



# **Gasification Technology**

*Proven  
Energy from Waste  
Systems*



## Company History

KIV, a Slovenian company, was founded in 1947. The factory is located in the small town of Vransko in the centre of the country with excellent road links.

Fossil fuelled boilers used to be the mainstay of production, then in the early 1980's KIV commenced the design and manufacturing of biomass boilers, supplementing existing product portfolio.

Increasing demand for higher output biomass boilers has now displaced the manufacture of fossil fuelled boilers.

This long biomass experience has given KIV over thirty years of operational knowledge and experience for continuous improvement in fuel handling, air cooled step grates and ash handling.



Typical biomass walking floor



2MWth Biomass boiler

## KIV - Gasification

Nearly twenty years ago, KIV commenced R&D into gasification and oxidation, starting with several pilot test plants. The first five years of pure R&D into gasification led to successful commercial bespoke EfW plants being designed and built for clients with specific fuel/waste requests. These early EfW plants used separated two stage process chambers as discrete components.

In this evolved design of gasification, the first stage is where 'syn' gases are created. The energy left in these gases (methane, hydrogen and carbon monoxide) then becomes the fuel to achieve the high temperatures in the secondary chamber (oxidation), by careful controlled addition of tertiary air, completing the process often called 'close coupled' gasification.

It simply and cleverly satisfy's the first requirement of the stringent EU law to hold the gaseous products of thermal treatment above 850°C for 2 seconds, without the need for supplementary use of expensive fossil fuels, sometimes called thermal treatment. The other two requirements, flue gas cleaning and Continuous Emission Monitoring (CEM), complete the legislation.

KIV ensure their plants are designed with the highest efficiency, so that based on the EU Waste Framework Directive (WFD), the plants can be deemed to be 'Recovery' plants.



Pilot Gasification Plant for testing wastes / fuels at Vransko.

## KIV - Experience and Provenance

### R&D and Engineering Resource

KIV's long biomass experience coupled with the incorporation of the latest developments in computer control (SCADA), transducers and variable speed drives has enabled KIV to take the bold step of integrating 'close coupled gasification' into a single module process design, encompassing the primary and secondary chambers, thus saving space and reducing costs whilst making for a more elegant solution.

KIV never rest on their laurels, and further R&D into EfW is envisaged into the foreseeable future, to ensure the plants achieve continuous improvement with much better standards than the current and future legislation is expected to require. This will help to 'future proof' KIV WID Compliant plant.

KIV recruits well qualified and talented young staff to work besides and learn from the existing experienced team of Engineers and Project Managers, similar to apprenticeships. KIV therefore has set up strong foundations upon which to encourage future developments and continuous improvement.

### Bankable Technology

From all the foregoing, KIV have the track record going back over thirty years of steady growth and continuous product development. Returning customers realise the robustness, reliability and efficiency of KIV plants. In the present financial climate, KIV are able to provide that 'bankability' which is paramount to reduce risk for investors.

### References

Many of the biomass plants KIV have provided in Europe, have been for District Heating schemes, where robustness, reliability and efficiency are paramount.

Below is a more relevant selection of larger KIV Biomass and Gasifier (EfW) plant from the main list of over 330 (available upon request), showing the unrivalled provenance for their proven technology in Biomass and Energy from Waste projects, this provides the confidence and comfort in KIV's ability to design, install and commission large EfW schemes using more than one line.

