

**BIOFUELS AND ENVIRONMENTALLY SUSTAINABLE TRANSPORT (EST):**  
**BIOGAS VÄST AS AN OPTIMAL MODEL FOR BIOFUEL MARKETS**



*(Biogas fuelling station for bi fuel cars, Göteborg, Sweden)*

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### Acronyms

FAO	Food and Agriculture Organization (United Nations)
OECD	Organization for Economic Cooperation and Development
PPP	Public Private Partnership
UQCN	Union québécoise pour la conservation de la Nature (Quebec Association for Nature Preservation)
UNEP	United Nations Environment Programme

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## ***The Global challenge for transportation in the XXI<sup>e</sup> Century***

Climatic change, million flights trips per year, billion cars running, oil depletion, international economic summits such as Davos and anti-globalization summits such as Porto Allegre, non-stop information and human-rights lobbying on the Web, virtual banks, business management of mega-enterprises: the beginning of XXI<sup>e</sup> Century is of amazing complexity. Governance is not the responsibility of only governments anymore; it is shared with all kinds of stakeholders. (Wilson, 2002). At the heart of this perception that the world has become a place where time and space has shrunk drastically, the heartbeat is movement or, as we call it, transportation.

More and more accused of being the main cause of a growing number of environmental and social problems, transport is tantamount to all human settlements. Thus comes the mobility paradigm: while there are more and more highways, bridges and other infrastructures built that urbanize societies even more, public and private sectors are looking for new ways and solutions to decrease the negative impacts of transport: better public management, denser urban and rural planning, energy efficiency and biofuel technology development. Some of these approaches are sustainable and, in the case of biofuel, can fit within the definition *environmentally sustainable transport or EST* – (OECD, 1996).

### ***Origins of “sustainable development” and “EST”***

The term *Sustainable development* appears for the first time in 1972 in a document written by the UNEP, the FAO and the Unesco (Thuillier, 2005). But that concept will get widely known with the Brundtland Commission Report for the United Nations on Environment and Development, in 1987, who proposes the following definition: **“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”** The now famous motto **«Think Global, Act Local»** also comes from that report. In the Québec version of the report (in French), Luc Gagnon and Harvey Mead, then UQCN’s education V.-P. and President, note that transportation doesn’t seem to be of specific concern to the Brundtland Commission.<sup>1</sup>

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<sup>1</sup> « Notre avenir à tous, Commission mondiale sur l’environnement et le développement », Les Éditions du fleuve, Montréal, Québec, 1989. Translation of « Our common future », Brundtland Commission, UN.

To study the sustainability of biofuels, the term *environmentally sustainable transport* (EST), as defined in the Report from the Vancouver Conference (OECD, 1996), is more precise:

*Transport that does not endanger public health or ecosystems and fulfill mobility needs while respecting the principles stipulating that:*

- *The rates of use of renewable resources should not exceed their rates of regeneration.*
- *The rates of use of non-renewable resources should not exceed the rates at which renewable substitutes are developed.*

But while this definition underscores the importance of replacing fossil fuel with biofuel, it doesn't take into account the production mode of different types of biofuels; neither does it include their impacts of distribution on local practices such as Agenda 21. A more exhaustive definition is thus necessary to distinguish the ethanol market from the biogas market :

*Transport that does not endanger public health or ecosystems and fulfill mobility needs while respecting the principles stipulating that:*

- *The rates of use of renewable resources should not exceed their rates of regeneration.*
- *The rates of use of non-renewable resources should not exceed the rates at which renewable substitutes are developed.*
- ***The support of renewal resources market should be done in regards to the lowest impact of biofuel production on environment and population health that are;***
- ***The support of renewal resources market should be discriminated in order to optimize the socio-economic and environmental benefits for the local population, without compromising international solidarity.***

By adding these two elements to the definition, there is a call for change of social practices towards energy markets as production that can be achieved in respect to the triple-fold of sustainable development: Environment, Economy and Society. As will be mentioned later on, biofuels are only one aspect of a holistic vision of sustainable transportation: Simply replacing fossil fuels with biofuels is not enough.

