

# Renewable Energy Capabilities

Stopford Projects Ltd



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Company Registration No. 1630328 VAT Registration No 388 107 726

*“Our pedigree in the process engineering sector coupled with significant scientific capability enables Stopford to provide innovative solutions throughout the renewable energy sector.”*

Stopford's Research and Environment Director, Ben Herbert

Stopford Projects Ltd was formed in 1982 in the North West of England to provide cost effective detailed design and project management services to local industry. Stopford has developed over almost three decades to become the company it is today serving international clients from our offices in Cheshire, Lancaster and Luton. Stopford provide world class consultancy, multi-disciplined engineering design, project management and construction services in a variety of industrial sectors, to both UK and international clients. We offer a comprehensive range of engineering services from concept to complete engineering design through to total project implementation.

We pride ourselves on providing high quality, cost effective services using the latest technology, software and design techniques throughout all areas of our work. All our work is carried out in accordance with the Stopford Quality System and to our ISO 9001:2008 certification.

We work in the following sectors:



Petrochemical & Bulk Chemical



Fuel Storage & Distribution



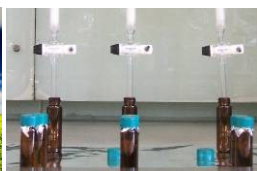
Fine Chemical & Pharmaceutical



Renewable Energy



Environment



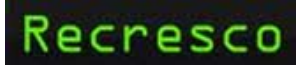
Biotechnology



Paper



Nuclear

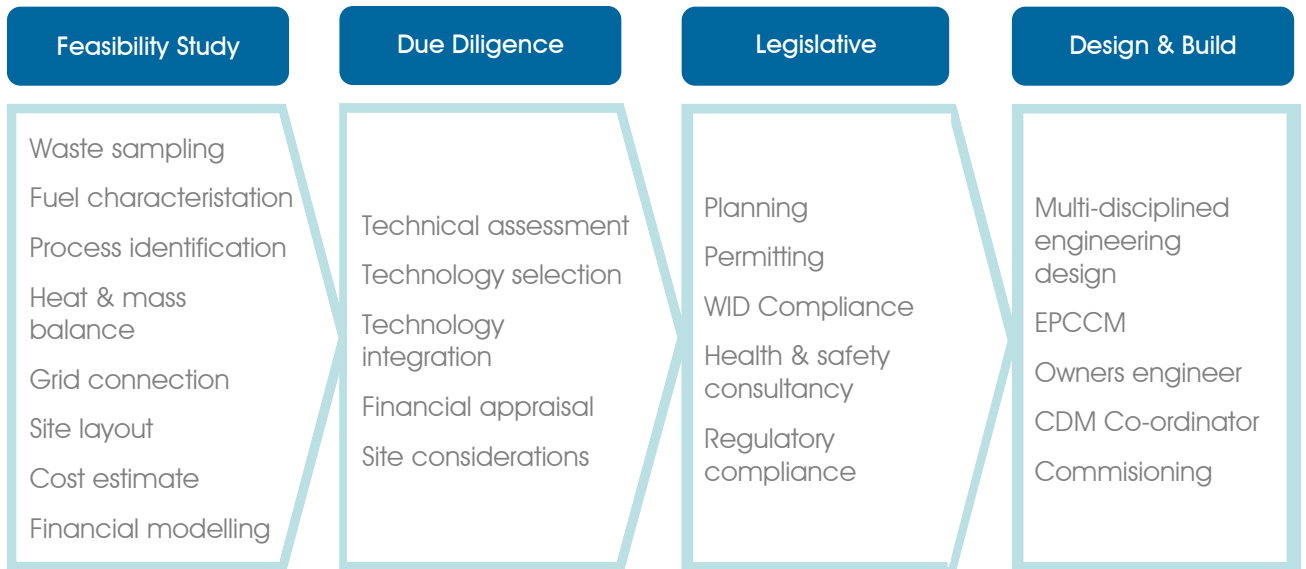


## Renewable Energy

Stopford has significant expertise in the development and execution of renewable energy generation projects. Our capabilities span project feasibility, technology due diligence and financing right through to multidisciplinary engineering design and plant commissioning. Our diverse multidisciplinary project teams comprise of environmental scientists, chemists, energy consultants, project managers and engineers. This allows a flexible approach to project development, whereby specialist consultancy services can be delivered throughout the lifecycle of renewable energy schemes.