### KIV reference excerpt for larger & WID Compliant Gasifiers and Biomass boilers

Year	Type	Project	Country	Plant Scope	Fuel	Capacity kW	Throughput TPA
1995	EfW	Nordhalben	Germany	WID Turnkey	Soft car parts (polymers)	1,700	2,400
1997	Biomass	Mindleheim	Germany	WID Furnace	Wood Chips	18,000	52,000
1999	Biomass	Leoben	Austria	Furnace/Boiler	Wood Chips	10,000	28,800
2000	EfW	Gradec	Slovenia	WID Turnkey	Soft car parts (polymers)	2,800	4,000
2001	EfW	Begunie	Slovenia	WID System	Mixed Factory Waste	1,200	2,400
2001	Biomass	Altusried	Germany	Furnace	Wood Chips	15,000	43,200
2003	EfW	Krsko	Slovenia	WID Furnace	Paper mill sludge	14,400	64,000
2004	Biomass	Altenstadt	Germany	Furnace	Wood Chips	18,000	52,000
2004	Biomass	Bohor	Slovenia	500kWe CHP	Low grade Biomass	9,000	26,000
2004	Biomass	Zelezniki	Slovenia	600kWe CHP	Low grade Biomass	8,000	23,000
2005	EfW	Sisak	Croatia	WID System	Various + MSW	850	1,200
2006	Biomass CHP	Sulzbach	Germany	WID 4.6MWe CHP	Low grade Biomass	22,000	70,000
2008	EfW	Celje	Slovenia	WID 2.1MWe CHP	RDF + Sewage Sludge	18,000	37,000
2009	Biomass	Stamproy	Netherlands	CHP 52 Barg	Wood Chips	12,500	36,000
2010	Biomass	Hrast	Croatia	CHP 40 Barg	Wood Chips	18,000	52,000

# KIV - Celje EfW Gasification CHP Plant

KIV won the turnkey contract to build the Celje Energy from Waste (EfW) plant under a competitive EU tender for the city of Celje and surrounding districts in Slovenia. The complete new waste treatment facilities comprise kerbside recycling, Eco Islands, a picking station with baling machinery, MBT and EfW. The remaining MSW goes through a MBT facility, where loose RDF output from the residual waste becomes the fuel supplying the KIV EfW plant. Additionally belt pressed sewage sludge is mixed into the RDF just prior to being fed into the KIV capacity gasifier.

The waste treatment plants (MBT + EfW), are designed to cope with the waste from up to 240,000 people across 24 Municipalities. The plant has been designed to divert the waste away from landfill. It is a town / city sized solution, only requiring short waste shipments thereby minimising carbon footprint.



The mixed RDF (80%) and Sewage Sludge (20%) has a combined net CV of 13.6MJ/kg. With this CV the 18MWth capacity gasifier plant is capable of handling up to 37,000 tpa, based on guaranteed operational hours of 7,800. 15MWth of high pressure superheated steam produces 2.1MWe of power as it passes through a steam turbo alternator. The plant is 'heat led' and feeds the recovered energy of up to 13MWth into the existing District Heating scheme as hot water at 110°C.

In the UK, this size plant would be optimised to generate more power, 4.2 MWe Gross to comply with the EU Waste Framework Directive, to be deemed a 'Recovery' plant.



*KIV gasifier- heart of the Celje plant*

## KIV - EfW fuel flexibility and Capacity

### WID Compliant plant sizes

KIV's proven WID Compliant process module design has been increased in size and the present safe maximum capacity for a single line is 25MWth (90GJ) input capacity, guaranteed for 7,800 operational hours per annum.

KIV - Multi Modular plants, single line sizes:- 12.5, 15.0, 18.0, 21.0 & 25MWth (45 to 90GJ) input capacity per line. Sized to the local residual waste arisings. Competitive and less carbon intensive than 'Mass Burn'.

### KIV EfW plants have wide fuel flexibility, between 8 & 24MJ/kg

#### Example plant configurations

Plant Size MWth	Fuel	Typical Net. CV MJ/kg	Gross power MWe	Annual throughput tpa
1 x 12.5	C&D Waste Wood	12.0	2.50	29,250
1 x 21.0	Refuse Derived Fuel (RDF)	16.0	4.60	36,900
1 x 25.0	Municipal Solid Waste (MSW)	10.0	6.00	70,200
2 x 25.0	Municipal Solid Waste (MSW)	10.0	12.00	140,400
4 x 25.0	Refuse Derived Fuel (RDF)	16.0	24.00	175,500