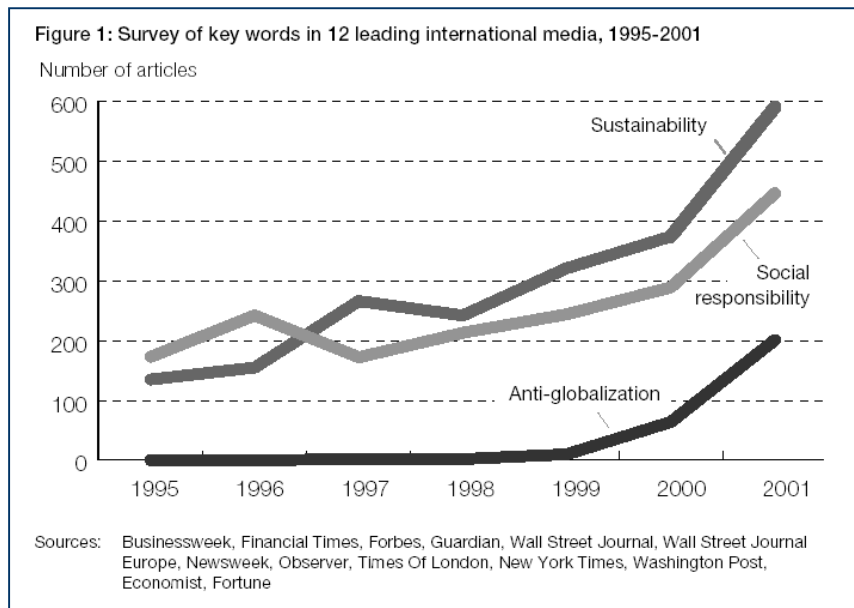
## ***The car manufacturer's context in the XXI<sup>e</sup> Century***

This new governance, where society is bigger than governments and enterprises, suggests that everybody has to share responsibility. (Le Gales, 1995). Head of the UQAM's Chair of Social Responsibility and Sustainable Development, Corinne Gendron writes this about enterprises and sustainable development: « Now, not only environmentalists but all kinds of NGOs, international organizations, governments and even enterprises are thinking of sustainable development. » (Gendron, 2001:282 translation by the author)

This is confirmed by Marianne Nivert, head of the Swedish Telecom Telia :

*“In a world characterized by global injustices and environmental destruction that represent a threat both to ourselves and to future generations, it is becoming increasingly important to step forward and take a position. Globalization highlights the importance of serving as a model and affirms the need to assume responsibility for developing a sustainable lifestyle.”<sup>2</sup>*

Because of transport impacts from CO<sup>2</sup> on the environment, carmakers must make products that are more environmentally sound, because their competitiveness and survival often depends on it (Austin et al., 2003).



