ENTHALPY ENERJİ DAN. TAAH. GIDA TİC. LTD. ŞTİ.
Bostanbasi Mah. Petrol Sok. No: 1 C/5
Yesilyurt / Malatya / Turkey
Tel: +90 422 290 3935
Tax Adm: Beydagi V.D. 3360572336

ENTHALPY ENERGY
ESCAPE FROM ADDICTION

NOTES FOR "7 TASKS" PRESENTATION

TASK 1	Fuel		
Availability:	Local resource of solid fuel. **For Ukraine (Kharkov reg.)**: sunflower husk non-pelletized and pellets, wood pellets, straw pellets, wood cheeps, saw dust, coal (anthracite), agricultural waste (corn ears, corn & sunflower stalks, grape-vine etc), brushwood, briquettes (sunflower husk, wood, peat) **In general:** coal (lignite), food processing waste (processed sugar sorgho, nut shell, apricot kernels, fruits' presscake etc.), tobacco waste, cotton straw, wood processing waste (bark etc), MDF (medium density fiberboard) waste, poultry waste, paper mill waste (wood pulp), "energetic herbs" (special kind of Willow, Miscanthus), peat.		**Available fuel within reasonable destination (volume, means of transport, package, distance)**
Properties:			
1) Calorific Value	**7500 – 6900 kcal/kg**	- Anthracite - Apple presscake (due to residual alcohol)	
	6900 – 4500 kcal/kg	- Coal (lignite) - MDF waste (due to residual glue)	
	4500 – 3500 kcal/kg	- Pellets - Hard wood (oak, beech) - Sunflower husk	
	≤ 3500 kcal/kg	- Other types	
2) Initial humidity (without drying)	**5% - 12%**	- Sunflower husk - Pellets - Coal	
	12% - 20%	- Straw - Agricultural waste - Wood - Peat	
	20% - 50%	- Saw dust - Food processing waste - Energetic herbs - Poultry waste	
	≥ 50%	- Others	
3) Ash content	**0.5% - 5%**	- Pellets - Wood - Energetic herbs - Straw	

	5% - 15%	- Anthracite - MDF waste - Agricultural waste	
	≥ 15%	- Others	
4) Fraction (size)	**0 – 5 mm**	- Dust coal - Saw dust - Processed sorgho - Sunflower husk	
	5 – 20 mm	- Anthracite - Pellets - Wood cheeps - Nut shell	
	≥ 20 mm	- Others	
Price	Price depends on several factors: - Origin & availability - Properties - Competition		

Example 1: Ukrainian (Kharkov) situation:

Fuel	Distance	Volume	Price	Package	LHV	Transport cost
Sunflower husk	100 km Truck	20-50 ton	20€/t	bulk	3500	20€/t
Sunflower pellet	100 km Truck	10-30 ton	65€/t	Big-bag, 35 kg bag	3700	9 €/t
Saw dust	200 km Truck	3-5 ton	20€/t	bulk	2500	25€/t
Wood	400 km Truck	10-30 ton	35 €/t	bulk	2800	40€/t
Anthracite	250 km Truck, railway	20-50 ton	100€/t	bulk	7000	10€/t
Wood pellet	500 km Truck, railway	20-50 ton	80€/t	Bulk, Big-bag, 35 kg bag	3000	60€/t
Straw	100 km Truck	10-20 ton	40€/t	bale	2500	15€/t

Example 2:	**"Free fuel" projects:** **Sunflower oil processing plant** (Vinnitsa city, Ukraine) processes 1000 ton of sunflower a day. Sunflower husk is 15% of this volume (150 ton, ≈ 750 m3). Husk is the waste to be utilized. Their own consumption for 16t/h boiler is 90 t/day, the rest 60 ton is pelletized for sale. **Bioethanol Plant** (Gaisyn city, Ukraine) processes 1200 ton of sugar sorgho a day. Waste is 50% of the volume. Their own consumption (10t/h) is 75 t/day. The rest 500 ton is to be utilized as waste.	