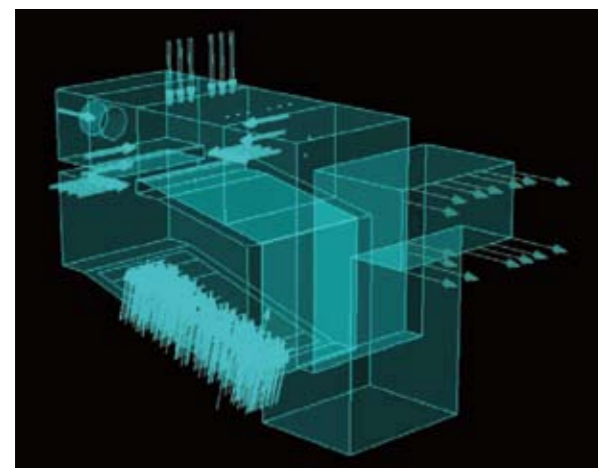
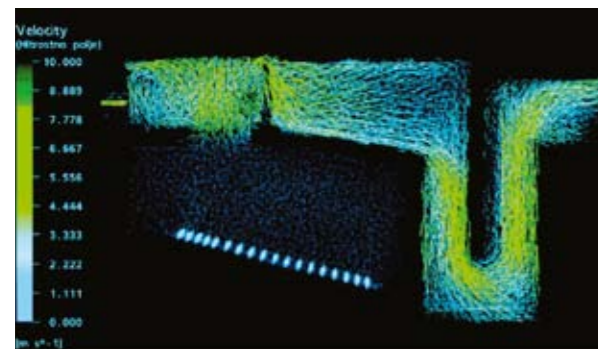
## Advancing the KIV 'Close coupled' Gasifying process module

A major stepping stone on the journey from the early days of Gasification and Oxidation using discrete separated components connected together with large insulated duct work, was the 14.4MWth Gasifying module specifically designed and installed in 2003, for the Vipap paper mill, Krsko, Slovenia. This was the first single large process gasification module design.

The plant was designed to handle up to 170 tpd of paper mill sludge, consisting of 34% ash, 33% moisture & 33% paper fibre with a very low net CV of 6.5MJ/kg. This sludge would normally have to go to landfill, at a considerable financial cost. The energy from the sludge produces steam in an existing waste heat boiler, displacing site process steam demand from fossil fuel fired boilers. The resultant high ash is very consistent and like fine silica sand which is tankered away to Italy to be mixed into the manufacture of building blocks.

No different to any other KIV plant, the process module has achieved >8,000 hours/ annum operation each and every year since commissioning.

## Examples of CFD from KIV's R&D



## That mound of waste!

They say that every picture tells a story, and that is certainly true of this picture of the KIV Vipap Gasification plant.

The experience of the running the KIV Gasifier on low CV sludge, gave the paper mill management the confidence to clean up the site which was littered with organic rubbish. The Vipap paper mill occupies a very large site and no one could remember the last time the site was cleaned up. This mound of sodden waste rubbish, including blocks of paper left out in the rain, etc., was the result.

All that was required was some coarse shredding and metals removal. Also the damp waste liberated it's energy to displace the cost of fossil fuels, so a beneficial tidy up saved fuel costs, transport and landfill charges into the bargain.

There was no waste to be seen on a return visit six weeks later. This real life example, shows the flexibility of the KIV Gasifier and air cooled step grate to deal with fuels/waste of all types, from 6.5 to 22MJ/kg, and with up to 60% moisture.



KIV gasifier during construction

This KIV supplied EfW Gasification plant for Vipap is a true 'Zero to Landfill' solution.

# KIV - Innovation and Future legislation

## Best Available Technique (BAT)

KIV always strive to ensure that BAT is incorporated into designs and take account of latest technology. For instance, to ensure the lowest NOx emissions, KIV first concentrate on optimising gasifier design, then incorporate flue gas recirculation, followed by spray injection of ammonia or urea solution into the secondary chamber, if necessary as 'belt and braces'.