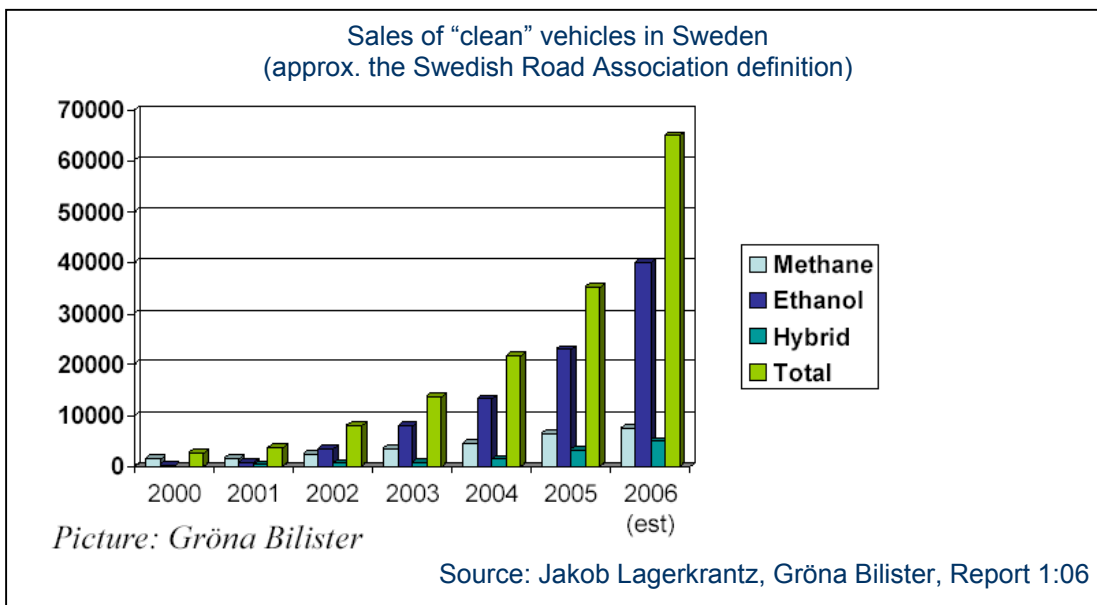
Source: Business Models for Sustainability: Experiences and Opportunities from the Nordic Partnership (p. 8)

But while there is a definite increase of awareness towards sustainable development issues, nothing indicates that green cars sell more (Wiliander, 2005). Its medium to long-term profits explain why the green market still needs to be sustained by government incentives and marketed through public-private partnerships.

<sup>2</sup> Telia's Relations Report 2001

“The development of environmental technologies in cars is largely governed by political decisions, and Volvo Cars welcomes legislative measures such as tax relief in the short and medium terms aimed at establishing a market for alternative fuels. Once a fuel is established, it should be able to bear its own cost. A stable long-term energy policy is crucial to continued investment in the development of vehicles and infrastructure for alternative fuels.”<sup>3</sup>

The car market is « mature », at least in the post-industrial countries (Dahlsten, Börjesson, 2004). To answer the wishes of more and more demanding customers, some carmakers business strategies consist in offering a few environmentally-friendly products clearly identified as such: this is the case for Toyota with its Prius, Echo or Yaris model. Others offer lower fuel consumption models than most other vehicles in the same category, like Ford’s Escape small SUV. And while most car manufacturers now sell some ethanol/petrol E-85 models, Volvo is one of the only carmakers to offer some *bi-fuel* models, with double tanks for biogas/natural gas (methane) and petrol.



Apart from low-fuel consumption non-hybrid cars, because there is no data on their long-term performance or reliability, these new models tend to be seen as suspicious, with or without reasons. In some cases, biofuel supply or second-hand sales are being questioned. Car magazines are full of those stories. To ascertain long-term biofuel market survival, the carmakers must build customer trust while planning business strategies that combine the « bottom line » (profitability) with the «triple bottom line» (corporate social responsibility).<sup>4</sup>, to reconcile both shareholders and stakeholders.

<sup>3</sup> Interview with Lex Kerssemakers, Manager for branding, business strategies and product planning, Volvo Cars Corporation. [www.autospectator.com/modules/news/articles.php?storyid=2115](http://www.autospectator.com/modules/news/articles.php?storyid=2115)

<sup>4</sup> See glossaire in [www.novethic.fr](http://www.novethic.fr)

## ***Ethanol and biogas: a different level of EST***

While ethanol and biogas are both biofuels, their production and distribution modes are not similar; it's worth looking more closely at the differences in environmental, economical and social impacts. They share one important element: both are publicly subsidized.

