London Accord: Purpose of SG report

In this report, we seek to offer investors a tool to assess the potential carbon costs at sector and company levels, under a business as usual scenario (BAU). Carbon cost is just one aspect of the carbon issue, as companies and shareholders have to deal with both increasing risks and emerging opportunities. These risks and opportunities will sometimes vary within a sector and sometimes across the board, at different paces and varying across countries.

New technologies will be the key driver on the opportunity side. They will play a major role to help reduce GHG emissions at least with regards to eco-efficiency (notwithstanding volumes). As time goes by, different technologies will be tried, tested, validated, and widely implemented at different levels so as to swing the carbon curve. This will inevitably generate initial costs (e.g. additional investments) and an expected payout over time.

However, in this particular report we do not wish to talk about additional investment or capital expenditure, and have kept the focus on the downside risks. We believe that a view on the extent to which carbon cost is already materially embedded into the revenues and earnings of companies is a crucial issue for investors. To our knowledge such an assessment has not yet been done on a comprehensive basis across the board beyond one specific level or sector. The results will impact profitability and conversely will be the key driver to spur technological changes and adaptation!

Using different assumptions, it is possible to assess how much sales – could be affected by valuing the carbon intensity of economic models - in our case, we have used a carbon intensity unit calculated as g CO_2 emitted / $ of sales generated.

In this report, we definitely join the camp of those who believe that carbon intensity is a more useful economic concept than carbon footprint. To clarify, by carbon intensity we are talking about the proportion and volume of carbon emitted at every stage of the life cycle of any product and service. Carbon footprint, in contrast only refers to direct emissions at the production stage along with indirect emissions (generated by power, fuel and heating consumption). While the footprint is very useful to help companies set their reduction plans and measure their proactivity, from an investor and economic perspective it is more useful to know the full carbon trail and see that at the end of the day, carbon costs along the full value chain might drastically jeopardize sales, margins and profits.

The report has been prepared for the London Accord, and is mainly based upon SG proprietary quant Carbon Risk Exposure Assessment Model (CREAM), as detailed in SG Report released on June 2007.

Scope of analysis

The scope of the analysis has been done on a global basis at sector level. Our estimates are calculated at company level but for the purposes of the London Accord we restricted our view to the superior level. All the tables and assessments below have been calculated using data provided by CentreInfo ("The EnvImpact data", see Annex). CentreInfo is a well-established SRI rating agency based in Geneva, Switzerland. For every company Centre Info generates a specific carbon intensity profile according to detailed sales breakdown. To do so, Centre Info extrapolates and adapts the carbon intensity provided for the 491 main economic processes included in the Input/Output Economic Matrix designed and maintained by the Green Design Institute (of the Carnegie Mellon University, Pittsburgh, Pennsylvania). We provide cross-secretor quantified outputs regarding carbon intensity, carbon cost related to sales and to EBITDA, the latter as a measure of potential threat on

Key questions to be answered

Let us be clear about our CREAM model. We would not dare say that our carbon cost estimates, using mid-long term assumptions, are exactly what companies / sectors are going to suffer in a mid to long term time frame. Rather, our model helps investors understand what the impact could be at different dates if constraints and regulations were to materialize overnight. In other words, the CREAM model is a static model helping understand the gap with a BAU (business as usual) situation.

This said, the model gives detailed and realistic insights about the potential downside for a company if a certain proportion of the carbon emitted for producing sales and products were to be soon internalized by the company, under pressure from regulators, clients or suppliers.

It does not yet take in account the windfall profits that might occur from time to time in specific situations, when a company or a sector is able to generate additional revenues and margins through increasing average price of the incremental marginal costs amount.

With those preliminary remarks, some key questions can be effectively addressed:

- How much can carbon impact sales and profitability for sectors and companies?
- Which sectors are least impacted?
- Is carbon price the main parameter to take into account at the end of the day - for revenues ? for profitability?
- Can a company with low carbon profile be more impacted than a big emitter?

Key assumptions

CREAM is a 5 step model using the following variable parameters:

- A carbon intensity unit per company according to the sales
- Carbon price: whether global, sector, country, company based. For the purpose of the London Accord we have used three main prices: €10, €32, and €60.
- Free allocation levels: which proportion of its current carbon emissions a company is allowed to emit without paying,

Those are the three carbon related assumptions, but to be run the model also needs two further assumptions:

- an EBITDA/Sales ratio (or equivalent) to measure profitability: here we adopt a normalized ratio estimated over the 4-y period; and
- a pricing power towards both supply chain and clients, to the extent that it is very unlikely that a company will internalize 100% of embedded carbon cost. A 50% pricing power means that in our view a company is able to pass on 50% of costs onto upstream and/or downstream.

From Carbon Intensity to EBITDA Exposure: SG's Carbon Risk Exposure Assessment Model (CREAM)

A carbon price helps the global economy tackle climate change

"A broadly similar global carbon price is an urgent challenge for international collective action." Stern Report 2006, Chapter 22.

Climate change is an undeniable reality and the likelihood that man-made causes directly or indirectly contribute to it (anthropogenic activity) is now accepted as an extremely strong scientific probability: 90% or greater. The UN IPCC's February 2000 report serves as the primary reference that man-made emissions of carbon and other greenhouse gases (GHGs) directly cause climate change.

The "right" to release carbon into the atmosphere is becoming increasingly limited. The price attached to carbon emissions is rising and this is stimulating changes in corporate behaviour and technology, making certain activities profitable while putting others in the red because of their high carbon intensity.

For investors: it's time to assess carbon risk exposure

Reducing carbon emissions is becoming a pressing necessity for many industry sectors and thus an increasing concern for investors. The carbon factor has a two-fold impact on financial performance:

- **A negative (risk) impact** coming from the likelihood of rising costs of energy, raw materials, and production-related emissions as well as from the cost of implementing new technologies
- **A positive (opportunity) impact** gained through innovation, the development of new markets and the capacity to pass on all or part of marginal costs to customers.

At this stage, we believe that the dynamic interaction between risks and opportunities is the best way to arrive at a relatively comprehensive carbon accounting, at least for less complex carbon issues. It is still too early in our view, for a classic cost-benefit analysis, in the context of "business as usual", given the long-term nature of carbon analysis.

For investors, a first step in tackling the carbon challenge consists of regularly evaluating the potential risk they are undertaking – that is, the potential impact in terms of BAU assuming that the total carbon generated by a company's activities can be monetised, partially or totally, in a company's accounts.

Carbon exposure: the financial translation for carbon intensity

In this report, we make our first use of the proprietary ENVIMPACT model developed by our Swiss-based SRI research partner CENTRE INFO. This carbon intensity model, which is based on the work of Carnegie Mellon University's Green Design Institute, models the quantity of carbon generated per unit of turnover.

Expressed in terms of grams of CO_2 emitted per unit of turnover (€ or $US), carbon intensity corresponds to the total emissions (direct and indirect) emitted throughout the value chain in order to put goods or services on the market, including the end usage of these products and services. For example, for the auto sector, carbon intensity includes the quantity of carbon needed to produce a car and its components, the energy consumed during production, as well as the carbon emitted during the use and eventual disposal/recycling of a car.