Stopford’s areas of specialism include:

- Fuel production from biomass and waste (characterisation, processing, pretreatment, fuel modeling and MRF design).
- Energy from biomass and waste (gasification, pyrolysis and anaerobic digestion)
- Biofuels (bio-ethanol storage and blending)
- Microgeneration (hydro, solar, wind)



## Prith Rajendran- Managing Director

Prith Rajendran is a Chartered Chemical Engineer. He joined Stopford in 1996 as Managing Director of its then fledgling process engineering division. Prith has been MD of the Stopford group since 2000. Prior to joining Stopford, he was a Chemical Engineer within the pharmaceutical and fine chemical manufacturing industries for a number of multinational companies. Prith has overall responsibility to ensure that Stopford achieves its strategic objectives and to provide leadership and direction to the board and staff.



Apart from his managerial roles, Prith continues to provide consultancy services to our clients. In particular to the environmental sector where he has provided support on a number of renewable energy projects both within the UK and abroad. He is also providing strategic support to the company's environmental division, Stopford Energy and Environment.

## Gavin Colls - Associate Director of Renewables and Nuclear

Gavin Colls is the Associate Director for Nuclear and Renewables at Stopford. Gavin has spent twenty years working in the area of process operation and design, with projects spanning from bulk chemicals to nuclear decommissioning. He successfully became a Fellow of the IChemE in his late thirties. His professional achievements include lowering heat requirements for a bulk chemicals facility, resulting in a 30% saving. He also provides dedicated project management to many of our large waste to energy ventures. His strength lies in solid process engineering from heat and mass balances through unit operations such as heat transfer.



## Ben Herbert- Director of Research and Environment

Ben was awarded his undergraduate degree in Environmental Chemistry from Lancaster University in 2001. Following the award of his PhD in 2005 he undertook a number of business development and consultancy roles which focused on commercialising activity in the chemicals and environmental technologies sectors.

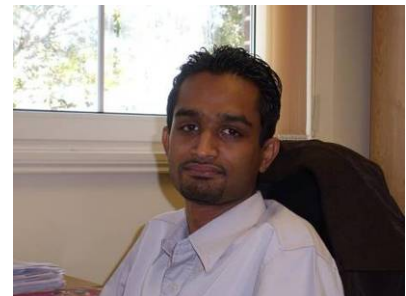
Ben joined Stopford Projects Ltd in 2008 and successfully developed a new R&D and environmental consultancy arm of the business. Ben now leads Stopford Energy and Environment Ltd, delivering green technology, waste, energy generation and low carbon projects in the UK and overseas. Ben aims to continue expanding the company's capabilities in the energy and environment sector inline with group strategy.



## Vajira Wijekoon- Senior Process Engineer

Vajira Wijekoon joined Stopford Projects Ltd as Process Engineer in 2007 and is currently working as a Senior Process Engineer. He is a Chartered Chemical Engineer with a B.Sc. (Hons) in chemical and process engineering.

Within the broad spectrum of the renewable energy sector Vajira has experience of advance gasification, pyrolysis and direct combustion technologies for biomass, waste and other renewable sources. Vajira is heavily involved in Stopford's renewable energy sector projects; in particular in process development, front end design, detail engineering as well as technical evaluation of different technologies. He has experience in solid fuel conversion, fuel gas conditioning, power generation and emission control in renewable technologies.



Research and development (R&D) is a fundamental part of Stopford’s strategy that enables us to deliver innovative solutions within the renewable energy sector to our client base. Our work to date encompasses the development of novel renewable energy technologies right through to identifying commercially valuable applications for the by-products from energy generation. To this end Stopford has developed a strong alliance with Lancaster University's Environment Centre, bringing together broad industrial skills with academic excellence. Stopford is an Associate Company of Lancaster Environment Centre giving our staff access to the world class research facilities and scientific literature/databases. In addition to this Stopford has also collaborated with Liverpool John Moore's University, Leeds University and The University of Teesside on low carbon R&D projects.