### ***ENVIRONMENTAL IMPACTS- ETHANOL AND BIOGAS PRODUCTION***

#### **Ethanol**

Ethanol is produced by a grain fermentation process (in North America, it's mostly corn, wheat and barley) from starch transformation into liquid fuel...<sup>5</sup> According to the World Bank, Brazil is the World's biggest ethanol producer, mostly from sugarcane<sup>6</sup>. Ethanol is used as biofuel in E85 engines (85 % ethanol and 15 % petrol) also called « flexi fuels ». The impact of agro-industrial corn and sugarcane energy crops on environment and human conditions must shed a light on the importance to produce biofuel in a sustainable way<sup>7</sup>. Ethanol crops have also been denounced and sometimes nicknamed «unsustainable subsidized food burning» by organizations as diverse as the National Farmer's Union of Canada<sup>8</sup>, the Church of Sweden<sup>9</sup> and Cornell University's Association Health & Energy in the USA<sup>10</sup>.

Some researchers, although controversial, are questioning the energy gain for this type of biofuel production, saying that the energy needed both for the cultures and the production can be greater than the energy produced by the ethanol itself (Pimentel, 2003; Patzek, 2004). If the ethanol has to be imported, the energy cost for transportation must also be added to the loss. The net energy gain is then the amount of energy produced by the ethanol, once the two energy losses from production and the energy loss for transportation has been subtracted. One of the solutions proposed to cut some energy losses is to grow crops locally.

#### **Biogas**

Biogas is produced locally by waste anaerobic digestion in «bioreactors » from local production plants. All kinds of waste can be used, from agriculture and restaurants to households, fisheries, sludge, wood, etc. No crops and limited transportation are needed, so energy costs are lower.

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<sup>5</sup> Lease, Nancy; Théberge, Louis. Direction de l'environnement et du développement durable, MAPAQ *Le secteur agricole au Québec: une source d'énergie pour l'avenir*. Magazine Franc Vert, hiver 2005.

<sup>6</sup> [www.worldbank.org](http://www.worldbank.org) Ethanol, Brazil Largest Produced in the World. 20 décembre 2005.

<sup>7</sup> L'alcool comme alternative énergétique : le bilan mitigé de l'expérience brésilienne  
<http://www.novethic.fr/novethic/site/article/index.jsp?id=74400>

<sup>8</sup> Qualman, Darrin, *Ethanol Ethics* Saskatchewan Notes, Canadian Centre for Policy Alternatives. Vol. 2 Issue 12, December 2003

<sup>9</sup> Interview at LRF, Swedish Farmer's Association, December 2005

<sup>10</sup> [www.HealthandEnergy.com/ethanol.htm](http://www.HealthandEnergy.com/ethanol.htm)

This process also reduces pollution since methane gas is 20 times more harmful than CO<sup>2</sup><sup>11</sup> when it's not burned or turned into biofuel. As with ethanol, biogas can be produced from crops; in that case, environmental and energy benefits from using methane from waste can be lost.

## ***ECONOMICAL IMPACTS – ETHANOL AND BIOGAS DISTRIBUTION***

### **Ethanol**

Since there is adequate supply from local productions or importations from countries such as Brazil<sup>12</sup>, ethanol can be easily distributed in fuelling stations. Energy crops can be seen as new market opportunities for farmers, although some studies show that profits are not guaranteed (Qualman, 2005).

