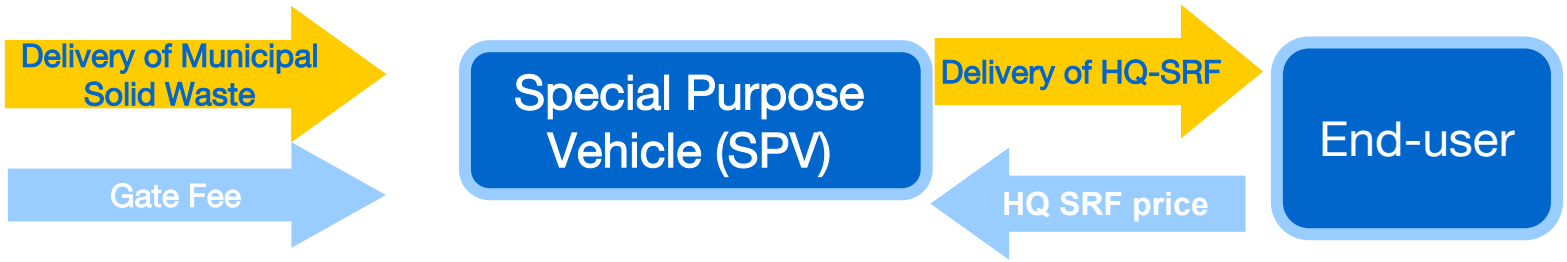
Business Model



- MSW management and ownership
- Community representative role
- Equity
- PFI - Project Finance Initiative (if available)

- Technologies (patents and know-how)
- Financial and project engineering management
- Operations management
- Supply agreement with SRF end-users
- Scientific and communications tools to achieve consensus (LCA)
- Equity

Revenue Streams



HQ SRF price as a formula: f (benefits to end-user)

- Coal substitution
- Incentives for renewable energy sources
- CO2 credits

Business Model: Business Plan drivers

- SPV revenues are based on:
  - a **long-term waste concession** (by local municipalities), with smoothly indexed gate fee
  - a long-term SRF selling contract to end-users (cement kilns and power stations).

- **Therefore risk profile is moderate, as far as counterparts and turnover volatility are concerned.**

- Each SPV is in charge of the Building Owning and Operating (BOO) of a plant for the production of High Quality Solid Recovered Fuel (HQ-SRF) out of Municipal Solid Waste (MSW). Each SPV is financially self-standing, on a **non-recourse basis**: leverage (prudently assumed at 70%) could be further increased.

- Pirelli Ambiente provides technology and management services to the SPV, being also a minority equity shareholder.

PIRELLI AMBIENTE

Pirelli Ambiente & C. Renewable Energy's Overview

- **Unique and proprietary process** of fuel production from waste
- **Large market potential worldwide** (where coal / petcoke is burnt)
- **Massive CO2 reduction** and improvement in NO_x and SO_2 emissions)
- **Cost effective** alternative among Renewable Energy Sources (RES) and waste disposal solutions

Pirelli & C. Ambiente Renewable Energy S.p.A.

Annexes

Information Material

Technical Specifications of HQ-SRF

Comparison between the chemical-physical properties of the High Quality -SRF and the normal grade SRF as per Italian Standards (UNI)

General Characteristics		HQ-SRF under Italian Legislation	SRF under Italian Legislation
Physical Aspect		-	-
Size	mm	-	-
L.H.V. (Lower Heating Value)	Kj/kg a.r. (as received)	>20.000	>15.000*
Humidity	a.r.	<18%	<25%
Cl	d.m.. (dry matter)	<0,7%	<0,9%*
S	a.r.	<0,3%	<0,6%*
Ash	a.r.	<15%	<20%
Cr	mg/kg a.r.	<70	<100
Cu	mg/kg a.r.	<50	<300
Mn	mg/kg a.r.	<200	<400
Ni	mg/kg a.r.	<30	<40
As	mg/kg a.r.	<5	<9
Cd	mg/kg a.r.	<3	<7
Hg	mg/kg a.r.	<1	
Pb	mg/kg a.r.	<100	<200

- A proposed European Norm for the standardization of SRF is expected to be edited soon by CEN (Comité Européen de Normalisation) for a validation program.
- The proposal - that will be published as Technical Specification (TS) is the result of the activity of a specific technical committee (CEN-TC343) appointed by the European Commission for the purpose.
- During the validation time (three years) and until the final approval of the European Norm (EN) each member state can apply its national standard