Stopford has an extensive range of capabilities in the development and delivery of green technology projects. Stopford’s specialist team of scientists and engineers are well placed to assist clients in the development and validation of a broad range of low carbon technologies. Assistance can be provided at all stages of development whether it be an initial idea, proof of concept study, laboratory scale trials, process scale-up or pilot plant design. Stopford excels in the development, planning and implementation of bespoke R&D programmes. Our services, which are delivered for both in-house and client based projects include:

	<b>Initial idea</b>	<ul style="list-style-type: none"> <li>• Desk based consultancy</li> <li>• Market research</li> <li>• Funding identification</li> <li>• Funding application assistance &amp; guidance</li> <li>• Feasibility studies</li> </ul>
	<b>Proof of Concept</b>	<ul style="list-style-type: none"> <li>• Market assessments</li> <li>• Technology, trials, validation &amp; assessments</li> <li>• Feasibility studies</li> <li>• R&amp;D programme development</li> </ul>
	<b>Pilot Plant</b>	<ul style="list-style-type: none"> <li>• Technology validation</li> <li>• Design</li> <li>• Construction</li> <li>• Process optimisation</li> </ul>
	<b>Scale-up</b>	<ul style="list-style-type: none"> <li>• Detailed design</li> <li>• Construction</li> <li>• Process optimisation</li> <li>• Life cycle analysis</li> </ul>
	<b>Route to Market</b>	<ul style="list-style-type: none"> <li>• Marketing</li> <li>• Market research</li> <li>• Regulatory reviews</li> <li>• End-user identification</li> </ul>

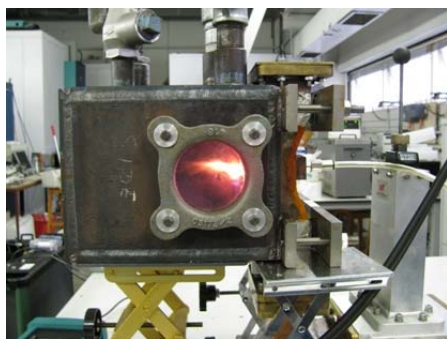
## Case Studies

### Microwave Plasma Gasification Technology

Stopford in partnership with Liverpool John Moores University has developed a novel plasma gasification technology using highly efficient microwave induced plasma as an alternative to DC plasma torches. The scheme, supported by the Technology Strategy Board's (TSB) Carbon Abatement Technology (CAT) competition, has many advantages over conventional plasma gasification technologies:

1. It can be generated using significantly less energy compared to that of conventional technologies. This results in a much reduced parasitic load on the plant, serving as a real opportunity to improve the efficiency of advanced gasification processes.
2. The technology has a significantly lower CAPEX compared to conventional DC plasma torches and as such makes plasma gasification a commercially viable option for smaller scale systems.
3. The torches have a significantly longer operational lifespan compared to that of conventional DC plasma torches, resulting in extended periods between plant shutdown and maintenance.
4. The application of microwave induced plasma significantly reduces the footprint of such high-temperature gasification systems making the technology suitable for smaller regional based projects and specialist field deployment.

The operational pilot reactor is currently being used to conduct gasification trials with a number of waste streams including municipal solid waste, refuse derived fuel, commercial and industrial waste and biomass.



## PhD Studentship in Plasma Gasification Technologies

Stopford secured a prestigious 3.5 year CASE PhD Studentship, in partnership with Lancaster University's Environment Centre, to investigate Plasma Gasification in the UK and the opportunities for Second Generation Biofuel Production. The project focuses on the suitability of waste streams and biomass for gasification, the operational performance of commercial plants, the use of synthesis gas for the production of second generation biofuels and assessment of the carbon footprint of different gasification processes.

## Assessing the Biomass Energy Content of a Mixed Waste Stream

Stopford has recently completed a research project commissioned by the TSB and DECC which saw the successful development of a  $^{14}\text{C}$  based analytical technique that provides online, in-situ measurements of the energy yield from the biobased component of mixed waste streams. Accurate quantification of the bio-based energy fraction of mixed waste is essential to enable the operators of energy from waste plants to claim ROCs from the industry regulator Ofgem.

## Biomass By-product Research Project

Stopford are currently working with academics from Lancaster University to enhance the properties of biomass ash for land application. The 12 month project is being part funded by the BBSRC industry interchange programme and aims to enhance the soil conditioning properties of an industrial waste product - biomass ash - through inoculation with naturally occurring soil bacteria. The effectiveness of the enhanced-ash product will be determined through the measurement of various parameters associated with plant health, including root length and plant mass.