### **Biogas**

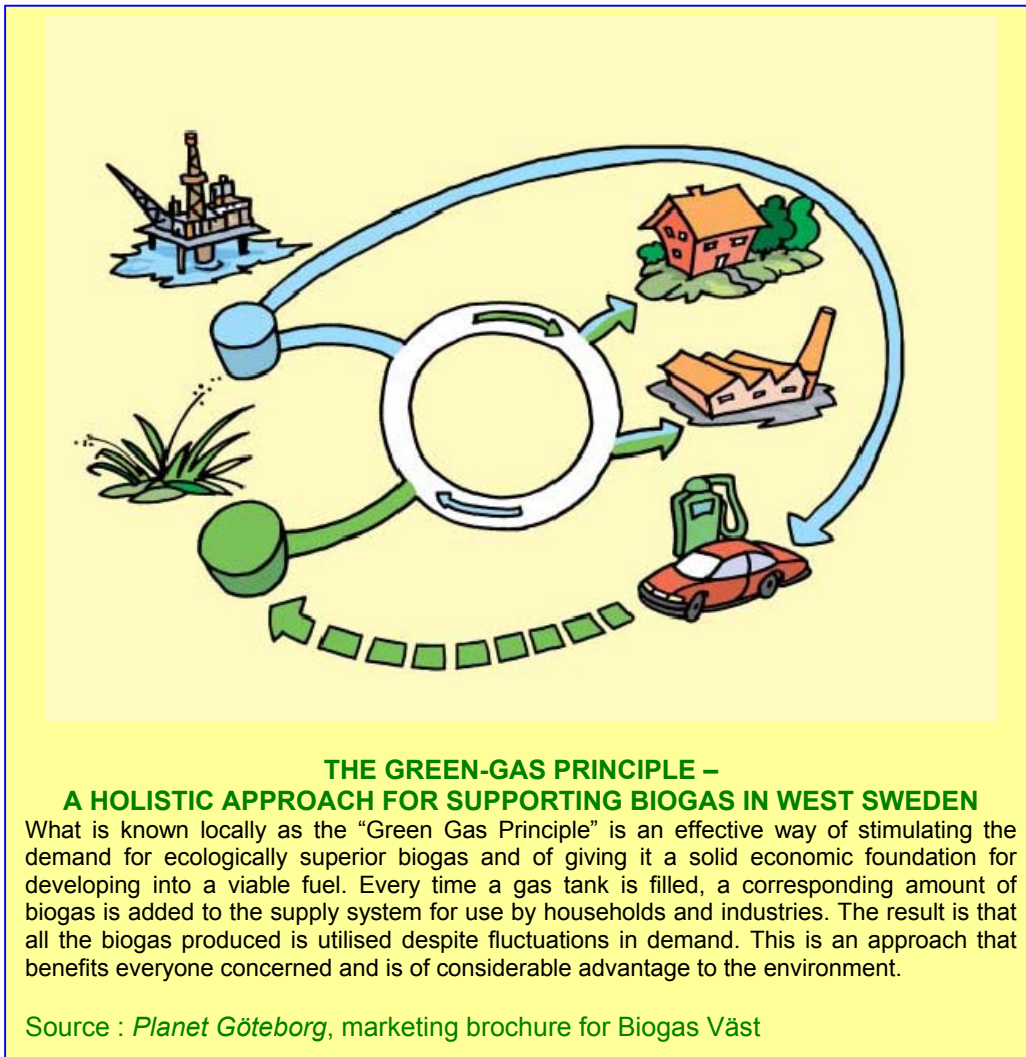
Because there is no constant supply and because it is distributed through natural gas grids to fuelling stations, it is thus mixed with natural gas. This mix makes it less costly to build a market for biogas since the natural gas companies finance the grid expansion. Even if natural gas, as a fossil fuel, is less environmentally-friendly than biofuels, its central role for biogas market expansion cannot be understated. And natural gas infrastructures are used to offer industries a change from oil to natural gas, which has environmental and economic benefits.

The growing demand for biogas, an important asset for market survival, also implies that the construction of biogas production plants has to be speeded up. This is very costly, so it must be planned in a long-term collective vision and sustained by local public and private partners, including governmental and supra-governmental organizations such as the European Union, using “carrot and stick” policies (subsidies and environmental laws).

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<sup>11</sup> Discussion with Ronald Svensson, Swedish Association for Biogas/<http://energybulletin.net/3647.html>

<sup>12</sup> Earth Policy Institute, [www.earth-policy.org/Updates/2005/Update49.data.htm](http://www.earth-policy.org/Updates/2005/Update49.data.htm)



The build-up of biogas market isn't simple: to create a biogas distribution system, both a sufficient amount of biogas, a critical number of fuelling stations and thousands of bi-fuel cars are needed simultaneously. Up to now, Volvo Car Corporation and the Volvo Group have been mostly the only manufacturers to produce enough bi-fuel vehicles to start up the market, at least in Sweden. The local market is important at the beginning but it cannot provide long-term profits for the companies. While both Volvos must continue to develop the bi-fuel markets in other countries, specially USA, other vehicle makers must also produce vehicles running on gas, whether natural or biogas.