Carbon intensity = quantity of CO_2 emitted (life cycle) / turnover generated (monetary unit)

We believe that this approach makes sense both from economic and carbon responsibility perspectives:

- From an economic perspective, downstream carbon intensity, notably from usage could have a boomerang effect on producers. The auto sector is a good case in point. Constraints on vehicle usage (i.e. lower CO_2 emissions) will be translated upstream into obligations on producers to develop and implement new technologies.
- From a carbon responsibility perspective, it makes little difference for end users or for regulators at what moment carbon exposure is incorporated in the value chain. What matters most is the authority behind the regulatory drivers.

On the basis of trans-sectoral ENVIMPACT data, we have calculated an index of current and potential carbon constraint exposition. Out formula is as follows:

Carbon exposure = CO_2 emitted (monetary value) / turnover generated (monetary unit)

SG's carbon exposition risk tool: Carbon Risk Exposure Assessment Model (CREAM)

Our CREAM model is based on five simple parameters which allow us to make the transition from carbon intensity to carbon-related EBITDA exposure:

- Carbon intensity of activity / company (ENVIMPACT's multi-sectoral data)
- Financial indicator (EBITDA)
- Changing market cost of a tonne of carbon
- Free allocation of CO_2 emission rights or alternatively, the margin for improvement to be achieved
- Hypothetical estimates of cost increases for end customers.

The application of these 5 parameters allows us to vary and adapt the potential carbon cost per company or sector of activity. We draw investors' immediate attention to the fact that our model gives them the level of potential exposition, from a business as usual perspective, without taking into account opportunities which might arise.

Our carbon findings

Using ENVIMPACT data on the carbon intensity of turnover and assuming a minimum carbon price of €50/tonne, we believe that there are 5 sectors facing a strong level of potential EBITDA exposure (c. 4-14%) when the carbon price exceeds €50, and despite free allocation of quotas covering 90% of emissions (for all sectors).

For specific sectors such as auto, where the EC is looking to set a 2012 target of 130g CO_2/km, the average technological costs could be as high as €180 per tonne of CO_2 reduction, which translates into an EBITDA exposure of 69%! This is in line with the results of our April 2007 report – "Auto & Pollution: Size matters: bigger is better."

Convergence towards a long-term carbon price: €50 a tonne for all sectors?

Our current hypotheses of a long-term carbon price of €50/tonne is based on an examination of different carbon costs including the current EU ETS quota price (€23 at 15/10/07 for EUA2008), the implementation costs of new technologies, and macro-economic modelling (based on the ratios in the Stern report).

Usually the cost of a tonne of carbon must however be examined sector by sector, according to the specific constraints, technological and regulatory, which could have a potentially marked impact on each sector. Our calculations for the auto and utilities sectors in this regard show that the differences may not be tenable over the long term and that a convergence on the price of a tonne is likely to take place.

For the purpose of the London Accord, we have simplified and used 3 main different prices across the board: €10/t, €32/t, and €60/t.

Carbon allowance prices are still controversial

While the European emissions trading scheme (EU ETS) is only two years old, permit price volatility in the first phase of the programme, the March 2006 price collapse (after the one-year reviews) and the tense negotiations between the EC and national courts were all reminders that carbon prices are ultimately a function of the larger political and regulatory frameworks. The inability or difficulty of calculating the economic value of services rendered to humans by nature and splitting the cost of damage caused by negative externalities necessarily define full worth, insofar as incentives must be provided to economic players to change their behaviour and reach their goal – i.e. the reduction of greenhouse gas emissions – in a cost effective manner. Thus the mechanisms put in place must help players achieve as much cost effectiveness as possible. There has already been much economic and political debate on the effectiveness of the mechanisms associated with new technologies.

But more recently, on 7 February 2007, the European Commission announced it would require the European automobile industry to reduce average car emissions to 130g of CO_2 per kilometre by 2012 (vs 165 on average for Europe in 2002), triggering another debate over the equity and homogeneity of carbon prices. The EC's target will require the industry to adopt technologies sometimes considered to be too expensive. In 2006, the ACEA (European Automobile Manufacturers Association) estimated that to reach 120g of CO_2 emissions in 2012 for all new types of vehicles sold, it would have to pay between €400 and €540 to prevent the emission of one tonne of CO_2. In reports published in 2005 and 2006 for the EC, depending on how rapidly targets are reached, the estimated cost of preventing the emission of one tonne of CO_2 ranged from €34/t to €71/t, or an average of €50/t (2004).

Meanwhile, carbon permits for the first year of phase two of the EU ETS have been trading at €15-25 over the past year.

Carbon intensity and carbon exposure: now a key consideration

Carbon emissions are what economists call a negative externality, that is, an undesirable by-product having negative economic consequences due to the damage they cause the climate – an issue of public well-being, if ever there was one. The last UN IPCC report published in February 2007 following a major meeting in Paris stated that there is at least a 90% probability that human (anthropogenic) activities are to blame for climate change.

All human activities, especially agricultural, industrial and even services, directly or indirectly emit CO_2 or other greenhouse gases capable – to varying degrees – of global warming. Since 1997 and the signature of the Kyoto Protocol, various mechanisms aimed at reducing greenhouse gas emissions in both relative (compared to economic or population growth) and – to the extent possible – absolute terms have been implemented. The goal is to maintain CO_2 and temperature change within a "manageable" range (temperatures rising by 2°C for CO_2 concentration of c.550ppm, compared with 280ppm for pre-industrial levels and c.450ppm currently).

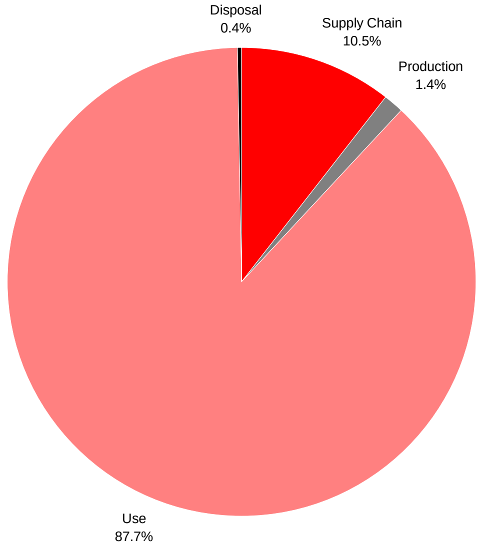
Various mechanisms can be used to reintegrate negative externalities into the economic and political decision-making process, including:

- A mechanism limiting emissions and allowing polluters to buy and sell permits for the highest price, otherwise known as the "cap-and-trade" system.
- An emissions tax.
- Subsidies for new technologies capable of producing equal service using low energy intensity.

A first step for assessing carbon exposure: carbon intensity per unit of turnover

Drawing on the econometrics research (input/output model) conducted by the Green Design Institute (Carnegie Mellon University, Pittsburgh) and life cycle analyses carried out by ECOINVENT (Swiss Centre for Life Cycle Inventory), our partner Centre Info has developed a tool to quantify the carbon required to generate one Euro/dollar of turnover. The primary appeal of such a model is that it takes into account both direct and indirect emissions, i.e. emissions caused by the manufacturing process and those generated by usage. So the CO_2 emissions stemming from the automobile industry, for example, are mainly the result of driving vehicles, not producing them.