## Fuel Characterisation

The characterisation of fuel is an essential stage in the development of energy from waste projects in order to determine the energy generation potential of a proposed scheme and also to identify whether a fuel pre-treatment stage is necessary. Results of fuel characterisation studies are also used as part of the technical due diligence process to identify candidate energy recovery technologies and also to determine opportunities for commodity recovery through front-end fuel processing.

Stopford's consultants have been involved globally in a number of feedstock analysis studies, comprising waste characterisation (in accordance to ASTM 5231), compositional analysis (paper, plastics, textiles, inert material etc) moisture content analysis, calorific value analysis, elemental analysis and carbon content analysis. Using its laboratories at Lancaster Environment Centre and through alliance with Higher Education Institutions and contract laboratories Stopford conducts all waste characterisation projects in accordance with the relevant CEN/TS internationally recognised standards.



## Case Studies

### Feasibility of Manufacturing Waste-Biomass Briquettes

Stopford was commissioned by a client to determine the viability of manufacturing novel waste-biomass fuel briquettes for use in domestic burning or commercial scale biomass to energy plants. Stopford conducted the project two phases. The first phase included a market assessment which identified competing products and intellectual property relating to the manufacture and use of the product. The second phase assessed the technical performance of the product, availability of the waste-biomass, classified the waste-biomass according to relevant legislation, and developed a commercial model for the production and supply of the product.

## Biomass Fuel Characterisation Study

Stopford conducted a fuel characterisation study for a client that is developing a portfolio of biomass to energy plants at sites across the UK. The study assessed the performance of different biomass fuels and compared the physical/chemical properties to that of existing feedstocks. The project encompassed a suite of analytical tests including, calorific value, moisture content, ash content and elemental analysis (C,N,H,& Cl).

## FEED and Fuel Characterisation Study – Saudi Arabia

Stopford conducted a Front End Engineering and Design (FEED) study for a waste to energy plant in Saudi Arabia. It is envisaged that the plant will receive 3,000 tonnes of municipal waste per day, generating both heat and power. As part of this study Stopford executed a full fuel characterisation study on the proposed waste stream so that a preliminary heat and mass balance for the project could be established. It is anticipated that Stopford will act as Owner's Engineer for the design, build and commissioning of this plant.

## Project Feasibility

There are various considerations and assessments that should be undertaken prior to embarking upon a renewable energy project. These considerations and assessments allow a developer to establish the technical, economic and environmental viability of a project.

Through the provision of feasibility studies Stopford can fully assess the viability of an energy generation scheme. Our project specific services include:

- Waste sampling
- Fuel characterisation
- Technology / process identification
- Policy Review (ROCs, RHI, FiTs, ECA etc)
- Heat & mass balance
- Grid connection
- Site design
- Cost estimate
- Financial modelling

## Case Studies

### Waste to Energy Technology Appraisal

Stopford conducted a technology appraisal for a regional waste management company to assess the viability of their proposed waste to energy scheme. The project involved a thorough assessment of their proposed technology, waste composition analysis, a financial appraisal and an assessment into the viability of the development of a district heating system.

### Options Appraisal for AD Facility

Stopford conducted an options appraisal for a consortium of farmers who are looking to install a 250 kW anaerobic digestion facility for the treatment of their cattle slurry. The study evaluated how resultant revenue streams could be maximised by considering income arising from power and biomethane sales, energy offset savings, the award of climate change Levy Exemption Certificates (LECs), plus revenue generated through three government schemes aimed at incentivising renewable energy deployment; the Renewable Obligation Scheme; Feed in Tariffs (FiTs) and the forthcoming Renewable Heat Incentive (RHI).

### Feasibility Study for an Onsite AD Facility at Brewery

Stopford, in partnership with Strategic Energy Consulting, was commissioned by a Northwest brewery to conduct an assessment into the feasibility of using anaerobic digestion to supplement onsite heat and power demand through the processing of organic waste. The study served to assess the viability of the scheme from a technological, financial and planning/permitting perspective.