## **SOCIAL IMPACTS – ETHANOL AND BIOGAS MARKETS –**

The most obvious differences between ethanol and biogas market development is their impact on the milieu.

### **Ethanol**

Ethanol being more or less distributed like any other fossil fuel, there are no significant social, economic or environmental impacts on the local milieu, apart from new market opportunities for farmers. Even the positive feeling that one can get in buying ethanol to help environment can be cancelled by the fact that it's very difficult to know if the imported ethanol has been produced in a sustainable way. Eco-labelling could be useful<sup>13</sup> but, in fact, the ethical question doesn't seem to weigh much in regards to ethanol's environmental benefits, when compared to fossil fuel; sold as a « green fuel » its sustainability is often put on the same level as biogas.

### **Biogas**

The biogas market impact on the local milieu and the community network has many benefits with its local production and distribution; like Biogas Väst, it can be done in a public-private partnership as a local community project. In order to be successful, a biogas market needs a stakeholders' collaboration to work together on « all sides at the same time » : sorted waste supply, biogas production and distribution, sales of bi-fuel cars and vehicles, marketing and lobbying. Biogas plant experiments on Denmark farms have shown limitations when trying to develop biogas production plans other than with local communities networks (Raven, Gregersen, 2004). Laws and policies, discriminating taxation, national and supra-national subsidies are all of importance. As Paul Deffontaine, v.-p. of Lillie's Urban Community, in France, said about French governmental support for biogas production plants and distribution facilities: "... *It should not be taxed or else the process would be too costly.*»<sup>14</sup>

So, while it is more difficult to build up a biogas than an ethanol market, benefits are more diverse and closer to the holistic definition of EST.

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<sup>13</sup> Lagerkrantz, J. 2006 Ethanol production from sugar cane in Brazil: review of potential for social and environmental labelling of ethanol production from sugar cane. [www.grönabilister.se](http://www.grönabilister.se)

<sup>14</sup> <http://www.lemonde.fr/web/article/0,1-0,36-754943,0.html> *Lille va traiter ses ordures ménagères pour en extraire du gaz.*

## ***Biogas Väst: a sustainable public-private partnership***

Second most-populated city, Sweden's main industrial region and leading transport centre for Northern Europe (Bäck, Johannsson et Tedros, 2003), Göteborg has the largest harbour of all Scandinavia and the City is home to many global companies such as Preem (refineries), Ericsson (IT), Saab (now owned by General Motors) and Volvo Cars (now owned by Ford), along with the Volvo group industrial complex, that manufactures trucks, buses, plane and ship engines, within other products.

While it used to be heavily polluted, Western Sweden (Västra Götaland) is now a dynamic region aiming at using and exporting the latest green technologies such as biogas. Biogas Väst is only a small element of the local and regional «transport sustainability»: for example, Göteborg is a very good model of «road sharing» planning that includes numerous cycle paths and pedestrian pathways, trams, a car-free pedestrian downtown and zone with environmental restrictions for delivery trucks, many private and public carpooling initiatives, many buses and taxis run on gas, whether biogas or natural gas.

An hour from Göteborg, the City of Trollhättan is also a founding partner of Biogas Väst. The biogas, produced from the municipal production plant with optical sorting technology, is used to fill-up the municipal fleet composed of cars, buses and garbage trucks. It is also used to heat many City-owned apartments blocks with district heating.

