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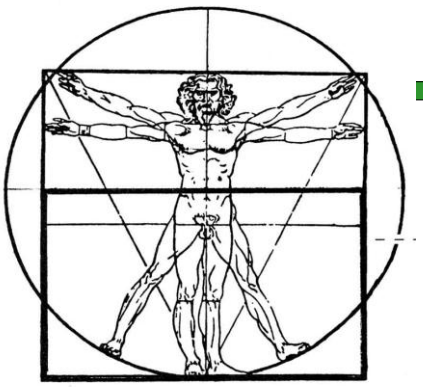

Public Science Report

Brighton & Hove City Council PFI Contract with VEOLIA ENVIRONMENTAL SERVICES (Waste Disposal)

Part 2

Version Ω 1.0, 7th October 2006.

Public Science Report

Contents:

1: EXECUTIVE SUMMARY:

This Public Science Report is a short-study outline of the VEOLIA ENVIRONMENTAL SERVICES[1] PFI contract. This contract[2] is now operational, and was signed in the spring of 2003. It requires a proper legal-technical research program to adequately and fully validate with precision all the points made in this paper. Such a study appears not to have been done by or for the Local Government. It is urgently needed. This paper illustrates why.

This paper briefly summarises the strategic risks and costs of the contract, the environmental shortfalls, and the social and political consequences. It has been researched and written "pro bono", with limited resources. A full-scale technical study, which is urgently needed, would run to some 500 pages and take two months of research work. This needs to be done. The reasons for such a study are explained below.

The bullet point preliminary conclusions are:

- The contract is a potential environmental, social, and financial disaster for the Brighton & Hove Local Authority, and the local residents.
- The total contract costs are approximately three hundred million pounds plus, greater than an alternative, "state of the art" environmentally acceptable (green) waste solution. This project will consume money and resources urgently needed elsewhere for social and public services, in the City zone.
- The existing contract, if performed as agreed, is a strategic level management debacle for the Council. It cannot be fulfilled, as planned, due to the multiple legal, environmental, technical and social factors outlined herein. No serious contingency policies appear to be in place to cope with this situation.
- The contract will inevitably lead to serious political opposition and mass protest from residents of the City of Brighton and Hove (already happening, re Hollingdean Waste Transfer Station). Additionally, there is significant official opposition from other Local Government organizations within the East Sussex County Council zone. Lewes District Council, and other LGO's, are very strongly opposed to this contract, on multiple grounds set out in this paper generically. Extensive and costly litigation against the Council is highly likely, unless there are significant changes to the entire project. The key issue is one of environmental impact.

Another important issue is public distrust and disquiet, and general public opposition to this program. There is a general public suspicion of the Council's intentions and of this specific project.

- The PFI contract requires the Local Government to perform a contract that is believed to be potentially illegal under EU environmental laws[3]; and also various international environmental treaties and agreements[4]. Heavy legal costs and Euro-fines might result for the Council Treasury, at some later date. Any legal action in European Courts will result in a non-functioning waste disposal system, as presently planned and projected. It is doubtful that any incineration based technical process will gain permanent approval by any European Union regulatory bodies, in the long term (as distinct from the UK domestic planning process and regulatory authorities). It is highly probable that the EU Commission will eventually make illegal all incinerator operations, due to climate change treaties, (post Kyoto) and internal EU policy[5]. The remaining written down capital costs of the then obsolescent incinerator will not be recoverable for the LGO waste plan. This will require substantial, unplanned for, further capital investment in alternative technologies that will inevitably become a charge on the Council Treasury. In the short term, the system will require substantial modification and development to become Euro-legal. Significant costs will accrue and will lead to serious cost escalation in the project. It is somewhat unclear, as to whether the City is liable for such costs.
- The contract uses technology and operational methods that are significantly out of date. Waste concentration (transfer stations) and incineration in industrial-scale incinerators has an extensive history. The technology was experimental in the 19th century, and used municipally from 1876 onwards in the UK. It was extensively utilized by the 1920's to 1930's era. There have been persistent problems with this technology, which has a history of health and environmental concerns. It is no longer considered "best practice" internationally for waste disposal. Large Authorities, such as the London GLA, have key policies of rapid phase out of existing incinerators. This has been based on significant technical and scientific appraisals of the environmental and health risks. Such risk assessments were and are public technical resources. They were and are available to both the Council, and to VEOLIA ENVIRONMENTAL SERVICES. They could have been referenced at an early stage of the waste-stream planning process. Therefore it appears that there is no rational or credible technical explanation for the decision of the Council leadership and senior

management to agree to VEOLIA ENVIRONMENTAL SERVICES choosing such obsolescent methods. The consequence of this is a contract that will cause serious environmental impacts throughout the County of East Sussex. It will also contribute to further damage of the national and Global Kyoto/Climate targets of the UK (and may therefore be subject to future Central Government intervention and termination).

- The contract was apparently negotiated and agreed without proper, extensive and careful technical and scientific studies of alternatives (see above), without satisfactory environmental safeguards, apparently without any significant comprehension of the risks, and without properly independent technical and scientific scrutiny and advice (which would have defined and quantified them). There appear to have been no proper risk analysis or cost-benefit financial studies or modelling undertaken prior to the contract being agreed, or afterwards. No proper consultation with external experts on the scale merited or expected by a billion pound contract was undertaken.
- The majority of elected Councillors of the City appear not to have been properly consulted, briefed, or closely involved in the contract negotiation process. They did not exercise proper oversight and scrutiny, and essentially did not understand the scientific, technical, legal and environmental consequences of this contract (but agreed to it).
- The contract will result in a near-future "waste disposal crisis" for the Council, probably as early as 2008, with heavy extra costs, extensive possible litigation, and public political confrontations with the residents of the City. The proposed project will probably not be operational by then. It is running seriously late in its implementation. The core-structure technical waste-stream, of transfer station and incinerator, are now at severe risk of delay and late commissioning - (the history of large-scale industrial incinerators is extant with start-up technical problems, malfunctions, and related problems). In this event, reversion to extensive, expensive, emergency landfill will be required. This will be a LGO debacle.
- The responsibility for the consequences outlined above lies mostly with the actions of some senior Council officers in 2003, and some Council elected members previously holding senior posts. We question whether they exercised due care and attention for the interests of the Council and local residents. Their primary concerns appeared not to have been environmental, or one of cost-effectiveness, or best technical practice, but of following

Governmental PFI objectives and policies. As a result, the project was designed in a way that was policy-skewed fundamentally against the best technical, financial and environmental solution. By default, this benefited VEOLIA ENVIRONMENTAL SERVICES, but not the Council. The entire project planning and policy formation process appears to have been carried through without due diligence, proper advice, or truly independent scrutiny by external experts.