Carbon dioxide emissions – automobile industry



Source: Centre Info

The main reason for developing an input/output model is to break down purchases and turnover for all sectors, and to do so in enough detail so as to apply a net carbon intensity coefficient to each item over the entire value chain. The graph below shows the level of carbon intensity involved in power generation by industry.

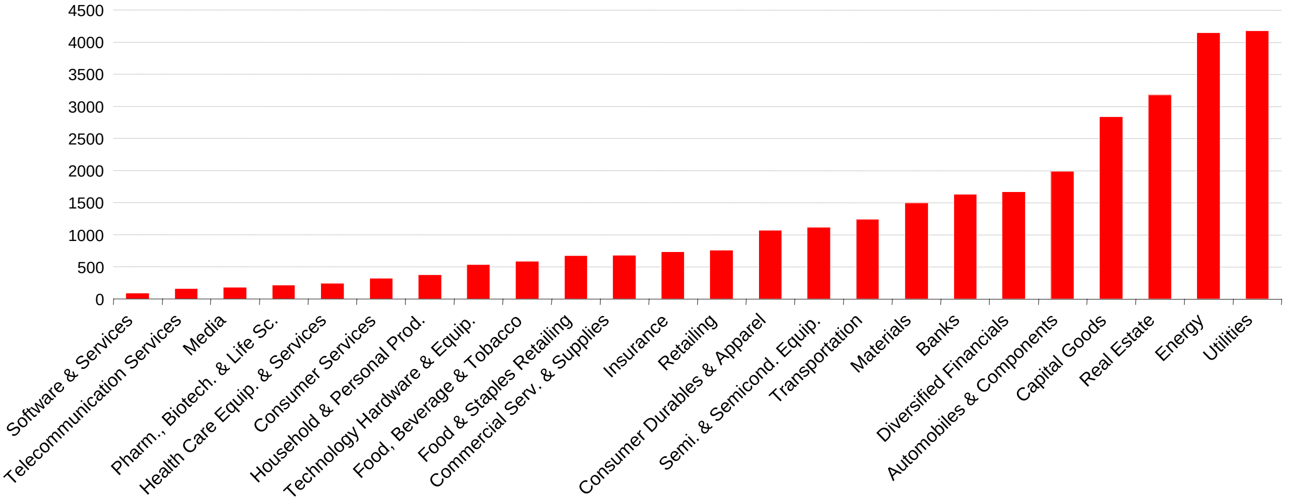
Carbon intensity can be defined as follows:

Carbon intensity = quantity of CO2 emitted (life cycle) / turnover generated (monetary unit)

Carbon exposure of sectors ranges from 1 to 50

After quantifying carbon intensity, i.e. how much carbon is emitted per unit of turnover, it is possible to assess gross carbon exposure by determining the ratio of direct and indirect carbon emissions relative to a monetary unit of choice. In this report, we consider two monetary units, turnover and EBITDA.

Carbon intensity by sector – worldwide average (g CO2/$ turnover)



Source: Centre Info (Envimpact), 2006 data, sector averages determined by companies in sector (1,800 companies worldwide)

Unsurprisingly, the utilities and energy sectors are the most carbon intensive, followed by other intensive industrial sectors. Real estate and banking are relatively carbon intensive given how much energy buildings consume (the building sector generates c.40% of all CO_2 emissions in industrialised nations) and the role that banks play in financing a number of industrial activities (financial inflows captured by banks at the time of financing).

Carbon exposure can be calculated using the previous figures by valuing carbon quantities, according to the retained carbon price.

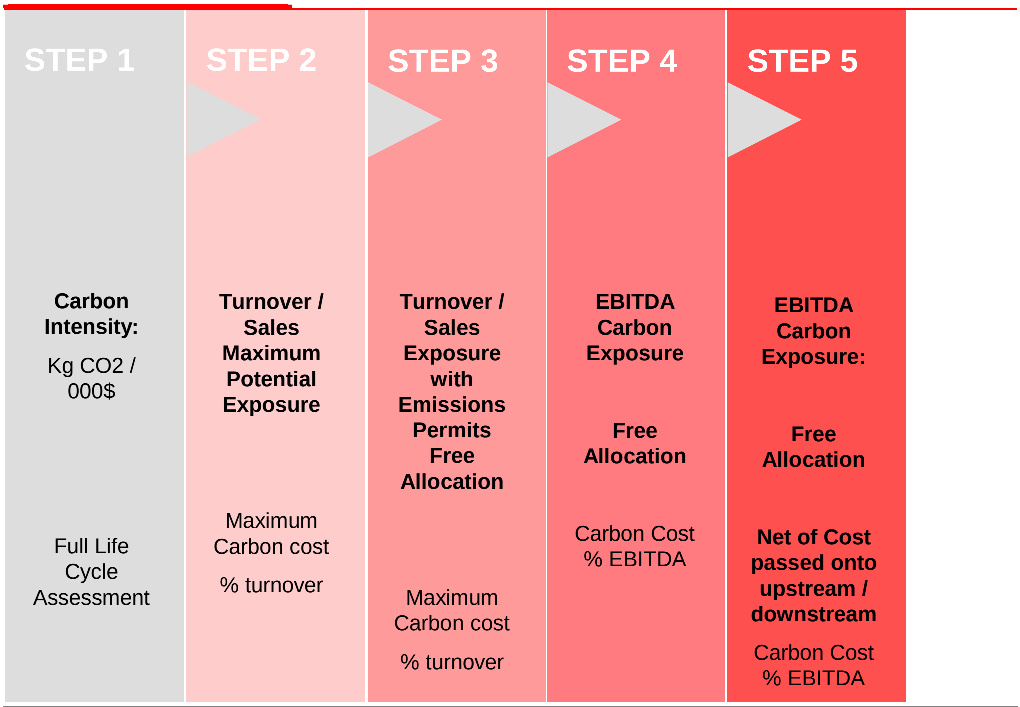
The 5-step model

Based on carbon intensity one can infer the potential carbon risk exposure for a company or a sector, in terms of monetary value relative to a financial ratio.

The process can be unfolded in five easy steps:

- Step 1: carbon intensity computation.
- Step 2: translation of carbon intensity into maximum turnover-related carbon exposure, through applying a well-chosen price per tonne of carbon, varying according to sectors and legal framework: carbon permits trading, carbon tax, technological cost induced by compulsory targets.
- Step 3: applying a certain level of free allocation (%), or inversely a certain level of compulsory reduction. Those percentages can be induced from Kyoto Protocol targets or sectoral frameworks.
- Step 4: applying the results to EBITDA, so as to obtain a first potential EBITDA carbon risk exposure.
- Step 5: estimating and applying a level of cost transfer to be passed on upstream and downstream, (i.e. suppliers and customers). Every company has margins to pass costs onto stakeholders depending on, for example, its market position, legal constraints, sales and purchases volumes, price sensitivity.