ENTHALPY ENERJİ DAN. TAAH. GIDA TİC. LTD. ŞTİ.
Bostanbasi Mah. Petrol Sok. No: 1 C/5
Yesilyurt / Malatya / Turkey
Tel: +90 422 290 3935
Tax Adm: Beydagi V.D. 3360572336

ENTHALPY ENERGY
ESCAPE FROM ADDICTION

Example 3:	**Import fuel object:** (Somewhere) a big boiler (> 20 t/h), located near a sea port, having big storage facilities (Silo elevator of 10 000 ton). No local fuel resource (or insufficient, or expensive). Possible variant of fuel supplying: 5000 ton bulk vessel of wood pellets from China (or Canada) by sea. 110-120$/t	
TASK 2	**Combustion**	
Bed combustion on grill type grates	Suitable fuel: wood (except saw dust), coal (lignite & anthracite, fraction ≥ 30mm), straw in bales, corn & sunflower stalks, energetic herbals, briquettes, peat, fruit presscake.	**Size ≥30mm** **Melting temp. >1000°C**
Fluidized-bed combustion on reciprocating grates	Suitable fuel: practically all types except coal dust and straw in round bales	
Stocker burner combustion	Suitable fuel: pellets, small fraction (5-30mm) coal (except dust), wood cheeps (except saw dust), crushed agricultural waste, nut shell	**No dust fuel,** **Humidity ≤20%**
Circulating fluidized bed combustion	Suitable fuel: dust coal (except anthracite), small fraction biomass + coal (70/30), poultry waste + coal (70/30)	**Fraction ≤8mm** **Humidity ≤20%** **LHV ≤ 6000 kcal/kg**
TASK 3	**Type**	
Fire tube manual feeding grill combustion	**Disadvantages:** Clock round staff presence, hand labor, low level of automation, manual ash removal, significant human factor, low efficiency, limitation of heating capacity (≤ 1000 000 kcal/h), only low pressure steam, narrow setting range of capacity (60-100%) **Advantages:** low price, significant competition among manufacturers (wide choice), simple designing & installation, wide range of usable fuels,	
Fire tube automatic feeding stocker type	**Disadvantages:** limitation of steam capacity (usually ≤ 10 t/h), limitation of fuel fraction (usually ≤ 50mm), limitation of fuel types (pellets, nut-coal, wood cheeps, nut shell), limitation of fuel humidity (usually ≤ 20%), only low pressure steam, significant contamination of fire tubes while dusty biomass burning, narrow setting range of capacity (50-100%), bad repairability. **Advantages:** competitive price for the most part of manufacturers, significant competition among manufacturers (wide choice), simple designing & installation, sufficient automation (automatic ash removal, pneumatic tube cleaning), high efficiency, fragmentary human factor	

Hybrid type automatic feeding (RG or Stocker)	**Disadvantages:** limitation of steam capacity (usually ≤ 20 t/h), limitation of fuel fraction (in case of stocker system), limitation of fuel types (in case of stocker system), only low pressure steam, significant contamination of fire tubes while dusty biomass burning, non-compact design (dimensions), narrow setting range of capacity (50-100%), bad repairability. **Advantages:** competitive price for the most part of manufacturers, competition among manufacturers (sufficient choice), sufficient automation (automatic ash removal, pneumatic tube cleaning), high efficiency, fragmentary human factor	
Water tube Moving grates horizontal	**Disadvantages:** limitation of steam capacity (usually ≤ 50 t/h), significant contamination of convective surface while dusty biomass burning (short inter-maintenance period), non-compact design (dimensions), high price, insufficient competition among manufacturers, problematic burning of dust coal **Advantages:** high level automation, high efficiency, minimal human factor, wide setting range of steam capacity (30-100%), long life-period, good repairability.	
Water tube Moving grates vertical (MIMSAN type)	**Disadvantages:** high price, insufficient competition among manufacturers, problematic burning of dust coal **Advantages:** highest level of automation, high efficiency, minimal human factor, wide setting range of steam capacity (25-100%), long life-period, compact design, wide range of models by capacity (4 – 100 t/h), almost all types of fuel are acceptable for burning, long inter-maintenance period (4 months), good repairability, boiling house is not compulsory (outside installation), short assembling period due to modular design, high-pressure co-gen mode (up to 90 bar).	
Water tube Fluidized-bed vertical (MIMSAN type)	**Disadvantages:** high price, insufficient competition among manufacturers, limitation of fuel by size (0-8mm) **Advantages:** highest level of automation, highest efficiency (92%), minimal human factor, wide setting range of steam capacity (25-100%), long life-period, compact design, wide range of models by capacity (10 – 100 t/h), long inter-maintenance period (4 months), good repairability, boiling house is not compulsory (outside installation), short assembling period due to modular design, high-pressure co-gen mode (up to 90 bar), best solution for coal burning.	
TASK 4	**Engineering**	
Local peculiarities	1) Local Construction & Building norms: Weather conditions – snow, winter, rain loads. Spot ground conditions – geodesic front-end engineering. Important for boiling house designing. Can influence on the total project's cost due to different construction materials (concrete basement etc.) 2) Local engineering and designing norms: **Ukrainian example 1**: to design a chimney's height it is	