2: INTRODUCTION:

In spring 2003 Brighton Council entered into a so-called "Private Finance Initiative" (PFI) agreement with the French industrial conglomerate "VEOLIA ENVIRONMENTAL SERVICES". This contract was for a term of twenty-five years. The total contract value is some £1000 million. One third of these costs fall on the Local Brighton and Hove Government. It is considered by some experts to be seriously flawed (in the technological, legal and environmental sense), and negotiated on terms significantly financially unfavourable to the Council. It appears to have costs significantly higher than might be expected.

3: BASIC COSTS AND LEGALITIES:

The contract appears to have total costs, for the Local Government, of approximately some £330 million sterling, (0.330 billion sterling). This is an annual cost-rate, amortized over the contract term, of some £13 million per year. There was a National Government incentive grant, of some £45 million, to enter into the contract. This must be subtracted from these costs. It is unclear as to how this grant was subsequently applied to the Local Council finances. The contract expires in 2028. The terms of the contract are contained in a complex, nearly five hundred page document, written in dense legalese and business terms, and appears to contain many clauses and sections interpretable only by experts on business law. The contract is potentially disputable, in some areas, as to clear legal meanings. It is doubtful, in these circumstances, that many elected members of the City Government knew exactly what they were supporting, or properly understood the consequences of approving the contract (but did so).

4: OBSERVATIONS:

The PFI contract with Veolia Environmental Services is also multi-lateral, involving interaction with third parties, such as East Sussex County Council. ESCC is at present subject to Central Government review with regards to its long-term future. No official disclosure has yet been made, but it is possible that Central Government policy will result, at some future date, in its ceasing to exist. A resolution of Government plans and intentions may emerge in the next five years. The significance of this is that the contract is long-term, and one of the contractual parties may disappear, leaving unclear and unresolved many significant legal and financial issues, during the next quarter-century[6]. Its legal liability successors are, at this time, unclear. It is presumed, (but legally unconfirmed) that they will be subsumed into the intended new Regional Government and Assembly for the South East. This may have serious consequences, financial and otherwise, for the Council. The tri-partite contract essentially splits the waste contract costs into two, with the existing ESCC taking circa 65% of the cost burden, and the Council the remainder. The financial burden is somewhat offset, by special long-term budget provisions of the Council against long-term financial costs. These are not guaranteed offsets, as they are market sensitive. The final, total global costs of the contract, over 25 years, are therefore uncertain. This is a matter for considerable public concern.

5: OPERATIONAL COSTS:

The contract is essentially for waste disposal and ancillary services. It replaced the previous financial arrangements in place. At present, Council waste is collected in dustcarts, transferred, and disposed of in East Sussex landfill sites. There is some useful recycling and material recovery. The landfills are scheduled to close and be unavailable after 2008. Subsequent to 2008, the operational plan envisages that all city "waste" will be collected and concentrated in a "Waste Transfer Station" constructed and operational at the old Brighton Hollingdean Rubbish Depot by 2006[7]. This timeline will not be met. Implementation, construction and commissioning are running behind schedule - (little or no site work has been done). The rubbish would then be sorted and a limited amount of recycling of material undertaken. The bulk of the residue rubbish/waste would be trucked to a purpose built incinerator unit at Newhaven. The incinerator is subject to considerable planning delay[8], planned legal challenges, and protest action by local residents. It is very unlikely it will be operational by the time the landfill sites close in 2008. There will be

no low-cost disposal method available at this point. The proposed possible alternative landfill disposal at Stoke, some 174 miles away, will entail a very limited disposal window, (closing under EU requirements) and very heavy transport costs and charges. It is possible that these will be circa £250 per truck, plus landfill charges on top to Stoke Local Government. To this must be added waste transfer levies. Total costs may reach in excess of £400 per truck. Other alternative sites will have similar costs. A possible site in West Sussex, in Storrington, appears to be unviable, and subject to litigation. The Council is at high risk it will find itself, in 2008, with no viable, operational process for waste disposal, at reasonable costs. It will probably be required to enter into expensive emergency arrangements via VEOLIA ENVIRONMENTAL SERVICES, with third parties.

6: VEOLIA ENVIRONMENTAL SERVICES PFI COSTS:

The contract with VEOLIA, replacing previous arrangements, needs to be contrasted with present Council waste costs. At the moment, they are approximately 10% of the Council annual budget, amounting to crudely £27 million per annum - (these are broadly in line with waste system costs for comparable LGO operations). This must be contrasted with the envisaged costs of the PFI contract, with its crude global costs of some additional £13 million per year of the Council budget (50% larger than previously). It is questionable, that in spite of these severe cost increases, running at a high level for twenty-five years, the Council will gain any significant advantages in its waste disposal. The total additional costs for the Council, over 25 years, amount to some £250-260 million plus. Some of this cost is somewhat offset, due to very prudent financial planning and cost risks limitation strategies by the Council financial officers. Additionally, some of the present waste costs, within CITYCLEAN[9], are deductible from the global VEOLIA annual charges. However, there are considerable unknowns, financial forecast risks, and other factors, that make a clear and defined set of final total costs unknowable. It is also unclear what portion, if any, of these increased costs are allocated for other services beneficial to the Council. This additional cost for waste, might have been funding that could have been allocated to other City services. Moreover, the present City budget is broadly in balance, between expenditure and income, with deficits of less than £½ million per annum, on a total budget of circa £270 million. Due to the PFI contract, some £10-14 million will eventually have to be raised in additional annual revenue (but subject to the offsets outlined above). This can only come, due to governmental financial constraints, from increased Council

tax levels, substantial increases in all Council charges for other services, and from increased rents and service charges on Council properties. It is concluded that the essential benefit of a PFI contract, that of financial risk transferral, cannot therefore be met in the present circumstances. Had the contract not been negotiated, it might have been better for the entire waste disposal process to have been performed "in-house", within the Council administration, with stricter and tighter internal controls and supervision, and lower risks, and very substantial financial advantages.

7: COUNCIL/VEOLIA ENVIRONMENTAL SERVICES WASTE DISPOSAL TECHNOLOGIES[10]:

The present operational plan for the VEOLIA PFI contract appears to be locked-in to the proposed incinerator project at Newhaven. All waste collection, processing, and recycling operations are totally linked with the requirements of the incinerator for fuel and "product" to dispose of under the general terms of the VEOLIA agreements with other Sussex Local Authorities. The incinerator requires a large tonnage throughput (for technical and financial viability, of some 210,000 tonnes per annum). It will "burn" waste additional to that from Brighton, from other local government output, commercial waste, and other sources. VEOLIA make claims that the incinerator is environmentally friendly, sustainable, and efficient at recycling waste, by "energy recovery" (electricity generation from heat). None of these claims, upon expert examination and legal-standard evidence, are scientifically and technologically credible.