Chart title



Source: SG Equity Research

Potential carbon price (€/tonne)

Price hypothesis	Cost (€/t)
Carbon allocation price EUA2007	0.5
Carbon allocation price EUA2008	23
Low end hypothesis for 2050 (Stern report 2006)	19
High end hypothesis for 2050 (Stern report 2006)	62
Cost carbon capture and sequestration	50
ACEA calculations (ex-fuel economy)	540
SG average technological cots for the Auto sector (ex-fuel economy)	180
EC cost for auto sector with fuel economy / bbl : 25€	166
EC cost for auto sector with fuel economy / bbl : 50€	135
EC cost for auto sector with fuel economy / bbl : 74€	108

Source: SG Equity Research, ACEA, ADEME, EC (TNO/IEEA), Reuters

For simplification we use here for the 3 prices already mentioned.

Based on average EBITDA forecasts for the next three years at the European level, the risk to EBITDA varies widely. The table below shows the various levels of carbon exposure based on the most credible price assumptions (those which take technological advances and oil prices into account) and the most realistic base-case scenario at this stage, i.e. that 90% of allowances are allocated at no cost to all players, including users (a low end assumption).

Estimated negative impact on carbon cost on EBITDA, per sector

Free allocation level	0.95	0.75	0.95	0.75	0.75	0.50
Carbon price	10 €	10 €	32 €	32 €	60 €	60 €
MSCI Industry Group	Total	Total	Total	Total	Total	Total
AUTOMOBILES & COMPONENTS	2.6%	6.2%	4.0%	19.9%	37.4%	74.7%
BANKS	0.4%	1.4%	0.9%	4.4%	8.2%	16.3%
CAPITAL GOODS	3.5%	11.6%	7.5%	36.4%	67.9%	135.4%
COMMERCIAL SERVICES & SUPPLIES	0.3%	1.4%	0.9%	4.3%	8.1%	16.2%
CONSUMER DURABLES & APPAREL	1.4%	3.7%	2.3%	10.6%	20.4%	40.9%
CONSUMER SERVICES	0.3%	0.9%	0.6%	2.9%	5.5%	11.0%
DIVERSIFIED FINANCIALS	0.5%	2.4%	1.5%	7.7%	14.4%	28.9%
ENERGY	3.7%	8.6%	5.5%	27.6%	51.7%	103.3%
FOOD & STAPLES RETAILING	1.2%	3.5%	2.2%	11.1%	20.8%	41.7%
FOOD BEVERAGE & TOBACCO	0.6%	2.0%	1.3%	6.3%	11.8%	23.6%
HEALTH CARE EQUIPMENT & SERVICES	0.2%	0.9%	0.6%	2.8%	5.3%	10.7%
HOUSEHOLD & PERSONAL PRODUCTS	0.2%	0.8%	0.5%	2.6%	5.0%	9.9%
INSURANCE	0.3%	1.5%	1.0%	4.9%	9.3%	18.2%
MATERIALS	1.3%	3.1%	2.0%	9.9%	18.5%	37.0%
MEDIA	0.1%	0.4%	0.3%	1.4%	2.6%	5.2%
PHARMACEUTICALS BIOTECHNOLOGY & LIFE SCI	0.1%	0.3%	0.3%	0.9%	1.6%	3.2%
REAL ESTATE	0.5%	2.5%	1.6%	8.0%	14.9%	29.8%
RETAILING	0.6%	3.0%	1.9%	4.5%	8.8%	15.5%
SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT	0.6 %	1.6%	1.0%	5.1%	9.5%	19.0%
SOFTWARE & SERVICES	0.0%	0.2%	0.1%	0.5%	1.0%	1.9%
TECHNOLOGY HARDWARE & EQUIPMENT	0.6%	1.6%	1.0%	5.1%	9.5%	19.0%
TELECOMMUNICATION SERVICES	0.0%	0.2%	0.1%	0.7%	1.3%	2.7%
TRANSPORTATION	1.3%	3.4%	2.3%	10.3%	19.0%	37.8%
UTILITIES	1.3%	6.3%	4.1%	20.3%	38.0%	76.0%

Source: SG Equity Research, centre Info, London Accord price scenario

Most of the industries are not at risk with a carbon cost only at €10 and a high proportion of free allocation. Even with a free allocation of only 75%, no sector would be impacted by an equivalent of 10% of EBITDA. To break through this 10% threshold free allocation will be key. With a 75% level (close to what the EC is about to impose on the auto sector for 2012-2015 with a reduction target of 21%), 3 sectors are above 20% of potential impact on EBITDA: . capital goods and utilities.

The industries whose EBITDA is not really at risk (free allocation of 0.5 and carbon price at €60 are not that many (<10%):

- Household Personal Services (but 909%!)
- Media
- Pharmaceuticals
- Software and services
- Telecommunication services

Reversedly, even with favourable assumptions close to (BAU (10€ and free allocation at 0.95), we could find already a full set of impacted sectors (>10%). Fortunately only a part of their revenues derive from Europe where already 4 sectors are covered by EU ETS. Those sectors (on a global basis) would be:

- Automobiles
- Energy
- Materials
- Real estate
- Utilities (especially electric utilities)

Case study: the auto sector currently the most impacted

At this stage one must bear in mind that our current turnover / EBITDA carbon risk exposure can only be partial, to the extent that :

- A company can limit increase in raw materials / energy / semi-finished product prices
- A company can pass increasing cost productions and final use costs onto its clients.

This last possibility has its own importance. With carbon intensity, we avoid being stuck to the assumption that companies only pay for their own direct emissions. On the one hand there are still raw materials, energy and semi-finished products to pay for, and new technologies to implement and make clients pay for.

The cost per tonne for carbon could increase owing to market valuation pressures as, for example, could be the case within the European quota market (European Union Allowance – EUA) or owing to the cost of avoidance of CO_2 depending on the technologies adopted.

The cost of reducing CO2 in the auto sector: at least €180/t to achieve 130g CO2/km

The European Commission reopened the debate about cost per tonne and available technologies with its 7 February announcement about achieving 130g CO_2/km.

Our initial estimate, based on European Commission assumptions, is for a direct cost of €180/t (or €36 per better g CO_2 efficiency).

Direct cost per tonne of CO2 in the auto sector

Operation	Cost	European average
(1)	Estimated CO2 emission in W. Europe in 05 (2002 for European average)	165 gCO2/Km
(2)	EU target 2012	130 gCO2/Km
(3) = (1) - (2)	**Difference to target in g/km**	35
(4) = (3) / (1)	**Distance to target (%)**	21%
(5)	**Average cost for mid-size car (130g)**	€1,266
(6) = (5) / (3)	**Average cost (€) per better g CO2 efficiency (full cost in 1 year)**	€36.2
(7) = (5) x 1.44	**Additional price to target (retail price) per vehicle**	€1,823
(8)	Number of km/year	16,000 km
(9)	Average car life period (years)	13 years
(10) = (3) x ((8)	CO2 avoided (tonne) per year	0.56 tonne
(11)	Long-term deterioration coefficient	1.1
(12) = (10) x (9) / (11)	**CO2 avoided (tonne) over the car life period**	7 tonnes
(13) = (5) / (12)	**Average cost (€) per tonne CO2 emission avoided (over the car life period)**	€180/tonne

Source: SG Equity Research, TNO/IEEP 2006 data average of costs at 120g and 140g

We get an average price of €36 per g CO_2 efficiency, i.e. €180/tonne avoided. In fact, the marginal cost would increase rapidly as efficiency per kilometre increased given the heavier technologies to put in place.