Use in a Plant for Instantaneous Combustion: Certifications Available to Pirelli Ambiente Renewable Energy

From 1997 to 1999 Pirelli Ambiente has carried out:

Tests at **IFRF Laboratories** (International Flame Research Foundation - Nederland) and at **SCC laboratories** (Stazione Sperimentale Combustibili – Experimental Fuel Station- Milan) for the **determination of combustion kinetics of singular constitutive elements of the mixture**

Tests at **IFRF Laboratories on. on fluid dynamic simulation of co-firing HG-SRF/ pulverised coal** for **ABB Ricerca S.p.A**

Combustion tests at ENEA (Italian Agency for Energy and Environment) La Casaccia **Experimental Station of Incineration** for the characterisation of **HG-SRF** in a circulated fluidised bed (c.f.b.) combustor

Tests at **Ansaldo Energia Termosud S.p.A. - Gioia del Colle** for the co-firing with **pulverised coal in a 48 MWt pilot plant equipped with industrial burner in full scale (30 / 40% of substitution)**

ENEA Certification of environmental survey of the above tests carried out at Termosud Plant in Gioia del Colle (Bari)

Characterisation of HG-SRF: simulation of **loading and unloading phase** of **HG-SRF** from a motor vehicle – **handling** of **HG-SRF**

USA: HQ-SRF strong potential applications

The Conclusions of Report (2005) by the EEC (Earth Engineering Center) Columbia University on the potential applications of Pirelli Ambiente HQ SRF process in the USA stated that:

- the detailed examination of the SRF process and the SRF by EEC confirmed the **full feasibility** from a technical standpoint

- there is **no technical risk** in designing and building a facility that will produce SRF of the specified size, moisture and calorific value

In the USA over 50% of electricity is generated by coal-fired power plants, with a consumption in 2004 of more than 1 billion ton of coal: this represent a very large potential for the co-firing of HQ-SRF, resulting in massive reduction in CO2 emissions.

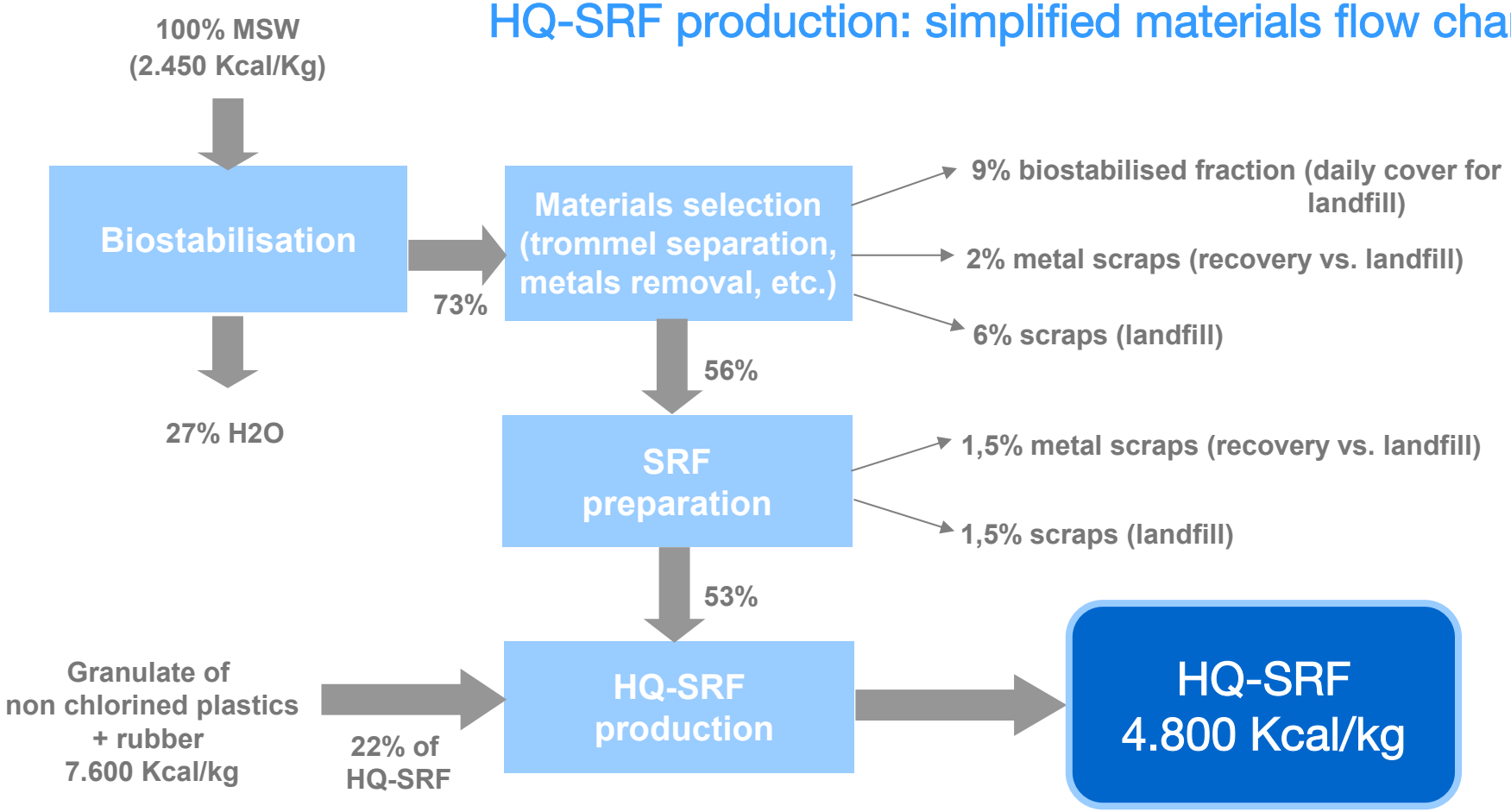
Europe: Co-firing in Power Plants - relevant experiences