### Feasibility Study for Biomass Gasification and CHP Technology

Stopford was commissioned by a global defence company to assess the viability of using a biomass gasification CHP technology for the generation of heat and power at one of their manufacturing facilities. The study involved assessment of on-site energy demand, calculation of anticipated energy outputs from the selected gasification technology, development of a flexible financial model accounting for income streams arising from government incentives, carbon reduction calculations, a plant layout plan and a site layout plan.

## Development of a Waste to Energy Park

Stopford acted as technical consultants for a national project development company to support the development of a 200,000 tpa energy from waste park in Scotland. To date Stopford has conducted:

- Waste compositional analysis
- Refuse derived fuel (RDF) composition modeling
- Waste flow modeling
- Technical due diligence of gasification technology
- Development of materials recovery facility (MRF) and RDF production facility
- Development of a site masterplan accounting for planning consents, site constraints, technologies (AD & gasification), process flow and project phasing.



Mixed waste



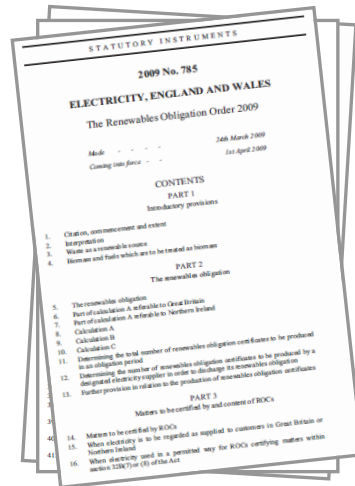
Segregated waste

Stopford’s due diligence processes are specifically designed to de-risk the development of renewable energy generation projects. Through the thorough assessment of existing and conceptual technologies, technology deployment models, government policy and policy initiatives, regulatory frameworks, contracts and financial incentives, Stopford is able to advise in a timely manner on the viability of a project from both a technical and bankability perspective.

Therefore, no matter what your role in a renewable energy project, Stopford is well positioned to ensure that you are fully aware of the specific project opportunities and potential risks associated with the development of low-carbon energy schemes. As such Stopford’s independent technical consultants can act on your behalf to identify candidate technologies for renewable energy schemes or work with you to appraise the opportunity for investment in new or existing schemes.

Our multi-disciplinary service offerings can be tailored to meet your specific project requirements:

- Technical assessment
- Technology selection
- Technology integration
- Policy review
- Financial appraisal
- Contract review
- Regulatory review
- Site considerations
- Expert Witness



## Case Studies

### Evaluation of Waste to Energy Technology in relation to RHI Eligibility

Stopford was commissioned by a US technology development company to provide an overview of the forthcoming Renewable Heat Incentive (RHI). The objective was to assess of the likelihood of their proposed novel gasification technology being eligible for reward if deployed in the UK.

## Financial Modeling of UK Energy Incentives for Innovate Technology

Stopford was commissioned by a US energy from waste company to investigate whether power generated by their novel gasification deployment model qualified, either partially or fully, for the award of renewable obligation certificates (ROCs). The study involved interrogation of the Renewable Obligation Order 2009 (ROO 2009) and liaison with industry regulators Ofgem. The study provided the client with a detailed report outlining how their technology and proposed deployment model would be considered under ROO.

## Waste to Energy Investment Due Diligence

Stopford was commissioned by an investment company to conduct a full technical and financial audit on a renewable energy company of whom they are seeking to acquire a shareholding. The study involved:

- Assessment of solid recovered fuel (SRF)
- Assessment of process flow and piping and instrumentation diagrams
- Review of heat and mass balance
- Full financial appraisal of operating model
- Assessment of the eligibility of the pyrolysis technology for ROCs
- Interrogation of all commercial contracts, including licensing agreements and power purchase agreements

## Technical Assessment of a Hydro-energy Technology

Stopford was commissioned by a green energy company to conduct a technical due diligence to assess the operational efficiency of a novel hydro-power devise. The study involved taking water flow measurements at the client's pilot plant and calculating the energy balance across the system.

## Pyrolysis of Waste Tyres - Malaysia

Stopford, on behalf of a client, undertook a survey and review of a 120 TPD continuous pyrolysis plant in Malaysia. The commission required Stopford to witness a performance test at the tyre pyrolysis plant in Malaysia. Stopford were also required to:

- Validate the plants declared capacity.
- Identify technical issues relating plant's optimum processing capacity.
- Record shortfalls in the engineering and construction of the plant that gave rise to the plant being 'unfit for purpose' for operational stability, safety, control, maintenance and reliability.
- Produce a report detailing the work required to resolve issues.