The tables below break down the cost per tonne of CO_2 per type of technology. The average cost varies according to the size of the vehicle and the type of engine (€125-145 for petrol and €155-€183 for diesel).

The full hybrid technology is still the most expensive at around €300/tonne avoided for a petrol engine and up to €460 for a diesel engine.

Nevertheless, valuing the cost of the technology is only a partial indicator of the real net cost per tonne avoided, as the technology also helps to reduce fuel consumption. Therefore, the net present value of the fuel savings must also be included in the cost of the technology. The table below shows the sensitivity calculation done for the European Commission.

Net cost of carbon emission reduction in the auto sector based on the price of oil

Oil Price		Retail price excl. tax per vehicle (€)	GHG abatement costs in €/tonne CO2-eq 25 €/bbl	36 €/bbl	50 €/bbl	74 €/bbl	Total annual reduction in (Mtonne/year) 2012	2020
Technical options at the vehicle level	140 g/km in 2012	245	--	--	--	--	--	--
	135 g/km in 2012	570	166	143	114	65	3	5.1
	130 g/km in 2012	960	187	164	135	86	6.8	21.4
	125 g/km in 2012	1,410	209	186	157	108	10.6	37.7
	120 g/km in 2012	1,940	233	210	181	132	14.4	54.1
Fuel efficient air conditioning system	x	33 / 19	68 / 90	48 / 66	24 / 37	1.5	1	2.7
Options reducing vehicle resistance	Low rolling resistance tyres	49	139	109	73	15	2.4	5.3
	TPMS	58	5	-20	-50	-98	2	9.6
	Low viscosity lubricants	20	181	150	113	53	2	9.6
CNG	Compared to 2008 petrol	2,030	400	356	302	208	2.4	7.3
	Compared to average 2008 vehicle	1,450	347	312	268	193	2.1	6.4
Biofuels	Brazilian ethanol	12 ± 2 €/GJ	52 / 136	16 / 90	-28 / 34	-103 / -63		
	European ethanol	19 ± 6 €/GJ	196 / 656	137 / 564	65 / 451	-58 / 257	3.1 - 4.0	3.1 - 4.0
	Biodiesel	18 ± 3 €/GJ	158 / 426	111 / 355	53 / 268	-47 / 118		
N1-vehicles	15 g/km reduction	410	6	-16	-44	-91	1.2	2.2
	30 g/km reduction	1,620	63	41	14	-34	2.4	7
	45 g/km reduction	3,850	131	108	88	34	3.7	11.7
	60 g/km reduction	7,240	206	184	156	109	4.9	16.5
Fuel efficient driving	New drivers	0	-35	-50	-69	-100	1.8	5.5
	GSI	17	-26	-50	-78	-128	1.5	4.4
	Existing drivers (lessons)	100	-2	-21	-45	-85	4	9.1
	Existing drivers (lessons + GSI)	135	-7	-26	-49	-89	6	13.7

Source: SG Equity Research, TNO / IEEP / LTA for EC, October 2006 / calculation based on the following assumptions:
Cost of removal per tonne of CO2 = (investment – net present value of fuel economy) / quantity of CO2 not emitted over a full life cycle
Life of vehicle: 13 years / number of kilometres: 16,000km/year / discounted annual fuel savings: 4%, cost of fuel [€/l]: 0.21, 0.30, 0.41, 0.60 for one barrel respectively at €25, €36, €50, €74.

Technologies and CO2 cost associated (petrol engine)

	Description	Small-size cars (average CO2 emissions: 148.5g/km) CO2 reduction %	Costs €	Attribution to CO2 %	Attributable costs €	Tonne CO2 abated €	Cost of CO2 €/tonne CO2	Medium-size cars (average CO2 emissions: 183.7 g/km) CO2 reduction %	Costs €	Attribution to CO2 %	Attributable costs €	Tonne CO2 abated €	Cost of CO2 €/tonne CO2	Large-size cars (average CO2 emissions: 237.5 g/km) CO2 reduction %	Costs €	Attribution to CO2 %	Attributable costs €	Tonne CO2 abated €	Cost of CO2 €/tonne CO2
Engine	Reduced engine friction losses	3	40	100%	40	0.9	43.2	4	50	100%	50	1.5	32.7	5	60	100%	60	2.5	24.3
	DI / homogeneous charge (stoichiometric)	3	125	100%	125	0.9	134.9	3	150	100%	150	1.1	130.9	3	175	100%	175	1.5	118.1
	DI / Stratified charge (lean burn / complex strategies)	10	320	100%	320	3.1	103.6	10	400	100%	400	3.8	104.7	10	480	100%	480	4.9	97.2
	Medium downsizing with turbocharging	8.5	225	100%	225	2.6	85.7	10	300	100%	300	3.8	78.5	10	375	100%	375	4.9	75.9
	Strong downsizing with turbocharging	12	390	100%	390	3.7	105.2	12	450	100%	450	4.6	98.1	12	510	100%	510	5.9	86.0
	Variable Valve Timing	3	100	75%	75	0.9	80.9	3	150	75%	113	1.1	98.6	3	200	75%	150	1.5	101.2
	Variable valve control	7	300	75%	225	2.2	104.1	7	350	75%	263	2.7	98.3	7	400	75%	300	3.5	86.8
	Optimised cooling circuit	1.5	35	100%	35	0.5	75.5	1.5	35	100%	35	0.6	61.1	1.5	35	100%	35	0.7	47.2
	Advanced cooling circuit+ electric water pump	3	120	100%	120	0.9	129.5	3	120	100%	120	1.1	104.7	3	120	100%	120	1.5	81.0
Trans-mission	Optimised gearbox ratios	1	50	100%	50	0.3	161.9	1.5	60	100%	60	0.6	104.7	1.5	70	100%	70	0.7	94.5
	Piloted gearbox	4	300	100%	300	1.2	242.8	4	350	100%	350	1.5	229.0	4	400	100%	400	2.0	202.4
	Dual-Clutch	4	600	75%	450	1.2	364.2	5	700	75%	525	1.9	274.8	5	900	75%	675	2.5	273.3
Hybrid	Start-stop function	4	220	100%	220	1.2	178.1	4	250	100%	250	1.5	163.6	4	280	100%	280	2.0	141.7
	Start-stop + regenerative braking	7	515	100%	515	2.2	238.2	7	600	100%	600	2.7	224.3	7	685	100%	685	3.5	198.1
	Mild hybrid (motor assist)	11	1200	75%	900	3.4	264.9	11	1600	75%	1200	4.2	285.5	11	2000	75%	1500	5.4	276.0
	Full hybrid (electric drive)	22	2800	75%	2100	6.8	309.0	22	3500	75%	2625	8.4	312.3	22	4200	75%	3150	10.9	289.8
Body	Improved aerodynamic efficiency	1.5	75	100%	75	0.5	161.9	1.5	75	100%	75	0.6	130.9	1.5	75	100%	75	0.7	101.2
	Mild weight reduction ((5% BIW = 1.5% veh. weight)	0.9	22	100%	22	0.3	79.1	1	28	100%	28	0.4	73.3	0.9	34	100%	34	0.4	76.5
	Medium weight reduction (12% BIW = 3.6% veh. weight)	2.2	57	100%	57	0.7	83.9	2.3	90	100%	90	0.9	102.4	2.2	115	100%	115	1.1	105.8
	Strong weight reduction (30% BIW = 9.0% veh. weight)	5.5	212	100%	212	1.7	124.8	5.8	294	100%	294	2.2	132.7	5.4	418	100%	418	2.7	156.7
Other	Low rolling resistance tyres	2	25	100%	25	0.6	40.5	2	30	100%	30	0.8	39.3	2	35	100%	35	1.0	35.4
	Electrically assisted steering (EPS, EPHS)	3	100	100%	100	0.9	107.9	2.5	100	100%	100	1.0	104.7	2	100	100%	100	1.0	101.2
	Advanced aftertreatment	-1	0	100%	0	-0.3	0.0	-1	0	100%	0	-0.4	0.0	-1	0	100%	0	-0.5	0.0
Average		**5.1**	**365.0**	**94%**	**305.5**	**1.6**	**144.8**	**548%**	**451.5**	**0.9**	**376.6**	**209%**	**134.3**	**5.4**	**544.4**	**94%**	**452.7**	**2.4**	**125.1**