Started in 2001 and coordinated by Business Region Göteborg, a non-profit economic bureau owned by 13 cities, Biogas Väst is a PPP between the Västra Götaland region, many cities including Göteborg, the car manufacturer Volvo Car Corporation (VCC) and the Volvo Group. As of 2006, there are dozens of fuelling-stations and thousands of cars running on biogas. To speed up and reinforce the market, the region and some cities have replaced their fossil-fuelled cars with bi-fuel cars. Working along with the national government, many incentives are offered in the region such as free parking, no taxation for biogas and car sales' tax reduction, best spots for taxis: these measures have been very popular. The public-private network was important but the presence of large natural gas infrastructures has been of utmost importance in the success of Biogas Väst.

Biogas Väst is a *symbiotic* PPP (Belhocine, Mazouz and Facal, 2005), also called *reciprocal partnership* (Le Cren, Boutin, 2004). It is defined as a collaboration where various stakeholders share *common values, mission and objectives*, and where the usual top-down hierarchy of a

« road building » PPP is replaced by an horizontal management where trust reinforces the partners' dependence. Trust is essential in such a context of risk and uncertainty (Ramonjavelo and al. 2006). Starting a completely new energy market is not without risks but in this region of Sweden, there is a fairly high level of trust within politicians (Bäck, Johansson, Tedros, 2003). There are also a strong and dynamic link between the industries and the public sector, sometimes nicknamed « Göteborg's Andan – the Spirit of Göteborg ».

Other Swedish regions such as Skåne now wish to develop biogas markets and this is more than necessary to insure the biogas market's survival. Out of the country, the expertise from Biogas Väst will be shared in a European Community project called Biogasmax that includes 28 European partners such as the cities of Haarlem in the Netherlands, Lille in France and Roma in Italia. In the USA, California, the most stringent State on CO<sup>2</sup> emissions, is interested in the expertise through another project from the region called Biogas Cities.

The biogas market development is being developed simultaneously with the ethanol market and the are both strongly supported by the Swedish government. In December 2005, Prime Minister Göran Persson declared that by 2020, Sweden should be oil-free.<sup>15</sup> In order to do this, beginning gradually in January 2006 with the largest ones, all Swedish fuelling-stations must offer green gas by 2009.<sup>16</sup>

But, because of the technical differences between distribution of ethanol and biogas and since the term « biofuel» doesn't discriminate ethanol from biogas, this decision favours ethanol over biogas. In its analysis of Ford's experiment with biofuel in the States in the '80, Mats Wiliander mentions "...these acts supported a whole range of alternatives to gasoline, and so methane not only had to compete with gasoline but with every other approved alternative as well." (Wiliander, 2005:97)

There must be a rating of biofuel types in order for the biogas market to expand. Sustainable development implying a change of paradigm (Thuillier, 2005) and Sweden being forward on sustainable development issues, biogas market must be prioritized for two main reasons:

1. Its greater complexity leads to a greater sustainability;
2. As a EST model, it can position government, bi-fuel vehicle manufacturers and other stakeholders as innovative, on the forefront of environmental and social technologies.