There is also a serious conflict, in the negotiated PFI contract, between the financial incentives for waste recycling and recovery, and supplying bulk incinerator waste (fuel) for the Newhaven plant. The financial outcomes may result in serious distortions of the waste recovery program from Council waste streams. (Waste will inevitably be processed in a way optimized for VEOLIA financial profit, rather than environmental benefits for the Council). This may happen in spite of contractual safeguards.

There are also serious concerns with the actual incinerator technology. The planned Newhaven bulk incineration plant is designed for an annual tonnage throughput of some 210,000 tonnes.

Firstly, large waste incinerators have a bad technical history, stretching back some one hundred and thirty five years (Nottingham, 1876)[11].

The modern benchmark case study is the Seveso (Italy) tragedy[12], where the incinerator generated large quantities of atmospheric fallout of toxins emitted from the incineration process. Birth defects, aborted pregnancies, respiratory illnesses in the local population, genetic damage to local inhabitants, and sharp rises in the incidence of respiratory and cardiac illness were recorded and substantiated. There were some thousands of casualties. This was a consequence of incinerator bad design, managerial malfunction, and lack of operational technical standards. Many subsequent large industrial incinerators have a long history of under-performance, large cost overruns, and technical failure[13]. The experience of UK Municipal and City Authorities with large incinerator projects has been abysmal. They may be typically categorized by reference to the Newcastle City project, which has been a massive debacle for the Local Authority (the Byker incinerator project)[14].

Secondly, there are considerations with regards to so-called "energy recovery" in the incinerator (conversion of waste to heat, and thermal steam turbo-generation of electricity). This cannot, due to technical limitations, exceed an average of 30% of the total thermal potential energy in the waste. 70% will be wasted, as unused heat. Additionally, another 5%-10% of the energy will be wasted as there will be fuel and energy expenditures, to transport bulk refuse to the incinerator, and bulk ash residue away from it for landfill. The total global energy recovery, as useful electrical power, may therefore be as low as 20%, once these energy requirements are calculated and integrated into the process. Due to the location of the incinerator, no viable proposals are possible for other uses of the otherwise wasted substantial thermal output of the incinerator. The incinerator is neither efficient at energy recovery, nor viable as a source of waste process heat. The efficiency is only about one quarter that of a more modern non-incineration technology (with regards to energy recovery, and recovery of material for industrial re-use). There are also further serious problems with bulk disposal of the residue incinerator ash, which may have serious toxic residues. The lethality of these toxic wastes to humans is comparable with that of some high and intermediate level nuclear wastes. Additionally, the incinerator produces in excess of 12 million gallons of seriously contaminated water, containing additional comparable wastes. The VEOLIA ENVIRONMENTAL SERVICES incinerator therefore does not meet any sensible or rational criteria for "greenness"[15].

Thirdly, the long-term sustainability of the incinerator is compromised by forthcoming EU policy and legislation on large-scale commercial incineration projects. The incinerator appears to be challengeable on the

basis of environmental EU laws. It also violates some European treaty obligations of the UK Government. It does not efficiently convert and recycle waste. It is a potential source of toxic fallout on the local population. The planned incinerator is also exceptional to the present technical and policy decisions of most other EU LGO programs[16]. Elsewhere, incinerators are being subjected to a program of de-commissioning, and dismantling. They are being replaced by a new generation of environmentally acceptable technologies. The VEOLIA incinerator is trailing this process by at least two or more technological generations. There appears to be no rational or credible scientific or engineering explanation or justification for this.

Fourthly, nearly all the "locked-in" potential energy of the waste is not recoverable, as a viable commercial by-product. The value of this by-product is some eight million pounds a year (de minima), calculated as an efficient conversion of bulk waste into bio-diesel, synfuel, and producer gas, by green, non-incinerator alternatives. There is also potential additional electrical energy generation, by fuel cell technology, at conversion rates of some 60-70% (conservative estimate).
In the VEOLIA proposal, some recycled waste, yielding commercial by-products, (organics and glass, metals) is recovered at the waste transfer stage. The substantial profits from this do not revert entirely to the Council - (Council share is 50%). Additionally, a base load of some 10 megawatts from electrical generation ($1/15^{th}$ of the local electrical load) is wasted for Brighton. The total value of recycled energy, materials, and other by-products, all of which are "lost" to the Council Treasury revenue, probably exceeds £12 million pounds per annum. Investment in high tech green waste solutions ("commercialisation" of an in-house operation) might develop a revenue stream considerably larger than this. There are no Council/VEOLIA plans to do so. There appears to have been no prior consideration whatsoever, at the contract negotiation stage, of such "green issues", which would have had very substantial financial benefits for the Council. At present, the proposed VEOLIA system makes no significant green contribution to Council environmental requirements or those of the planet that has any financial savings for the Council whatsoever, beyond the limited pre-incineration waste sorting.

8: FINANCIAL RISKS:

It is also critical to consider the financial risks inbuilt into the existing contract, which might substantially impact on Council finances later, due to a total lack of foresight in considering environmental EU legislation

and directives. The most significant of these risks, if the incinerator is allowed to operate, is that of possible "carbon tax" levies. It is very probable that at some future date, substantial carbon financial levies will be introduced by the EU. Predicted estimated tax rates have varied from £50 to £250 per tonne of emitted carbon. This would yield carbon taxes on the proposed Council/VEOLIA project of some £4 million to £20 million (per annum)[17]. These carbon taxes would entirely wipe out the financial viability of the present contract. VEOLIA would be insolvent, on the contract, if such levies were introduced. Inevitably, the Council would be coerced into substantial carbon subsidies to VEOLIA. None of this appears to have been considered, whatsoever, by VEOLIA or Council officials engaged in negotiating the contract. Additional costs, due to carbon taxes, of £70 million to £500 million (at maximal rates) would be involved, calculated over the entire 25 year lifespan of the project, assuming carbon levies enforced from 2015 onwards. All of this funding must be potentially subtracted from funds available for application elsewhere, in areas such as public services.