Source: SG Equity Research, TNO / IEEP / LTA for EC, October 2006

Downsizing is a highly efficient solution:
- Cost effective
- Large amount of CO2 avoided

Hybrids performance:
2x average abatement cost!

Technologies and CO2 cost associated (Diesel engine)

	Diesel vehicles	Small-size cars (average CO2 emissions: 148.5g/km) CO2 reduction	Costs	Attribution to CO2	Attributable Costs	Tonne CO2 abated	cost of CO2	Medium-size cars (average CO2 emissions: 183.7 g/km) CO2 reduction	Costs	Attribution to CO2	Attributable costs	Tonne CO2 abated	Cost of CO2	Large-size cars (average CO2 emissions: 237.5 g/km) CO2 reduction	Costs	Attribution to CO2	Attributable costs	Tonne CO2 abated	Cost of CO2
		%	€	%	€	Tonne	€ / tonne CO2	%	€	%	€	Tonne	€/tonne CO2	%	€	%	€	Tonne	€/tonne CO2
Engine	Reduced engine friction losses	3.0	40	100%	40	0.8	52.0	4.0	50	100%	50	1.3	39.3	5.0	60	100%	60	2.1	28.7
	Mild downsizing	3.0	120	100%	120	0.8	156.1	3.0	150	100%	150	1.0	157.2	3.0	180	100%	180	1.3	143.7
	Medium downsizing	5.0	160	100%	160	1.3	124.9	5.0	200	100%	200	1.6	125.8	5.0	240	100%	240	2.1	115.0
	Strong downsizing							7.0	300	100%	300	2.2	134.8	10.0	375	100%	375	4.2	89.8
	Optimised cooling circuit*	1.5	35	100%	35	0.4	91.1	1.5	35	100%	35	0.5	73.4	1.5	35	100%	35	0.6	55.9
	Advanced cooling circuit + electric water pump*	3.0	120	100%	120	0.8	156.1	3.0	120	100%	120	1.0	125.8	3.0	120	100%	120	1.3	95.8
	Exhaust heat recovery*							1.5	45	100%	45	0.5	94.3	1.5	45	100%	45	0.6	71.9
Transmission	Piloted gearbox	4.0	300	100%	300	1.0	292.7	4.0	350	100%	350	1.3	275.1	4.0	400	100%	400	1.7	239.5
	Dual-Clutch	5.0	600	75%	450	1.3	351.2	5.0	700	75%	525	1.6	330.2	5.0	900	75%	675	2.1	323.4
Hybrid	Start-stop function	3.0	180	100%	180	0.8	234.1	3.0	200	100%	200	1.0	209.6	3.0	220	100%	220	1.3	175.7
	Regenerative braking	6.0	475	100%	475	1.5	308.9	6.0	550	100%	550	1.9	288.2	6.0	625	100%	625	2.5	249.5
	Mild hybrid (motor assist)	10.0	1200	75%	900	2.6	351.2	10.0	1600	75%	1200	3.2	377.3	10.0	2000	75%	1500	4.2	359.3
	Full hybrid (electric drive capability)	18.0	2800	75%	2100	4.6	455.3	18.0	3500	75%	2625	5.7	458.5	18.0	4200	75%	3150	7.5	419.2
Body	Improved aerodynamic efficiency	1.5	75	100%	75	0.4	195.1	1.5	75	100%	75	0.5	157.2	1.5	75	100%	75	0.6	119.8
	Mild weight reduction	1.0	23	100%	23	0.3	89.8	1.0	31	100%	31	0.3	97.5	1.0	38	100%	38	0.4	91.0
	Medium weight reduction	2.4	65	100%	65	0.6	105.7	2.5	101	100%	101	0.8	127.0	2.4	136	100%	136	1.0	135.7
	Strong weight reduction	5.9	231	100%	231	1.5	152.8	6.3	333	100%	333	2.0	166.2	5.9	538	100%	538	2.5	218.4
Other	Low rolling resistance tyres	2.0	25	100%	25	0.5	48.8	2.0	30	100%	30	0.6	47.2	2.0	35	100%	35	0.8	41.9
	Electrically assisted steering (EPS, EPHS)*	3.0	100	100%	100	0.8	130.1	2.5	100	100%	100	0.8	125.8	2.0	100	100%	100	0.8	119.8
	DeNOx catalyst	0.0	0	100%	0	0.0		0.0	0	100%	0	0.0		0.0	0	100%	0	0.0	
	Particulate trap / filter	-1.5	0	100%	0	-0.4	0.0	-1.5	0	100%	0	-0.5	0.0	-1.5	0	100%	0	-0.6	0.0
Average		**4.0**	**344.7**	**96%**	**284.2**	**1.0**	**183.1**	**4.1**	**403.3**	**96%**	**334.3**	**1.3**	**170.5**	**4.2**	**491.5**	**96%**	**407.0**	**1.8**	**154.7**

Source: SG Equity Research, TNO / IEEP / LTA for EC, October 2006

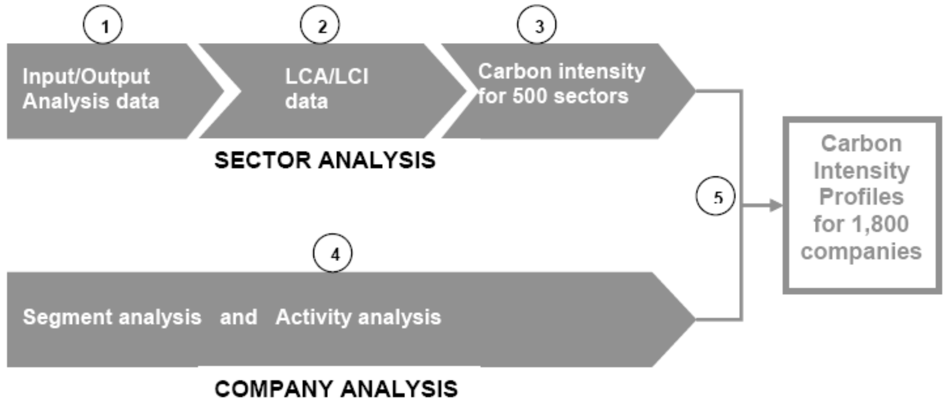
Hybrid applied to diesel engines still seems too costly, especially for small cars