	necessary to appeal to the Local Sanitary & Epidemiological Station which issues the local wind diagram and indicates so called "atmospheric dispersion point" – the height of chimney permitted for the certain site of boiler's installation. **Ukrainian example 2**: to indicate dimensions (square) of a boiling house where a solid fuel boiler (f.e. stocker type) is to be installed it is necessary to design at least 3m empty distance between the boiler's front side and the boiling house wall. This norm is in power since 1978. The sense of it is to be able to mix burning fuel inside the boiler by manual fire hook. Even if the boiler has automatic feeding from the rear side the norm is working… 3) Local ecological norms: It may differ very significantly depending on the Country of installation. **Ukrainian example:** SOx pollution norm in Ukraine is 250 mg/m3. This is significantly severer than Turkish, German or Singapore norms. While using coal for a boiler in Ukraine it is necessary to equip the boiler not only with a filter, but also with a desulfurization system (wet scrubber). 4) Local level of Corruption: Unlike European Countries Ukraine particularly (and SIC in general) has enormously overall & total corruption in State Authorities. It means significant additional expenses (undertable money) to be spent for different administrative officials while getting local permissions or approvals. 5) Local Certification: **Ukrainian example 1:** ISO, CE or other International & European Certification means nothing in Ukraine. Almost all foreign products MUST be certified in Ukraine BEFORE import. **Ukrainian example 2:** assembling & commissioning of the boilers in Ukraine can be provided only by those Companies which have all necessary local Licenses and Certification. 6) Ethnic aspects: **Russian example:** Mimsan's offer for a twin boiler (2x25 t/h) was preliminary accepted by one of Russian sunflower processing plants. But the Contract was refused by the owner of this plant just because of the ethnic reason. The owner is an Armenian person who hates Azerbaijan which is the best friend of Turkey. 7) Local living standards & salary: **Ukrainian example:** due to extremely low living standard of country-side people one our customer who planned to install a boiler in a country side refused automatic feeding boiler along with its automatic fuel storage. The price difference between fully automatic and manual systems compensates him local people hand labor for 15 (!) years.	
Front-end engineering	- deep marketing of local fuel resources - professional geological & geodesic examination of the site - professional analysis of local norms & legislation - marketing of local manufacturers of building materials and auxiliary equipment (to estimate the share of import in the project) - professional feasibility study of the project	

Auxiliary equipment & accessory suppliers	- choosing auxiliary equipment oriented on the fuel-boiler-pollution basis. **Example 1**: a big steam boiler for sunflower husk burning should not be equipped with a bag filter – it is fire dangerous due to magnesium (Mg) content in the ash of sunflower husk. **Example 2:** Dust pollution in Ukraine is limited by 50 mg/m3, so only a multicyclone is not enough. There must be a filter. - Water treatment system depends on local water quality. The system's characteristics (and cost) should be selected basing on return condensate volume of the certain object. - Cost analysis of equipment: evaluation of actual cost by comparison with analogues to realize the proper price (cost ≠ price). - **Ukrainian Example:** ViOil Company (Vinnitsa city, Ukraine) purchased 10 t/h low pressure fire tube steam boiler (Italian Brand) for 1.2 million USD. The adequate cost is at least 8 (!) times less. Reasons: 1) improper type for sunflower husk, 2) no tube cleaning system (maintenance each 4 days!), 3) ESP does not work, 4) wrong design of ID fan & chimney (wrong engineering), 5) there was enough better and significantly cheaper analogues on the market (no marketing), 6) chief engineer supported the boiler's supplier for undertable money (inner corruption), 7) the Company's management did not establish the project Department with its responsible Chief (low professionalism).	**Brand and Experience are not enough factors for choosing equipment (examples: Monastyrische, Vyncke)**
Proper timing	Due to different norms & legislation among Countries it is necessary to take into account possible delays connected with project designing, certification and assembling works. **Ukrainian Example:** 1) it is possible to make local certification of a boiler while manufacturing. It is about 3 months reduction of the project's period; 2) It is impossible to start construction works without necessary State permissions (must be solved during designing); 3) It is necessary to announce the Company's intention to have a definite pollution volume in local mass-media (public consultations) at least 1.5 months before starting the assembling; 4) It is necessary to get the State permission for capital construction works before starting any early (preparatory) works. 5) Commissioning should be held along with confirmation of pollutions and the State technical inspection tests. (3 weeks reduction of putting-into-operation period). 6) Transportation and custom clearance: Ukrainian Custom Legislation requires the following "peculiar" docs to be issued before custom clearance of a	