It is important to contrast the loss of plus (+) £12 million in city revenue, (de minima) had the waste disposal plan for Brighton been different, coherently and intelligently thought out, and had utilized modern technologies in-house (Direct Works), with the increased costs, (circa 50%, or minus (-) £13 million, gross) of the existing plan. Simple addition of these sums gives a total variation of City funds, (otherwise available for social expenditures and programs) of some minus (-) 1 million per year. That is to say, an in-house, Council controlled advanced waste project, would cost, approximately, one million per annum in extra costs. However, deducted from this would be various other funds that are contingent on the extant VEOLIA contract. It is entirely possible that an alternative project would cost less than the existing Council waste disposal system. However, even taking conservatively this figure, pro-rata, it amounts, over the life of the PFI contract, gross costs, to approximately £300 million, circa 2006-2028, in potential revenue savings and cash flows, otherwise expendable for the benefit of the people of Brighton. Evolving "green" technologies over the lifetime of the contract would have inevitably increased these revenues and savings. With bulk incineration as the preferred option, there can be no such revenue stream, or cost reductions. There is also a serious carbon tax burden risk (see above). This is due to the total inflexibility of the chosen incineration technology, which cannot be modified to non-incineration technologies.

9: OUTLINE ENVIRONMENTAL AUDIT:

There is also a substantial and quantifiable environmental loss. A simplified environmental audit of the complete VEOLIA ENVIRONMENTAL SERVICES waste transfer program chain indicates the following:

1. The disposal incinerator will generate greenhouse gases, (principally CO_2) at a rate of at least 250% greater than alternative green technologies that are readily available. By contrast, using advanced green technologies, this is increased to approximately 400% (or more, as technologies evolve).
2. The incinerator will convert waste heat energies to electricity at only 25-30% of the efficiency of a basic green technology process. Additional efficiency losses will reduce this to 20%-25%, or even less.
3. The incinerator will have local human health impacts that are at present unquantifiable, but indicative of increased localized disease rates, chronic medical conditions, etc, at some level. Historic experience shows that all large incinerators cause public health hazards. No proper studies of this risk, by genuinely independent experts appear to have been commissioned or done by the Council.
4. The incinerator utilizes a waste transport mechanism, (large diesel industrial trucks), that have an extensive environmental impact (pollution, greenhouse gases, road damage, traffic accidents, etc). This is entirely avoidable, but is resisted by VEOLIA. There has been no credible explanation by VEOLIA for this policy[18].
5. There is a serious, long-term toxic disposal problem of waste dust and vitrified slag from the incinerator - (output, 200 tonnes per diem). Additionally, the incinerator produces annually 12 million gallons of contaminated and toxic wastewater. VEOLIA has obfuscated this problem, and has no credible policy in place for resolving this.
6. The existing Veolia incinerator plan is globally, in terms of total environmental impact, and on a “greenness rating”, at least about four times worse than a viable existing green technologies alternative. By choosing an advanced, latest research technology, this could be doubled again, to some eight times. Long term technology upgrades, would undoubtedly increase this further still. The present waste technology system is not credibly upgradeable.

10: GREEN TECHNOLOGY ALTERNATIVES:

To understand the present situation, a critical technical study exercise was undertaken for this memorandum. The problems of the existing project were then compared with an alternative. This involved making a technical audit of the existing project, based on known incinerator parameters. For the purposes of benchmarking the existing PFI contract with a "best practice" alternative waste processing system, an outline technical-organizational proposal was studied. This is presented in this report. This alternative has very significant "green" and financial advantages over the existing project. The proposed alternative technology project is predicated on two primary criteria, environmental impact and cost effectiveness, with subsidiary issues of recycling and energy self-sufficiency for the Council. This was been done to highlight the almost total lack of proper consideration of alternative technologies and methods other than those of the existing contract, and to contrast the significant environmental and financial differences between a "green" alternative and the "brown" extant Council project. This should have been done by the Council officers and senior elected representatives at the very earliest stages of the planning and development of its new waste management and disposal project. This does not appear to have happened. This alternative "bench-marker" therefore illustrates the environmental and financial consequences of the total failure of the Council to do so.

If the required Council function of waste removal and disposal had been "tasked" by the Executive Officers and management of the Local Government within a framework of both financial cost-effectiveness, environmental benefits, and secondary social and local economic benefits, nearly all of the consequences outlined in this paper could have been avoided. In commercial projects financed on a scale of a billion pounds sterling, careful consideration would have been given to factors of operational research, business plans, technology assessment, team studies of technical and organizational alternatives, and proper cost/benefit analysis of such alternatives. Such a program methodology would have been expected, and would have amounted to normal practice. We are unable to discover any such activities, by the Council, prior to it entering into the VEOLIA contract. Such an omission, by public officials and elected representatives, is extraordinary. Moreover, no proper consideration appears to have been given, at any time, to seeking a genuinely "green" solution to City waste disposal. Such a proposal is now made, in greatly simplified outline form. It speaks for itself.

11: ALTERNATIVE OPERATIONAL PLAN:

Bullet point issues:

- If planning and operational priorities are given to scoring all waste disposal proposals on a scale of "greenness", the most "high-tech" solution that emerges is also the most cost-effective. Substantial savings are made. Secondary economic local effects are maximized.
- The advised technical solution was selected after consideration of a large variety of alternatives. This resulted in estimated savings of some £350 million, which would be returned to the local economy. These included various types of composting landfill, methane digestion/compactification, etc. The selected example was chosen as the highest scoring technology, environmentally, with the largest energy conservation and recycling efficiency. The process is one of utilization of small bioreactors. These result in a decentralized, high efficiency, low environmental impact technical and organizational project, that totally avoids incineration, and converts the waste into bio-fuels, producer gas, industrial feed-stock chemicals, and low residue non-toxic solid waste. Total energy efficiency recovery is 80%, or more. Total useable materials and resource recovery is approximately 75% (of waste contained potential energy).
- The solution envisaged is that of a ring of three small industrial bioreactors, established on small (one hectare) brown-field sites, on the City margins. The sites are "green-screened" with transplanted vegetation. These depots are sited distant from local housing, and serve a localized waste collection and management zone, approximating 50% of the local output of waste. Transportation and collection distances would be minimized. Transport energy requirements would likewise be reduced. The maximum annual throughput, per depot, is estimated at approximately 60,000 tonnes max (with growth to 2030). It is envisaged that one bioreactor would be located on the western edge of Hove, one in East Brighton, and one on the boundary of North Brighton[19].
- The waste would be collected and transported in a fleet of Council electric powered trucks (fuel cell technology). The truck fuel is recovered from waste processing, (methanol reformulated hydrogen) and is 100% green and non-carbon loading. Substantial EU funding is available for this transportation system[20-21]. The net costs are therefore significantly lower than conventional diesel technology. There are long-term financial savings that reduce total waste costs by 10% or more, as a result. The proposed VEOLIA

transport system, using diesel 44 tonne trucks, is substantially more expensive, and will cause significant environmental damage. The diesel vehicles selected, although less polluting than conventional heavy trucks, must be contrasted with the zero net carbon burden of an electric vehicle fleet running on fuel cells, and recycled liquid fuels.