A cheap price but only 0.6t CO2 abated

Appendix: Overview of ENVIMPACT methodology

envIMPACT®: Assessing carbon intensity of sectors and companies

Analysis of carbon intensity by sector and by company

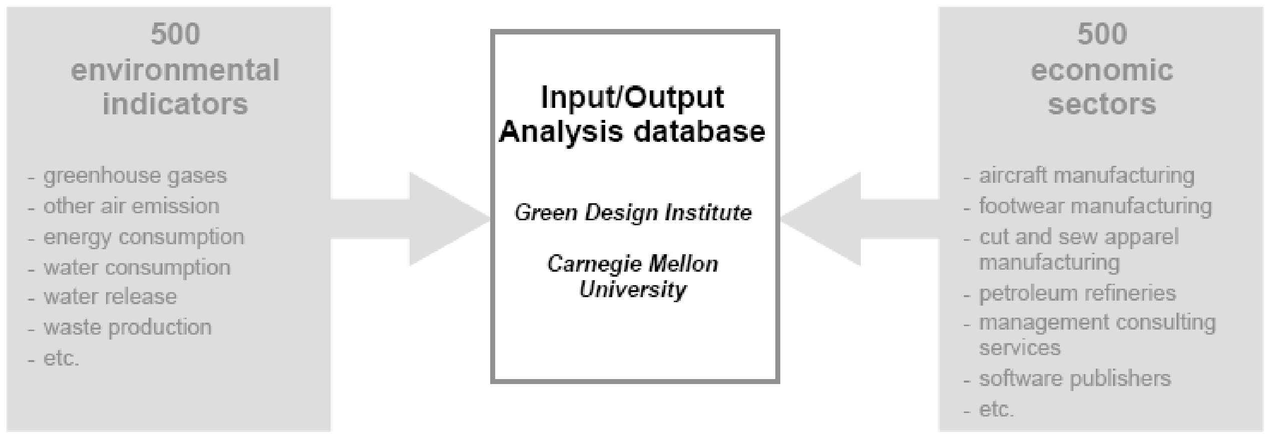


Source: Centre Info

STEP 1: Assessing the impact of the supply chain and production phase

The Input/Output Analysis is a method based on the monetary flows induced in the economy and through all the supply chain by a product or a service. It quantifies resource consumption and pollutant releases that are linked to monetary transactions according to the sectors to which these transactions are related. In order to account for carbon intensity of the supply chain and production, envIMPACT® integrates Input/Output Analysis data from the Green Design Institute (Carnegie Mellon University, Pittsburgh), the world's most comprehensive environmental dataset on economic sectors.

Input/Output analysis



Source: Centre Info

The Input/Output Analysis provides data on environmental impacts occurring during the production and supply phase of all existing economic sectors.

STEP 2: Extending Input-Output Analysis with LCA and LCI

While Input/Output Analysis is very helpful in quantifying the carbon intensity of the supply chain and of the production phase of economic activities, some specific sectors require data from Life Cycle Assessments[1] (LCA) and Life Cycle Inventories[2] (LCI), if one wants to account for the carbon intensity of the use of products and their disposal.

envIMPACT® uses the definition of "passive" and "active" products as employed by LCA practitioners to determine whether products may have a significant environmental impact during the use phase. "Active" products are defined as products that use energy and/or supplementary materials during the use phase (cars, aircrafts, household appliances, etc), while "passive" products do not (e.g. cement, footwear, kitchen utensils, wine, books, etc.).

The example above on elevators highlights the combination of Input/Output Analysis with LCA and LCI for calculating the impacts over the whole value chain. This combination is a fundamental step as the impacts from the use of many active products are much bigger than the impacts from production or supply chain.

STEP 3: Expressing carbon intensity of sectors in units

The carbon intensity of sectors (such as oil, gas, cars, books, power, etc.) is analysed over the entire value chain. Carbon intensity of a sector is defined as the total amount of greenhouse gas emission over the entire value chain per one unit of turnover of this particular sector and is expressed in Carbon Intensity Units (CIU). Carbon intensity allows comparing sectors between each other. For example, the carbon intensity of the cement sector can be compared with the carbon intensity of the footwear sector. envIMPACT® allows the comparison of a total of 500 sectors.

From the figure above, one can observe that the footwear sector is approximately nine times less carbon intensive than the cement sector. All subsectors within a given sector have the same carbon intensity. For instance, oil drilling, oil transporting, and oil refining all have the same carbon intensity, as they are part of the same value chain (the value chain of oil).

Step 4: Company activity analysis

The analysis of segment sales is an important step since it defines the company's exposure to particular economic sectors in terms of carbon intensity. The objective is to research in-depth the activity mix of companies, in order to be able to attribute to each activity its respective carbon intensity. In many cases, information on segment sales is not sufficient. A more in-depth analysis of the activities is needed.

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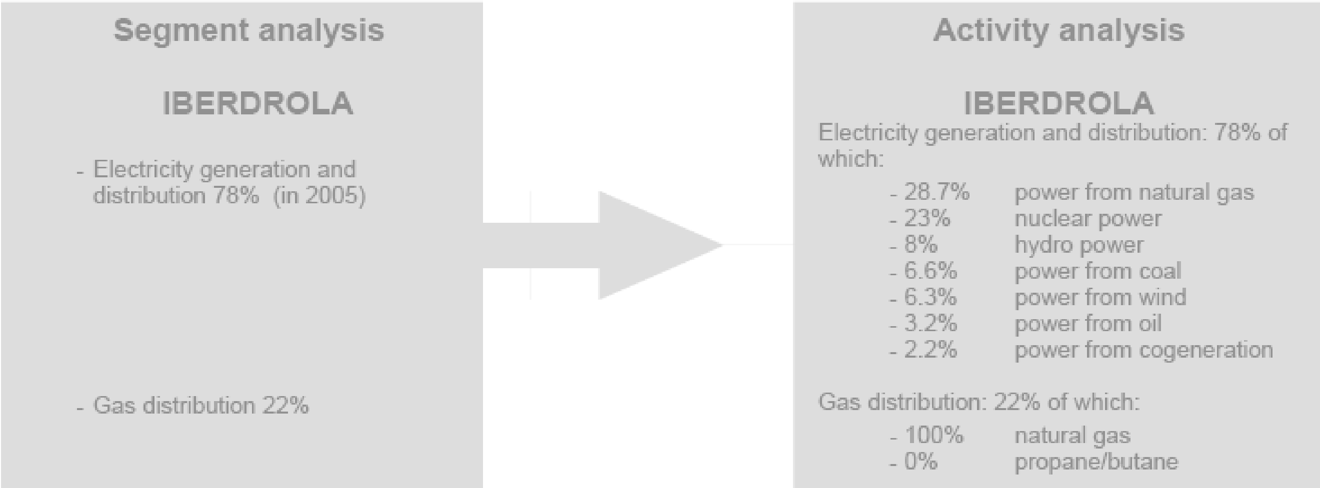
[1] A Life-cycle assessment (LCA) is a process of evaluating the effects that a product has on the environment over the entire period of its life. This technique also is "cradle-to-grave" in scope. It can be used to study the environmental impact of either a product or the function the product is designed to perform

[2] A Life Cycle Inventory (LCI) is a scientific technique for assessing the potential environmental impacts of industrial systems (like power generation, transportation, buildings, etc.) and their associated products. This technique is "cradle-to-grave" in scope.