	boiler: - UkrSEPRO Certification, - the boiler's prime cost (!) calculation from the Manufacturer, - the State Technical Inspection's Conclusion about the boiler's conformability to local norms, - the complete & detailed description of materials, design and application of the boiler, - the detailed list of equipment of each truck with photos, etc. In-time preparation of such docs can reduce the custom clearance period for 5-40 days. 7) National & religious Holidays: it is necessary to take into consideration that all State Authorities and most part of Companies follow week-ends due to National & religious holidays. **Example:** "the New Year & Christmas" holidays can continue up to 10 days in Ukraine.	
On-line contact with experts	Each stage of engineering should be approved by the certain experts (consultants). The negative consequences of local peculiarities' disregard are indicated above. Communication: Language problem. Due to low level of English among local workers and engineers the additional expenses for interpreters have to be considered. Professional consultants can solve the problem on all stages of the project.	
TASK 5	**Control**	
Fuel control	- Fuel logistics: depending on fuel volume & destination the own Transportation Department can be established. **Ukrainian Example**: Lviv oil extraction plant buys lignite coal for their 20 t/h boiler. The coal supplier is 200 km far from the Plant. The only delivery terms are EXW. The Contract for coal supplying is a long period one (5 years). The plant has purchased three trucks (2 main, 1 auxiliary) specialized for coal bulk transportation. The fuel logistics' cost cutout due to using own trucks is equivalent to 40% annual fuel volume they use. Besides the plant gives 1 truck in rent that gives the profit equivalent to 4% of their annual fuel volume. 44% cost reduction for fuel is achieved by establishing of their own fuel transportation department. - Automatic storage of fuel: in case of fuel consumption bigger than 300 kg/h it is necessary to arrange some automatic storage & feeding facility. Especially it concerns those fuels which are sensitive to environmental factors (humidity, temperature): pellets, saw dust, straw, sunflower husk, peat etc. Also such necessity depends on the boiler's size and type. **Turkish opposite example**: Oyka Paper mill (Zonguldak city) has 35 t/h high pressure (60 bar) RGB boiler. The fuel is biomass (wood processing waste + food industry waste). The fuel storage is the "open-air" out-door type. The average humidity of fuel – 50-55%. The feeding from storage to the boiler is made by front loaders. It is possible just because of the boiler's ability to burn such wet fuel. Types of storage facilities:	

	1) silo types bunkers with pneumatic (or other type) transporters (sunflower husk, powdered straw, saw dust, pellets); 2) moving floor bunkers (wood cheeps, crushed sunflower & corn stuck, crushed sorgho & sugar cane, energetic herbs - Miscanthus) 3) Underground area with front loaders and hoppers (coal, dust coal) 4) Stocker with turners (mixers) for small & middle size stocker boilers (pellets, wood cheeps, sunflower husk)	
Combustion Control	The efficiency of a boiler (along with the prime cost of steam or heating energy) depends on process of combustion. The boiler's control system should have functions to control all aspects of burning. The ideal control system has a programmable controller (PLC). The controller should take signals from the outer sensors (must be available) and control invertors on motors (must be available). At the best case the following functions should be available and controlled: - primary & secondary air fans for combustion (invertors); - recuperator air & gas temp. sensors - ID fan (invertors) + vacuum sensor - Fuel feeders (invertors) - All sensors & transmitters dedicated to steam characteristics (temp, pressure) - Feed water sensors & transmitters (level, temp., pressure, quality) - All transporters (invertors) - Ash removal transporters (invertors) - Soot blowers - Combustion chamber temp. sensors - Automatic surface &bottom blow down valves - Fuel bunkers' level sensors - Fire alarm Besides it is desirable to have such devices as fuel humidity sensor, steam flowmeter, lambda sensor, feed water quality control.	
Pollution control	While the ideal combustion for the certain fuel is achieved the pollution control will depend on the filtering facilities available. Local Ecology Legislation regulates the type of filter to be used for certain boiler while burning the certain fuel. **Ukrainian example:** Interkorn Corn Processing Plant (Dnepropetrovsk city) is going to install 30 t/h CFB boiler to burn dust coal. The plant is located only in 200m from a big 9-floor apartment house. They will use not only dry desulfurization (10% lime stone content in the fuel) and ESP, but also a wet-scrubber. It is connected with Ukrainian pollution norms (SOx ≤ 250 mg/m3, dust ≤ 50 mg/m3).	
Staff Control	Even if a boiler is maximally equipped with automatic control systems and the fuel storage & feeding facilities are up-to	