## RDF Plant assessment

Stopford was commissioned by Envirolink Northwest, on behalf of the North West Regional Development Agency, to conduct a technical and commercial review of a proposed Refuse Derived Fuel (RDF) plant to be built in the region. The project involved a detailed technical assessment of both the plant and process culminating in the preparation of a thorough report providing an overview of the technology and a recommendation relating to the viability of the project.

Stopford acknowledge the importance of regulation and legislation when developing renewable energy generation projects but also recognise that compliance can often be a complex and arduous process. As such Stopford has a variety of in house experts that can help you identify regulation relevant to your scheme and assist you with interpretation, implementation and compliance. From planning and permitting, through to health and safety considerations Stopford's expert consultants will decipher your regulatory issues and guide you to a solution.

Areas of significant experience in:

- Planning
- Permitting
- WID compliance
- Health & safety
- Construction Design Management (CDM)

## Case Studies

### Planning Application for a 5 MW Biomass to Energy Plant

Stopford is currently leading a planning application for a 5 MW biomass to energy facility in the North West of England. The consultancy has involved working with the client to gain a broad knowledge of the project scope and to develop a thorough understanding of the planning requirements of the scheme. Research was conducted into existing planning permissions imposed upon the site and an evaluation of the most suitable planning route has been considered. Correspondence with the local planning authority has been maintained throughout project development and detailed talks relating to the execution of a scoping opinion are now underway.



## Waste Horizon Analysis and Environmental Permitting Consultancy

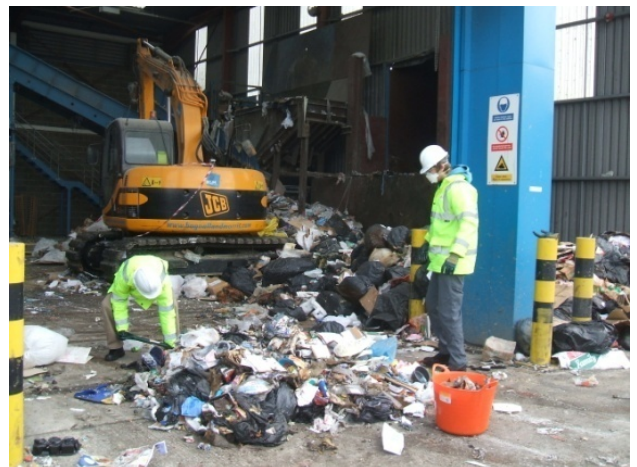
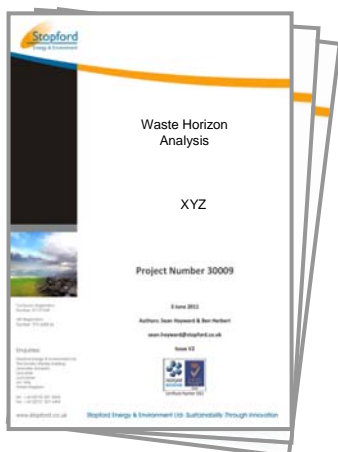
Stopford secured a contract to support the development of a novel anaerobic digestion project in the North West of England. The project was conducted in two distinct phases. Phase 1 involved the analysis of waste horizons within a 50 mile radius of the facility. Phase 2 involved the assessment of permitting requirements for the facility. The scope of work was as follows:

### Waste Horizons:

- Waste availability assessment
- Waste stream mapping
- Telephone survey

### Environmental Permitting:

- Review of technology specification
- Regulatory impact assessment
- Review of compliance to standard permitting
- Review of requirements for non standard permit application



Stopford's engineering pedigree in the process industries has enabled Stopford to develop significant expertise in the renewable energy sector. Our multidisciplinary engineering capabilities spanning process, mechanical, civil and structural, electrical and instrumentation enable Stopford to build project teams' specific to the requirements of individual projects.