Italy	In **Fusina (Venice)** power plant, owned by Enel, the experimentation of co-firing of SRF was positively concluded and the industrialization phase is underway.
Deutschland	In **Weisweiler** brown coal power plant (2.060 MWe) fitted with FGD and owned by **RWE,** SRF co-firing industrial run has been conducted starting from July 2004 up to now substituting 8% thermal input into 600 MWe groups. In **Janschwalde** coal power plant (3.000 MW) fitted with FGD and owned by **VEAG,** since 2001 SRF is directly co-fired on industrial scale, substituting up to 5% of fossil fuel. In **Gerstein Werk** coal power plant, owned by RWE, SRF is co-fired with pulverised coal.
Netherlands	In **Maasvlakte** coal power plant (1.000 MWe), owned by E.ON, liquid refuses and other organic wastes are utilised in co-firing
Denmark	In **Fynsvaerket Odense** coal power plant (385 MWe), grinded plastics are utilised in co-firing
Finland	In **Lahti** (150 MWe) coal power plant, a gasification plant is operating with SRF and feeding in combustion chamber a volume of syn-gas equal to 10% of thermal input of the power station

USA: Co-firing of SRF in Power Plants – relevant experiences

Plant	Fuel	Capacity
- **Ames Municipal Electric System** Ames, Iowa	- Coal/SRF	- 33 MWe 75 MWe
- **Illinois Power Co Baldwin Power Station** Baldwin, Illinois	- Coal/end of life tyres	- 560 MWe
- **Lakeland Electric and Water Mcintosh Plant** Lakeland, Florida	- Coal/SRF	- 350 MWe
- **Otter Tail Power Co** Big Stone City, South Dakota	- brown coal/SRF/ end of life tyres/ biomass	- 440 MWe
- **Tennessee Valley Authority Allen Station** Memphis, Tennessee	- SRF/waste wood and coal/ biomass/ end of life tyres	- 176 MWe

HQ-SRF production: simplified materials flow chart



Landfill usage: 7,5% (vs. up to 27% in the case of incinerator)

HQ-SRF enables the lowest costs (among Renewable Energy Sources)

Technology	Production costs (€/MWh)	Notes
Co-firing of HQ-SRF in coal fired power plants	30*	HQ-SRF price = cost of avoided coal
Hydro (small plants)	66	Small capacity
Wind	63	Limited load factor (2000 h/y)
Biomass incineration	121	Limited biomass availability/calorific value
MSW incineration	228*	Consensus problems (NIMBY syndrome)
Photovoltaic	280	Limited load factor and limited availability