	date the human factor can not be eliminated for 100%. It means an object must have sufficient quantity of staff and the staff must be properly trained. Such document as the Boiler Parameters Chart is to be developed during the boiler's commissioning and staff training in cooperation with Chief Energy Engineer and Operation Department of the Company. The number of staff also depends on the Local Labor Legislation. For example the same boilers in Turkey and in Ukraine have different staff (Ukrainian has app. double staff). When it is possible to use some option which can eliminate even a small part of human factor it is desirable to use it (of course price factor matters). **Ukrainian example:** Kiev Private University installed 1000 000 kcal/h hot water pellet boiler (stocker type). Pneumatic tube cleaning system was an option (not installed). The price of the system was app. 5 000 Euro. It was equal to 2 operators' salary for 10 months. They used low quality wood pellets with app. 15% dust content. The staff of the boiling house was insufficient for hard manual labor. The result: each 2 days they had to stop the boiler for several hours to clean the tubes manually by a self-made device (brush) because due to contamination of tubes the boiler's efficiency dropped down from 85 to 50%. The temperature mode in the University students' hostel was broken. Foreign students (especially from Africa) complained to their Embassies. The University had to decrease the study's fee to meet such claims. The overall penalty losses of the University for 6 moths period was 45 000 Euro. Some people (like most part of Ukrainians) should have financial (or material) or even legal responsibility for neglect of duty while they are staff crew. Instead of Chinese people their level of self-discipline is very low (especially it concerns people older than 40 who started their working activity during Soviet or post-Soviet period). It means the necessity of quite cruel inner working regulation is to be developed by the Company's Management where the boiler is to be installed. At most cases only financial penalty is able to keep the staff from neglect at their positions. Besides it is always necessary to remember that a steam boiler is a potentially dangerous explosive object.	
TASK 6	**Team**	
	The diagram shows the general direction of working relations between project's team members. The extent of responsibility of the positions is indicated vertically from top downward. The Responsible Project Manager is the top and most important person who is a critical link to everyone indicated. At a time each position can appeal not only to the Top Manager but also to any specialist needed. Each position's area of expertise grows corresponding from top downwards. Consultants are indicated at the bottom because they have the smallest responsibility (their job is just giving advices) but the widest are of expertise (to be able to advise all upper	

	positions). The number and the exact names of positions may differ depending on certain definite project.	
TASK 7	**Balance**	
	To make the right choice for solid fuel project it is necessary to take into consideration all above mentioned factors. The analysis of equipment should not be based on a famous Brand-name or on a huge reference list. **Ukrainian example:** Monastyrische Boiler Plant (Cherkassy reg.) has 50 years history, several thousand installations all over CIS, the lowest price ever. BUT the boilers have 50 y.o. design, ≤ 50% efficiency, the worst quality materials & labor. 90% of installations were made during Soviet period when quality-function-price balance was not considered at all due to so called "State-planned economy". **European example**: Vyncke Company (Belgium): 126 years of experience. One of the most famous boilers' manufacturers in the World. Everything is perfect except price. The price 2-3 times exceeds the real cost. The main parts of Vyncke boilers were produced at Mimsan within 2008-2013. But the Company was keeping this information in a secret from customers. Advantages of Vyncke boilers in comparison with Mimsan ones (if any) can not cost double or triple. Overpayment is connected only with Brand-name. ***The tight cooperation with experts & consultants along with all above mentioned instructions can guarantee really cost effective high-efficient and trouble-free solid fuel solutions wherever & whenever they are to be arranged.***	