For the Celje plant, a multi pod 'Mineral Fibre' element flue gas filtration plant from England was chosen, using Sodium Bicarbonate mixed with Activated Carbon to absorb acid gases, furans, dioxins and heavy metals. The filter is also excellent in virtually eliminating all particulates, including PM 10's and 2.5's.

Overall the combined flue gas abatement technologies that KIV employ make for much lower emissions than the present legislation requires, also furthers existing standards lodged at the EU BREF documents office.

## Changing legislation

KIV keep up with Government policies:-

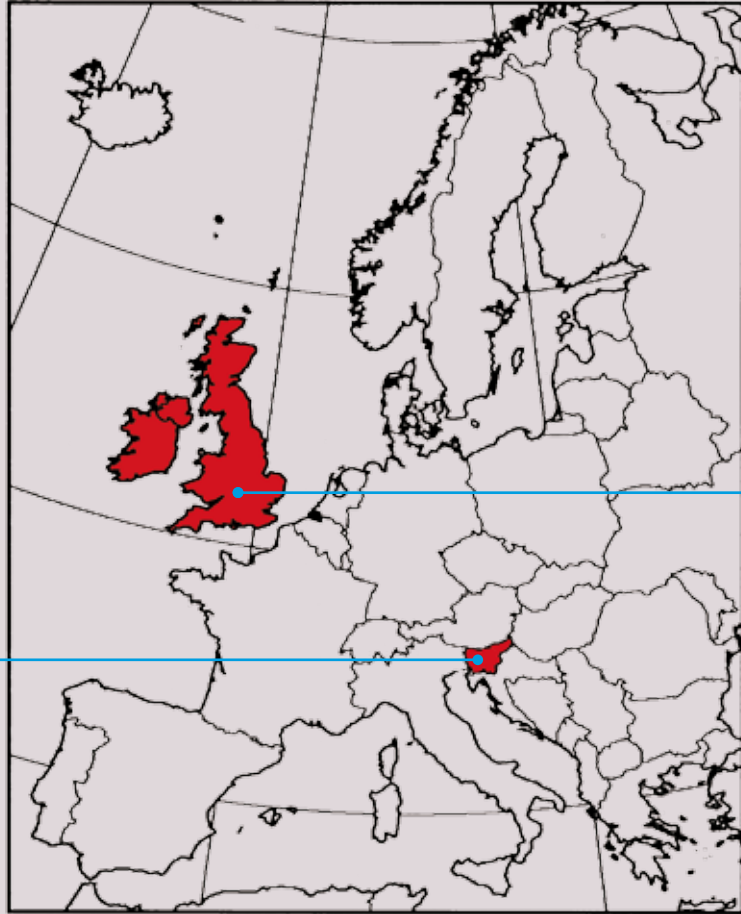
### December 2008

In the UK, the new department DECC made the ruling to clearly define 'gasification'. Standard Gasification is deemed to be where the energy in the 'syn' gases can be sampled, tested and proven to be between 2.0 and 4.0 MJ/Nm<sup>3</sup>. Whereas Advanced Gasification which attracts two ROC's is deemed to be where the energy in the 'syn' gases are greater than 4.0 MJ/Nm<sup>3</sup>. The frequency of sampling and technical details of measuring are yet to be decided upon. KIV understands the importance of this requirement and is working with clients to ensure the benefits of the ROC system can be fully exploited.

### January 2009

The EU issued the Waste Framework Directive (WFD), part of which requires EfW plants to achieve a minimum efficiency to be deemed 'Recovery' plants. KIV have stepped up to the mark and now offer high efficiency electrical generation plants for the UK when small or no heat load exists. Plant not achieving this efficiency threshold will be deemed 'Disposal' plants.





*Slovenia is in the heart of Europe, north east of Italy and south of Austria.  
KIV are based in Vransko, one hours drive east of Ljulljana, the capital of Slovenia.*



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