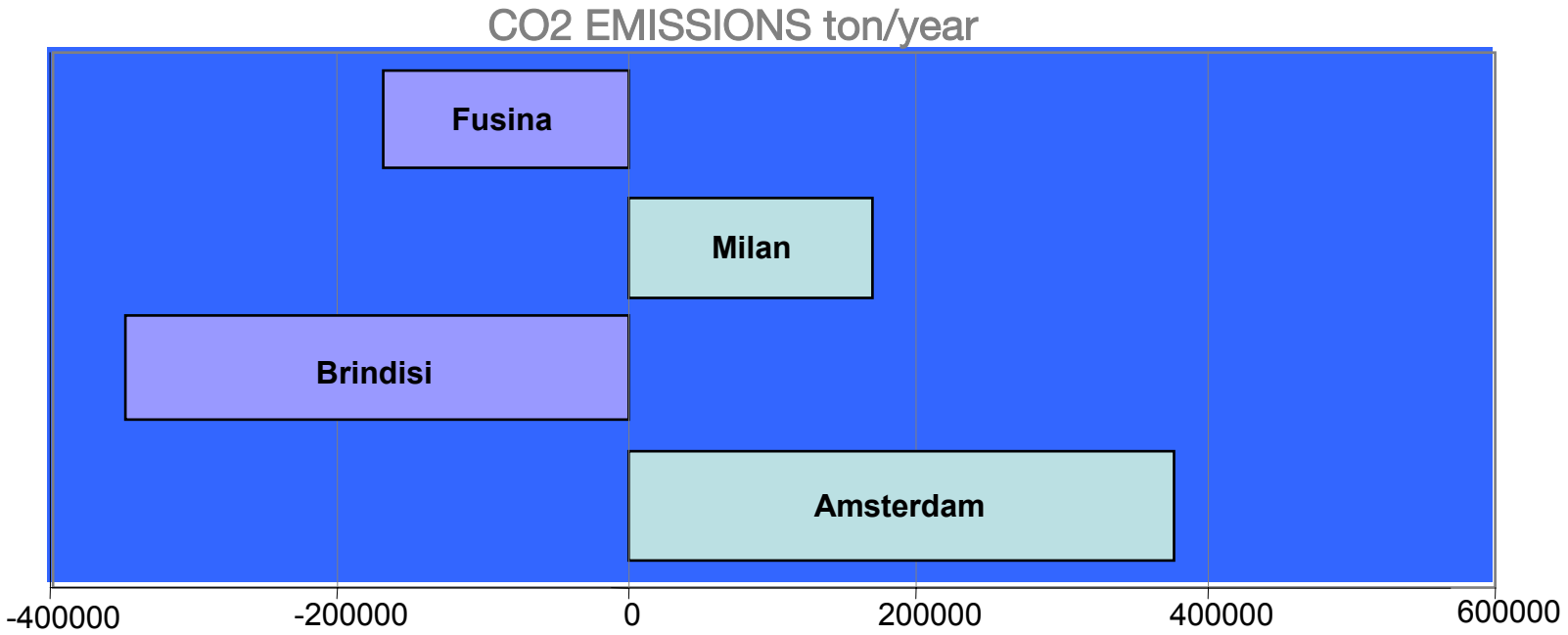
Sources: IEFE (Institute of Economy and Politics of Energy and Environment) – Bocconi University, 2005

* Not considering any gate fee for MSW

ANNEX 8

CO2 emissions: savings by co-firing of HQ-SRF vs. MSW incineration

Potential comparative analysis	energy recovery (ton/year MSW)	basin (inhabitants) (b)	CO2 emissions (ton/year) (c)
Co-firing in 2 groups of 320 MWh of a coal-fueled power plant, as Fusina (a) (Italy)	425.000	1.260.000	- 247.000
Incineration in a middle-size plant, as Milan (Silla 2) - Italy	400.000	1.200.000	+ 168.000
Co-firing in 2 groups of 660 MWh of a coal-fueled power plant, as Brindisi (a) (Italy)	870.000	2.600.000	- 507.000
Incineration in a large-size plant, as Amsterdam-NL	900.000	2.680.000	+ 375.000



(a) Potential substitution: 10%
(b) Assuming a production of 516 kg. of waste per person per year, and a separated collection of 35% (Italian data – APAT 2004)
(c) Calculations do not include avoided CO2 emission from MSW disposed in landfill nor CO2 avoided by the additional electricity generated by MSW incineration that could replace other electricity production