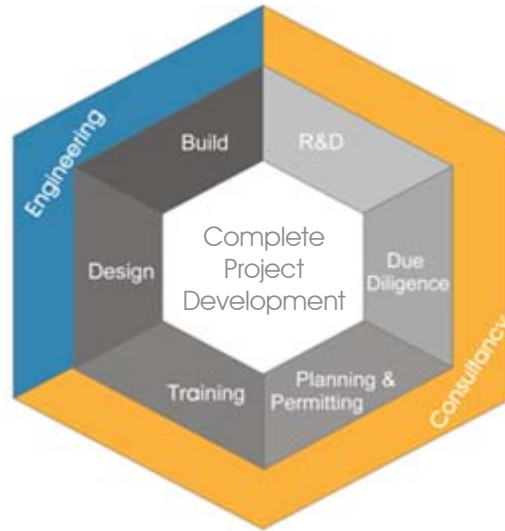
Stopford's multi-disciplinary engineering, design and project management services allow us to offer our clients the complete project service from conceptual design and site planning through to detailed design, construction, supervision and commissioning. Within this broad remit Stopford can act in various roles including

- Consultant
- Multi-disciplined engineering designer
- EPCCM
- Owners engineer
- CDM co-ordinator
- Commissioning Supervisor

## EPCCM Contractor for 40MW Plasma Gasification Facility

Stopford is currently EPCCM contractor for a 40MW plasma gasification waste to energy plant in Sri Lanka with a capital investment in excess of \$220 million. The plant will process 1 300 tonnes of municipal waste per day, which will enter the gasifier as a processed refuse derived fuel (RDF). Plasma gasification technology works by using high temperatures to break the waste stream down into an elemental synthesis gas (H<sub>2</sub> and CO) and a solid waste vitrified slag. The synthesis gas generated in the Sri Lankan plant will be used for electricity production. However synthesis gas, produced at other plants, can also be used as an intermediate for chemical synthesis or as a precursor for the production of second generation biofuels. The vitrified slag is an inert glass which can be used in a number of applications ranging from tile manufacture to a construction filling material.

Stopford provides consultancy and engineering services to its renewable energy clients throughout the complete lifecycle of projects spanning, feasibility, technical due diligence, financial appraisal and regulatory compliance right through to engineering design, construction and plant commissioning.



## Case Studies

### Development of Bioliq Energy Generation Facility

Stopford are currently assisting a client in the development and installation of a 5 MW bioliq energy generation facility in the Northwest of England. The facility will convert virgin and waste vegetable oils into electricity and heat. Stopford are currently acting as development consultants to the client, providing advice on technology selection, planning and permitting and developing site layouts. Once the initial regulatory barriers are navigated Stopford will then become Owners Engineer for the design and build of the facility.

### Portfolio of Biomass to Energy Projects

Stopford has been appointed as the client’s Owner’s Engineer for the development of five biomass fuelled power plants. The client’s portfolio totals ca. 60MWe in size, with four plants located at UK ports and one located in-land. As part of this project Stopford conducted a biomass fuel characterisation study, a technology assessment/selection exercise, and heat and mass balances for each of the plants. Stopford also provided design consultancy for the site layouts and developed commercial models for plant operation.



Stopford has led the development of a professional renewable energy course entitled 'Postgraduate Certificate in Energy & Fuels from Waste'. The course has been developed in partnership with Lancaster University and Peak Associates and aims to address the skills shortage identified in this rapidly evolving sector. Delivery of the course follows a broad curriculum which covers the financial, technical, operational and regulatory aspects of industry. The course is aimed at new entrants and experienced practitioners alike and has provisional accreditation by the CIWM.

The course is packaged into three modules, each delivered in a 'CPD-style' in just three days. The three modules, which cover all aspects of the EFW industry, are delivered in consecutive months. Each module features site visits to operational facilities in the NW region, with presentations delivered by some of the sector's leading industrial, academic and regulatory experts.

Module 1: Feedstocks and Technologies for Energy & Fuel Generation

Module 2: Management of Energy & Fuel Generation Project

Module 3: Environmental Management of Waste Derived Energy Generation

The next course will be delivered 10-12th January 2012, 7-9th February and 6-8th March. For further details please visit the course website [www.lec.lancs.ac.uk/effw](http://www.lec.lancs.ac.uk/effw)



Post Graduate Certificate in  
**Energy & Fuels from Waste**