- The waste would be machine sorted and categorised. Most of the metal, glass, and paper can be separated. Solid refuse would be separated into pyrolizable and non-pyrolizable streams. The non-pyrolizable would be compacted and thermally treated into non-toxic pelletizational form. The main bulk of the refuse is then machine loaded into the local depot bioreactor. This processes the waste without incineration or combustion, or environmental over-burden[22]. The bioreactor utilizes a two-stage thermal-de-polymerisation process, with residual pyrolization. All processing takes place in a pressure sealed bioreactor. There are no emissions from this thermal process, except combustion gas (CO_2) from the reactor heating system. The carbon emission is one fifth or less of the planned VEOLIA incinerator. The emission of other gases, or compounds, such as nitrides, is essentially zero. The carbon emissions can be reduced to almost zero, with emerging technologies that can be added later, as downstream after-processing. These technologies would yield further valuable bio-fuels outputs, and substantial fuels revenue.
- The process yields substantial quantities of re-saleable, recycled high value product. Waste heat generates electrical power at 60%-75% conversion efficiency (with an advanced Rankine cycle). Fuel cell technologies are also viable. Outputs of 12,000 tonnes per annum base load of liquid bio-fuels from the waste conversion are possible. These are "carbon neutral". The fuels could be made available to the city bus fleet. Further technical developments might result in a dual technology upgrade of the bioreactors that would double this (carbon-emission suppressors).
- The secondary energy, in the form of synthetic fuel gas, waste heat for district heating, and in-process heat (the bioreactor makes its own fuel supply to run the process) would be recovered with very high efficiency.
- The high efficiency recycling and energy generation mode would contribute very substantially to the base load of energy required to run the City. Ten percent of local electrical power, plus bus transport fuels, some domestic and commercial heating, and district council properties heating, might eventually be achieved. The contribution, by way of contrast, of the extant VEOLIA /Council

plan to these areas is essentially zero. No consideration appears to have been given to such second level energy recovery and utilization, resulting in very substantial losses of potential financial revenue, and increased energy efficiency of the waste system.

- If the entire waste collection and disposal cycle are done "in house" and by direct labour, by the Local Government, all the substantial revenue funds from this process would be passed to the Council Treasury. Essentially, they would make a substantial offset of total waste costs. This needs to be contrasted with the present VEOLIA/Council proposal. This allows only some 50% of the surplus from converting some 20% of the waste (thus, 10%). Therefore it is globally ten times less profitable, for the City, than the proposed process. This loss of financial revenue is entirely avoidable, given even a modicum of proper consideration of a suitable, non-incinerating waste technology.

12: RECOMMENDATIONS:

The Local Government urgently needs to reconsider its present situation regarding the existing PFI contract. It is suggested that:

1. In view of the issues outlined above, serious consideration needs to be given to any further continuation of the contract, in its present format and methodology. The contract is multiply deficient, as it stands, in multiple areas, technical, environmental, and financial. The consequences of continuation almost certainly significantly outweigh the benefits of termination. The costs of termination, however, might be excessive, due to the Council being "locked in" to a waste contract that is significantly disadvantageous to it.
2. It may well be in the best interests of the Local Council to conduct an internal review of the present PFI contract, factoring in all of the points established in this report. There are powerful arguments that could be made for contract termination. Replacement with an entirely new LGO Waste-Management Program for Brighton and Hove is without doubt an option with significant benefits.
3. Even in the event of a decision being made for continuation, very significant changes absolutely need to be made to the technical methodology, to transform the existing obsolescent technical system to one that is significantly more "green", financially effective, and acceptable to local residents. The contract contains provisions, relating to the introduction of

new technology, that legally makes this possible. Failure to do so, therefore, would be entirely the responsibility of the senior council officers involved, and those elected representatives holding senior supervisory posts. It is very important to realize that the existing contract proposals probably make the PFI contract legally void. (It is apparently an agreement to do things that are illegal under EU law[23], or international environmental treaties. That is not a contract. It is, legally, potentially, a civil conspiracy against EU law. Such "contracts" are not upholdable in the EU Courts and Tribunals.)

4. If the existing actual "contract" remains in place, it essentially needs to be renegotiated extensively in some areas. Its technical provisions will require substantial modification. The core technical and logistical operational plan must be altered to conform to present and future EU law. The present PFI contract is probably in legal violation of the EU "Treaty of Aarhus". It is essential to consider renegotiation of the contract to make it legal in all its terms of conformity with EU law. It is urgent that this is done, as soon as possible. If third party legal challenges are made to the City PFI contract, as regards legality, there are significant risks of the contract being overturned (at least in part). The costs of this may run to considerable sums. With regards to the City Government legal department, there appears to have been a total failure to comprehend the legally related aspects of the issues raised in this report. There are concerns with the actual legal scrutiny of the conformity of the PFI contract with EU and other law that took place. There appears to have been a failure of communication of any problems (such as those raised in this document). These were neither realized, understood, nor properly communicated to the general body of City Council elected members. This, in itself, represents a very serious failure of Local Government, involving sums of public monies amounting to one billion pounds or more. Full and proper disclosure, to the full Council of elected representatives, of all the issues referred to in this document, was required. This did not happen. Expert advice and help should have been made available to elected members to understand and act effectively on these issues. This significant failure to properly brief and co-opt the elected councillors, beyond the membership of specific Council

Government cabinet and scrutiny committees, might result in serious future legal and administrative challenges.

5. The Council has significantly ignored the considerable public opposition to the entire waste project. This is generating large-scale protest, potential litigation, delay, and increased costs. Most of the opposition is financial, environmental, and amenity based. Most of it could be largely mitigated by establishing a proper public dialogue, admitting past mistakes and mis-judgments, and adopting a significantly revised waste management plan that was acceptable to the local residents. There is no reason why this cannot be done. All elected representatives, from all political parties on the Council, share collective responsibility for the present situation with regards to Council Waste Disposal. This should be resolved on a collective basis. Failure to do so, will inevitably be seen by the local residents and Council tax payers as an issue of institutional intransigence and wilful avoidance of responsibility, both by individuals, and by the Council as a whole.