Iberdrola: activity analysis



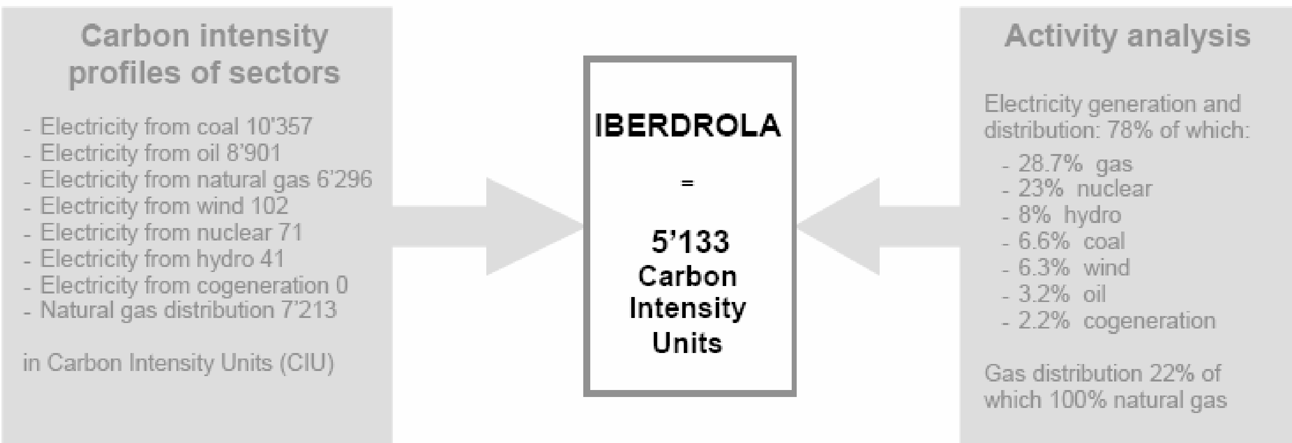
Source: Centre Info

This example shows that segment analysis is not sufficient to make a detailed analysis of the carbon intensity of Iberdrola. It is necessary to assess the energy sources used to generate power, as different energy sources have different impacts in terms of greenhouse gas emission per kWh electricity. An assessment of which gases are distributed is also necessary, since natural gas has lower carbon intensity than propane or butane (per unit of energy delivered).

STEP 5: Linking company activity analysis to carbon intensity of sectors

Step 5 involves the matching of company activity analysis (step 4) with the carbon intensities of economic sectors (step 1 to 3). This allows assigning a precise carbon intensity to each activity of a company, that, when aggregated for all company activities, provides the total carbon intensity for that company.

Iberdrola: carbon intensity analysis



Source: Centre Info

The 5'133 Carbon Intensity Units (CIU) of Iberdrola represent the greenhouse gas emission (over the entire value chain) resulting from a unit of turnover of the company.

From the graphic above, one can observe that American Electric Power has a carbon intensity of 10'908 CIU that is more than twice as high as the carbon intensity of Iberdrola at 5'133 CIU. This is due to the fact that 76% of American Electric Power activities have high carbon intensity (i.e. electricity generation from coal, natural gas and oil) while Iberdrola has a diversified energy mix focused more on nuclear, hydro and wind power (three energy sources with very low carbon intensity).

Conclusion

The five steps process described above constitutes the foundations of envIMPACT®. This unique methodology results in a deep understanding of the carbon intensity of 500 economic sectors over the entire value chain. Based on envIMPACT®, investors are now able to identify the least carbon intensive industries or the least carbon intensive companies within a given industry. envIMPACT® opens new horizons for investors in the optimization of their investments against carbon constraints.

Centre Info SA Founded in 1990, Centre Info SA is the first European research and consultancy firm entirely devoted to environmental, social and governance (ESG) issues. Building upon research provided by SiRi Company – in which Centre Info SA holds a controlling stake – Centre Info offers solutions to SRI and mainstream investors who whish to integrate ESG issues into their investment processes. Centre Info SA also provides advice on SRI product concept and design, on SRI investment strategy formulation and undertakes specific research projects related to sustainability and ESG issues.

IMPORTANT DISCLOSURES

Accor	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Accor.
Accor	SG acted as Mandated lead-arranger and Bookrunner to Financière Agache Investissement in the acquisition financing of its bid for Go Voyages together with the management
Air France	SG acted as Joint-lead manager and Joint-bookrunner in Air France-KLM's senior bond issue (4.75% 22/01/2014)
Air France-KLM	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Air France-KLM.
Carrefour	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Carrefour.
Carrefour	SG acted as Joint-lead manager and Joint-bookrunner in Carrefour's bond issue (FRN 27/06/2006 EUR)
Carrefour	SG acted as exclusive financial advisor to Carrefour in its public offer for Hyparlo.
Carrefour	SG is a long-standing banker of Carrefour as well as the Halley Family
Casino	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Casino.
Casino	SG acted as joint bookrunner in the Casino's senior bond issue (4.875% 10/04/2014).
Continental	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Continental.
DaimlerChrysler	SG acted as Joint-lead manager and Joint-bookrunner in Daimler Chrysler's bond issue (FRN 17/07/2008 EUR)
DSG International	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of DSG International.
EADS	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of EADS.
Fiat	SG makes a market in Fiat warrants
Finmeccanica	SG makes a market in Finmeccanica warrants
Iberdrola	SG acted as sole bookrunner in the IBERDROLA's senior bond issue (FRN 14/08/2008)
Imerys	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Imerys.
Kingfisher	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Kingfisher.
OMV	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of OMV.
Peugeot SA	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Peugeot SA.
Porsche	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Porsche.
Renault	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Renault.
Suez	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of Suez.
Suez	SG is advisor to Gaz de France in its merger project with Suez
TUI	Societe Generale and affiliates beneficially own 1% or more of any class of common equity of TUI.
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Vinci	SG acted as sole adviser to KarstadtQuelle in the outsourcing to a subsidiary of Vinci of its car park operations
Vinci	SG acted as advisor to Vinci in the acquisition of Autoroutes du Sud de la France
Volkswagen	SG acted as sole bookrunner in the VOLKSWAGEN's senior bond issue (FRN 19/02/09)
Volkswagen	SG acted as financial advisor to Eurazeo and arranged the financing for the acquisition of Europcar from Volkswagen.