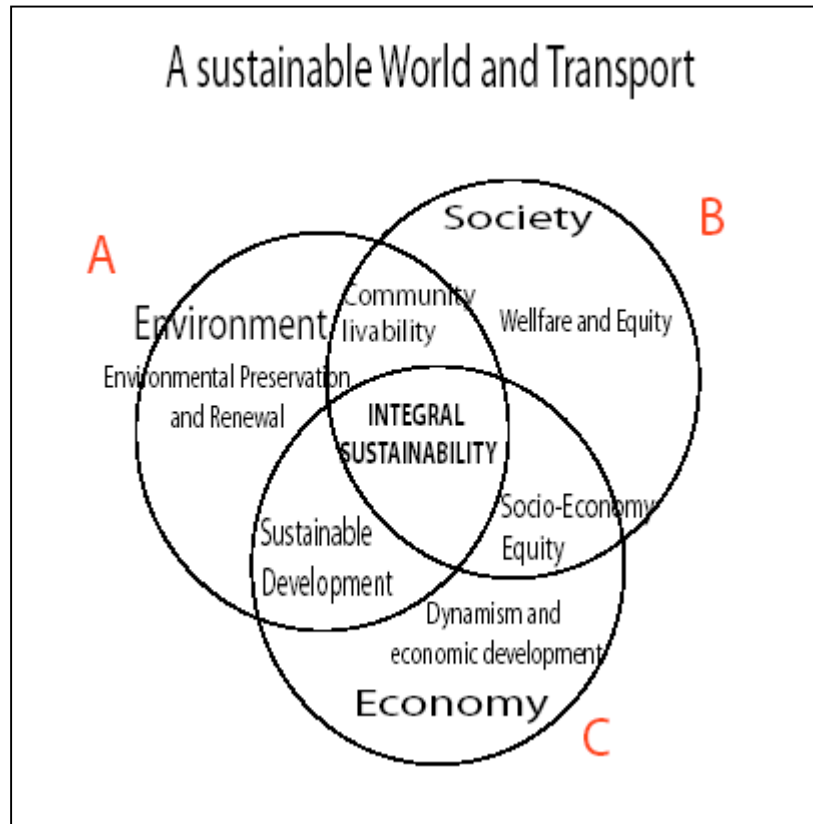
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<sup>15</sup> <http://energybulletin.net/11759.html>

<sup>16</sup> <http://www.miljo.se>

## ***Biogas market as an environmentally sustainable transport model EST***

A project such as Biogas Väst illustrates how a biogas market can be more sustainable than just replacing fossil fuels with biofuels, as explained in the following schema:



Source: Centre pour un transport durable 2002, [www.cstctd.org](http://www.cstctd.org)

Biogas Väst as an Environmentally Sustainable Transport project:

**A Environment:** preservation of farmland for other cultures by using waste – reduction – not crops - production; use of biogas plants' residues as more environmentally-friendly fertilizers that raw material (ex : manure); plus-value of methane used as replacement for fossil fuel instead of being burned or worse, let free in the atmosphere;

**B Society :** more sustainable communities because of the improvement in air and water quality and consumption, locally-owned energy production with local priorities, use of bi-fuel cars and public buses, better waste management and local decision-makers.

**C Economy:** build-up of local expertise in green technologies, high-skilled jobs offers, publicly-owned energy market that can profit farming practices – higher level of independence towards energy sources.



## ***Conclusion***

While it is possible to improve ethanol production crops in more sustainable ways<sup>19</sup>, biogas will also face ethical questions when it will be produced largely by crops instead of waste. Biofuel markets must be developed with an ethical vision that gives priority to the resolutions of many problems at the same time, while reinforcing the local capacity to grow in harmony, health and self-dependence.

Transport is more than often a question of comfort. And while consumers play a important role in their mobility choices, public and private organizations can greatly influence the sustainability of mobility, by a holistic vision combining many transportation modes, by replacing whole public fleets running on fossil fuel by biofuel ones, by offering high-class and reliable public transport and by planning less “energy gobbling” habitats. As for carmakers, profit-driven strategies must be developed with environmentally sustainable transport decisions in mind, to enhance credibility and trust towards discriminating and often well-educated consumers.

The automobile is one of the most extraordinary inventions in transport that has ever been. Together with planes, it has played a key role in democratizing mobility. The challenge now consists in resolving the many remaining problems, in a context where cars could soon be produced and used in a harmless product lifecycle. This way, the next generations won't have to pay for a short-term solutions on alternatives to fossil fuels and other transport-related problems. Our children and grand-children should be able to experience even greater freedom without endangering the planet, its ecosystems and its societies.

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<sup>19</sup> Lagerkrantz, J. 2006 Ethanol production from sugar cane in Brazil: review of potential for social and environmental labelling of ethanol production from sugar cane. [www.grönabilister.se](http://www.grönabilister.se)

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