13: CONCLUSIONS:

The primary reasons for the present VEOLIA ENVIRONMENTAL SERVICES/Council Waste Plan being continued, and the council refusing to consider green and financially effective alternatives, are complex. Much of the responsibility for the extant situation must be placed upon the internal and public politics of the Council, with reference to both the elected members, and the senior officers. There appears to have been a total failure to develop a waste disposal program that will be legal, sustainable, environmentally sensitive, and acceptable to the residents of the City of Brighton and Hove. The non-existence of a program that is highly efficient, environmentally effective, and substantially more cost effective, is due entirely to issues of “human factors”, such as social and technical conservatism, lack of knowledge of appropriate scientific and technical solutions, and lack of executive and managerial imagination. Political considerations appear to have overridden basic concerns for cost-effectiveness, “greenness”, and “human-centred” solutions that would directly benefit the city population. The outcome of this process has been to impose on the city very large and long-term environmental, financial, and social costs, with little significant financial and environmental benefits to local residents.

CAVEAT:
This report has been prepared “PRO BONO”. It is a “Public Science” document. It is in legal conformity with the relevant legislation both EU and UK, on public legal immunities re “whistle-blowers”. It has limited legal privilege. Wherever contentious statements are made, these are qualified, where required, as an expressed legal-technical-scientific opinion on a matter of public policy and concern. The opinions expressed herein, are entirely those of the author.

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Nota Bene:

Public Science: - what it is, what it does.

Public Science is when scientists and technologists operate in the public world, to examine and evaluate the science and technology content of public policies, of either National or Local Government. Independent scrutiny of the scientific and technological content of Governmental policies is an important role and function. Without such external oversight, significant public harm may happen. It is this function that is fulfilled by a scientific-technical group, such as the Omega Institute.

The research into relevant public policies, the issuing of public reports, such as “Public Science Documents”, is all part of this process. Such activity, in the public domain, involving public bodies, has qualified legal privilege, to enable the benefit of the public good.

14: REFERENCES:

1. Veolia Environnement (chairman Henri Proglio) ranks in the largest 16 French companies, with interests in 65 countries. 56% of shares are held by institutions. R&D is mainly in France. [Le Monde 14th March 2006].
Its global business is 25,245 million euros. It has, globally, 12% growth. 38% of business is in the EU outside of France, where it gets 50% of its profits. The company has a 9% return on investment.
[www.veoliaenvironnement.com].
Veolia Environnement is split into four divisions – water (Veolia Eau, ex Veolia Water), refuse collection and waste disposal (Veolia Propreté, ex Onyx) for which in size it is No. 2 in the world, – energy (Veolia Energie, ex Dalkia) – and transport (Veolia Transport, ex Connex).
[www.wikipedia.org/Veolia].
Nottinghamshire Council is negotiating a 26-year waste PFI contract with Veolia. [www.indymedia.org.uk].

2. The contract is now available on-line in downloadable format at the Brighton & Hove City Council website [www.brighton-hove.gov.uk].

N.B. Although a French company is legally liable in the EU and UK courts for performance of the contract, it is also subject to EU Commission regulations and EU internal treaties.

3. EU Environmental regulations. e.g. European Commission "Burner Directive".

4. Treaties. (1) Treaty of Aarhus.
(2) Stockholm Convention.
(3) Basle Convention.
(4) Rio Declaration on Environment and Pollution (adopted at the Earth Summit in Rio de Janeiro 1992).
(5) The 1996 Protocol to the London Convention.
(6) Preamble to the Protocol to the Convention on Long-Range Transboundary Air Pollution (LRTAP) on Persistent Organic Pollutants (a European regional treaty).
(7) The Bamako Convention.

5. Ref. "It is highly probable that the EU Commission will eventually make illegal all incinerator operations, due to climate change treaties (post Kyoto) and internal EU policy".
N.B. EU Commission draft discussions for policy indicates future policy of more severe controls on carbon emissions and carbon sequestration,

and switching wherever possible to more efficient carbon emission minimalisation technologies. Incinerators are considered high-level carbon emitters.

6. At present Regional Government in the SE has an additional tier in the form of "GOSE" – Government Offices South East – plus the Regional Assembly selected by nomination from existing Regional County Councillors. [www.nwra.gov.uk]. There are no plans not to proceed with elective Regional Government.

7. Ref. Council documentation and statements. (Hollingdean Waste Transfer Station). See Council website [www.brighton-hove.gov.uk].

8. Ref. Planning application. At present the latest re-application has been submitted and will be decided in May 2006.

9. CITYCLEAN is Brighton and Hove City Council refuse collection service. It is an "in-house" service not a private sub-contractor operation.

10. The incinerator will be located at Newhaven Harbour Docks, designed by Veolia Environnement in France. All four components are manufactured in France. Effluent and waste profiles: – this incinerator is a typical current technology installation. For detailed technical studies see [www.no-burn.org]. With regards to modification to comply with future standards, this is not possible as it is a combustion/incineration process not a reprocessing technology.

11. (Nottingham, 1876). Ref. Nottingham City Council website.

12. Seveso (Italy). Ref. Google Search Engine 'Seveso dioxin poisoning'.

13. Examples of large industrial incinerators underperforming, with large cost overruns and technical failure, may be found at [www.no-burn.org].

14. The Byker incinerator project. Ref. Google Search Engine 'Byker incinerator project'.

15. The Veolia incinerator does not meet any sensible or rational criterion for "greenness". The ibid. notes: A "green" waste processor requires an inherent low-carbon profile and high energy-recycling efficiency.

The Newhaven incinerator produces between 400% and 800% of the carbon output and 600% - 800% less energy recycling than "best practice" non-incinerating current leading-edge technology.

16. Ref. "The planned incinerator is also exceptional to the present technical and policy decisions of most other EU LGO programs". See extensive discussion and examples in [www.no-burn.org].

17. Ref. "This would yield carbon taxes on the proposed Council/Veolia project of some £4 million to £20 million (per annum)". There is extensive EU discussion at Council of Ministers level and in the EU Parliament with regards to both carbon taxation and also eventual EU directives and regulations phasing out large-scale incineration in favour of more "green" alternative technologies.

18. Ref. With regards to environmental effects of heavy truck traffic see: FoE Specialist Report – Google Search Engine 'Heavy vehicle traffic environmental impacts'.

19. Bioreactor locations for the rest of East Sussex: – it is strongly suggested that instead of long-distance transport of urban waste across Sussex, there should be a series of localised sites (upwards of six) to give local access by communities to non-incinerator recycling.

20. Waste collection and transport is recommended by electric fuel cell vehicles.

21. See website for Bollard fuel cells. Google Search Engine 'Bollard fuel cell', also Mercedes Benz main website re. fuel cells and buses.

22. A local depot bioreactor would require a relatively small site of 2-4 hectares depending upon capacity. East Sussex would require perhaps four clusters of reactor pairs. The process time per load cycle can be as little as four hours. The typical daily capacites per reactor are at present 200/250 tonnes of waste.

23.

(1) The present contract has been referred by members of the EU Parliament to an EU official body for investigation of its fundamental legality.
(2) It is questionable that this contract complies with the EU "Treaty of Aarhus".

(3) There are concerns that the contract violates other international treaties that are binding upon EU member states. See the reference on Treaties in 4. above.

15: APPENDIX:

Algae Bioreactors

From smokestack to gas tank

New Scientist 7th October 2006
by Phil McKenna, Boston

Power plants emit carbon dioxide, algae make sugar and oil out of it. It's time to put the two together.

"If you're working at a power plant, you just saw your carbon dioxide turned into something you can drive home with". So says Isaac Berzin of GreenFuel Technologies in Cambridge, Massachusetts, which is developing a way of producing biofuel from the noxious emissions of power plants.

Two of the world's greatest energy users are electricity generation and transport. Both are responsible for huge quantities of greenhouse gas emissions, as most power plants and vehicles still rely on fossil fuels. Now GreenFuel and others are hoping to marry the two together with an emerging technology that uses a by-product of one to supply to the other. Doing so could dramatically reduce their overall carbon dioxide emissions.

At the heart of the technology is a plastic cylinder full of algae, which lierally sucks the CO_2 out of a power plant's exhaust. The algae can in turn be converted into biofuel, creating a cycle that takes the carbon from the smokestack to the gas tank before it enters the atmosphere.

If successful, the technology could capture all of a power plant's CO_2 emissions. "Right now, when you say CO_2, people want to hide under the table. Carbon dioxide is not something you want to pump underground, it's something you want to reuse", says Berzin.

To produce fuel from CO_2, the flue gases are fed into a series of transparent "bioreactors", which are two metres high and filled with green microalgae suspended in nutrient-rich water. The algae use the CO_2, along with sunlight and water, to produce sugars by photosynthesis, which are then metabolised into fatty oils and protein. As the algae grow and multiply, portions of the soup are continually withdrawn from each

reactor and dried into cakes of concentrated algae. These are repeatedly washed with solvents to extract the oil.

The algal oil can then be converted to biodiesel through a routine process called transesterification, in which it is processed using ethanol and a catylist. Enzymes are then used to convert starches from the remaining biomass into sugars, which are fermented by yeasts to produce ethanol.

GreenFuel is testing a pilot facility at the Redhawk power station in the Arizona desert. The size of a couple of trailers, it treats only a tiny fraction of the plant's exhaust, but it works, and has so far produced several gallons of algal oil, which the company is planning to convert into biodiesel this week. A second, larger prototype of around 1300 square metres is now under construction.

The new facility will also capture the heat produced by the plant and use it to help dry the algae before the oil is extracted and converted to biodiesel. This excess heat could also make it esier to recover the solvent from the oil after extraction. "The main energy requirement is recovering the sovent from the oil once it is extracted", says Berzin. "Seventy per cent of a coal-burning plant's energy is lost as heat. That's a lot of waste heat to use".

GreenFuel has so far received more than $18 million in venture capital funding, and hopes to install a full-scale algal farm at least one kilometer square near the Redhawk plant by 2009. Berzin calculates that if the farm has enough algae to absorb all the CO_2 produced by the 1000-megawatt plant, GreenFuel could ultimately produce more than 150 million litres of biodiesel and 190 million litres of ethanol a year. To do this, it would need a farm of between 8 and 16 square kilometers.

The idea of producing biofuel from algae is not new. The US Department of Energy began investigating algae in the 1970s during the global oil shortage. Researchers scoured the US, collecting more than 3000 different strains of "extremophile" algae that could withstand the high temperatures, salinity and pH required to absorb the exhaust from power plants.

The Aquatic Species Program, as it was known, grew algae in open pond test sites in Hawaii, California and New Mexico, but was mothballed in 1996 when lower crude oil prices made it difficult for alternative fuels to compete. "It's an entirely different world now", says John Sheehan, an analyst with the National Renewable Energy Laboratory in Golden,

Colorado, who worked on the project. “I’ve had a call or email a week enquiring about it”.

Although ahead of the competition in terms of developing prototype bioreactors, GreenFuel is not the first to use algae to produce samples of biofuel from power plant exhaust. In March Laurenz Thomsen and his team at the Greenhouse Gas Mitigation Project at the International University Bremen in Germany used microalgae to produce 10 milliltres of biodiesel. Thomsen is now working with GreenFuel to develop algae farms at CO_2-belching coal-fired plants in eastern Europe.

“Using technology based on GreenFuel, we can mitigate 50,000 tonnes of CO_2 per square kilometer per year”, he says. Building a one-square-kilometer facility would cost approximately $20 million, he estimates, but the payoffs would be equally large. “I think we are close to the point where we can gain $5 to $10 million a year by selling the fuel”.

Another company building a pilot algae reactor is New York-based Greenshift. The company plans to begin testing its reactor at a bioethanol plant in Iowa in early 2007, where waste CO_2 is emitted when corn is converted into ethanol. “Roughly one-third of the corn that goes into a facility comes out as ethanol”, says Kevin Kreisler of Greenshift. “With algae and other technologies we can increase that to two-thirds”. Like GreenFuel, the company eventually plans to use the technology at power plants.

Instead of exposing the algae directly to sunlight, Greenshift uses an array of mirrored troughs and fibre optics to carry sunlight to the plants. Algae don’t need strong sunlight for photosynthesis, so the bioreactors could feasibly be housed in buildings or underground. “It’s all about efficiency”, says Kreisler. “By diffusing the light we can take one square metre of sunlight and spread it out over 10 square metres of growth plates, thus reducing the amount of land we need by a factor of 10”.

Indeed, one key advantage of algae farms over other sources of biofuel such as corn and soybeans is that they need much less space (*New Scientist*, 23rd September 2006, p 36). In Germany, where rapeseed is the primary crop used for biodiesel, it would take up to 33 times as much land as is needed by the algae bioreactors to produce the same amount of fuel, Thomsen says. What’s more, unlike other biofuel crops, algae do not require precious commodities like fresh water or fertile land. That makes the technology suitable for use in the deserts of the American south-west and China. “If you really want to make an impact on CO_2, you have to look at the US and China”, Berzin says.

If the technology is to be successful, though, the energy industry will need to be convinced. Barry Worthington of the US Energy Association in Washington DC, which represents the electricity generators, says the economics of algal biofuel still have to be borne out. But he is optimistic about its potential. All the conventional ways of reducing CO_2 emissions are considered a cost, he says. "This changes the dynamics dramatically".

A Taste for Sewage

Carbon dioxide is not the only waste substance algae can convert into biofuel. Algae also like to munch on the organic matter in human waste, producing a carbon-rich oil.

Aquaflow Bionomic of Marlborough, New Zealand, is extracting oil from the algae that grow naturally in wastewater treatment facilities. In may the company produced its first 300-millilitre test batch of biodiesel, and hopes to have enough to fuel a vehicle test drive this year.

"There is a certain elegance to unlocking the waste flow and turning it into a significant asset", says Nick Gerritsen of Aquaflow. "If you leave a bucket outside your back door anywhere in the world, it will turn green with algae. We are basically leveraging existing assets, because sewage ponds exist all over".

Appendix Two:
Press Article.

Is this the ultimate recycler?

An experimental recycling plant in Philadelphia is turning waste from a nearby turkey factory into gas and oil. It could, in theory, convert any old kind of rubbish into fuel. Jerome Burne reports

Thursday May 22, 2003
The Guardian

How about this for a ridiculous modern myth. There is a machine somewhere in America that can take virtually any sort of waste - offal from an abattoir, old tyres, junked computers - and turn it into high quality oil, plus pure minerals and clean water, all in a few

hours. It is an invention that could change the world. Not only might it end the west's, and in particular America's, dependence on imported oil, but it has also the potential simultaneously to solve the increasingly pressing problem of waste disposal.

A fantasy along with the everlasting light bulb, the car that runs on water and the perpetual motion machine, right? Well, no.

An experimental unit that uses a technique known as the "thermal depolymerisation process" (TDP) that can recycle seven tonnes of waste a day into gas and oil has been running for three years in Philadelphia. A scaled up version is due to open in Carthage, Missouri next month. It is designed to transform 200 tonnes of guts, beaks, blood and bones a day from a nearby turkey processing plant into 10 tonnes of gas and 600 barrels of oil.

This is not being funded by some eccentric billionaire. The impressive results from the Philadelphia plant convinced the US environmental protection agency to put up $14.5m (£9m) to fund four more plants, while private investors are backing the Missouri plant to the tune of $40m (£25m). The company, Changing World Technologies, has also acquired such powerful friends as James Woolsey, former CIA director, and Alf Andreassen, former science adviser to George Bush. It's worth mentioning such well-connected backers because, says chief executive officer Brian Appel: "When people first hear about us they always say they don't believe it."

Trials at the Philadelphia pilot project have given the engineers a good idea of what different feed-stocks would produce. For instance, a 175lb (79kg) man could, theoretically, yield 38lb of oil, 7lb of gas, 7lb of minerals and carbon and 123lb of sterilised water. More practically, 100lb (45kg) of sewage becomes 26lb (11kg) of oil, 9lb of gas, 8lb of minerals and carbon and 57lb of water. Medical waste, generally regard as tricky to dispose of, is particularly valuable - its equivalent yields are 65, 10, 5 and 20.

Philadelphia council is planning to give this value-added treatment to its sewage and there are also plans to handle chicken offal and manure in Alabama and pork and cheese waste in Italy.

The company envisions a large chunk of the world's agricultural, industrial and municipal waste going through TDP recycling plants all over the globe. "You are not only cleaning up waste: you are talking about the distributed generation of oil all over the world"

says Michael Roberts, an engineer with the Gas Technology Institute. Changing World say that converting all of the US agricultural waste into oil and gas would yield the energy equivalent of 4bn barrels of oil, roughly equal to the volume of US oil imports in 2001. So oil tankers might soon go the way of tea clippers.

Transforming waste into energy is an old vision and there have been many attempts at it but only a few minor successes, such as the production of ethanol from cornstarch. All suffer from two big flaws. They can only handle a few different types of "feedstock" and they usually generate only a little more energy than they use. "The only thing this process can't handle is nuclear waste," says Appel. "If it contains carbon we can do it."

TDP is said to be 85% efficient - that is, only 15% of the energy it produces goes to fuelling the process. The initial estimate of the cost of the oil from the Missouri plant is $15 (£9) a barrel. The "lifting" price - how much it costs to get oil out of the ground - is very cheap in the Persian Gulf, around a dollar a barrel, while from Gulf of Mexico, North Sea or Alaska the "lifting" price is $8-12. So a price of $15 a barrel for this technology is high but Appel predicts his prices will come down to $10 in a few years, making them comparable with a medium-size oil exploration and production company. "The oil that comes out is very light," says Appel. "It is essentially the same mix as half fuel oil, half gasoline."

Environmental legislation seems to be running in TDP's favour. Last month, tougher emissions standards were set for diesel in the US, prompting a switch to the type of low-sulphur fuel that Changing World produces. The US is expected to ban recycling of abattoir waste into animal feed soon. That could well launch TDP big-time.

Making the switch is going to take a long time, but experts reckon it can make the oil industry cleaner and more profitable. The process can handle heavy crude, shale and tar sands - generally considered not to be cost-effective - as well as heavy solid waste left over from normal refining. A modified version could also be used to pre-treat coal, extracting a range of minerals and leaving the residue to burn hotter and more cleanly.

Although trial results have been impressive, the technology has to prove itself at the new Missouri plant. There are a few sceptical

voices. "Once they are producing something as valuable as they say they are," says Professor Robert Brown of the Center for Sustainable Environmental Technologies at Iowa State University, "people aren't going to give dead chickens to them any more."

Where there's muck there's gas...how the recycler works

Turning organic waste into oil is a trick the earth perfected long ago. Applying pressure and heat to the decaying remains of plants and animals transforms their long chains of hydrogen, oxygen and carbon into the short-chain hydrocarbons that make up oil. But while the earth takes millions of years, TDP takes a few hours.

The principles remain the same, however, and no fancy new technologies are involved. In fact most of the pressure tanks and reactor vessels the system uses are available off the shelf. What allows TDP to succeed where others fail is the way it handles the volumes of water found in most organic waste.

Feedstock is first ground into slurry and heated under pressure, which breaks down some of the long carbon chains. Then it flows into a "flash vessel" where a dramatic drop in pressure removes much of the water far more efficiently than boiling it off. Minerals settle out at this stage and the remaining organic soup is then heated in "coke ovens" to break any remaining chains before the end products - oil, gas, water and carbon - are drawn off from a distillation column. The "coke oven" heats the organic soup to about 900F (480C) turning it into a vapour. What happens next is just the same as what goes on in an oil refinery, or indeed in a whiskey still. The vapour flows into tall containers, known as distillation columns, where the various molecules separate out - the lightest molecules rising to the top and the heaviest sinking to the bottom. So the gas is drawn off from the top, the oils are removed from the middle and the powdered carbon is taken out from the bottom.

The gas, expensive to transport, is used to power the process, while the oil, minerals and carbon are sold off. The calcium and magnesium produced from the turkey waste, for instance, make a perfect fertilizer.