# Alternative Fuels Strategies and Key Success Factors: Global Experience

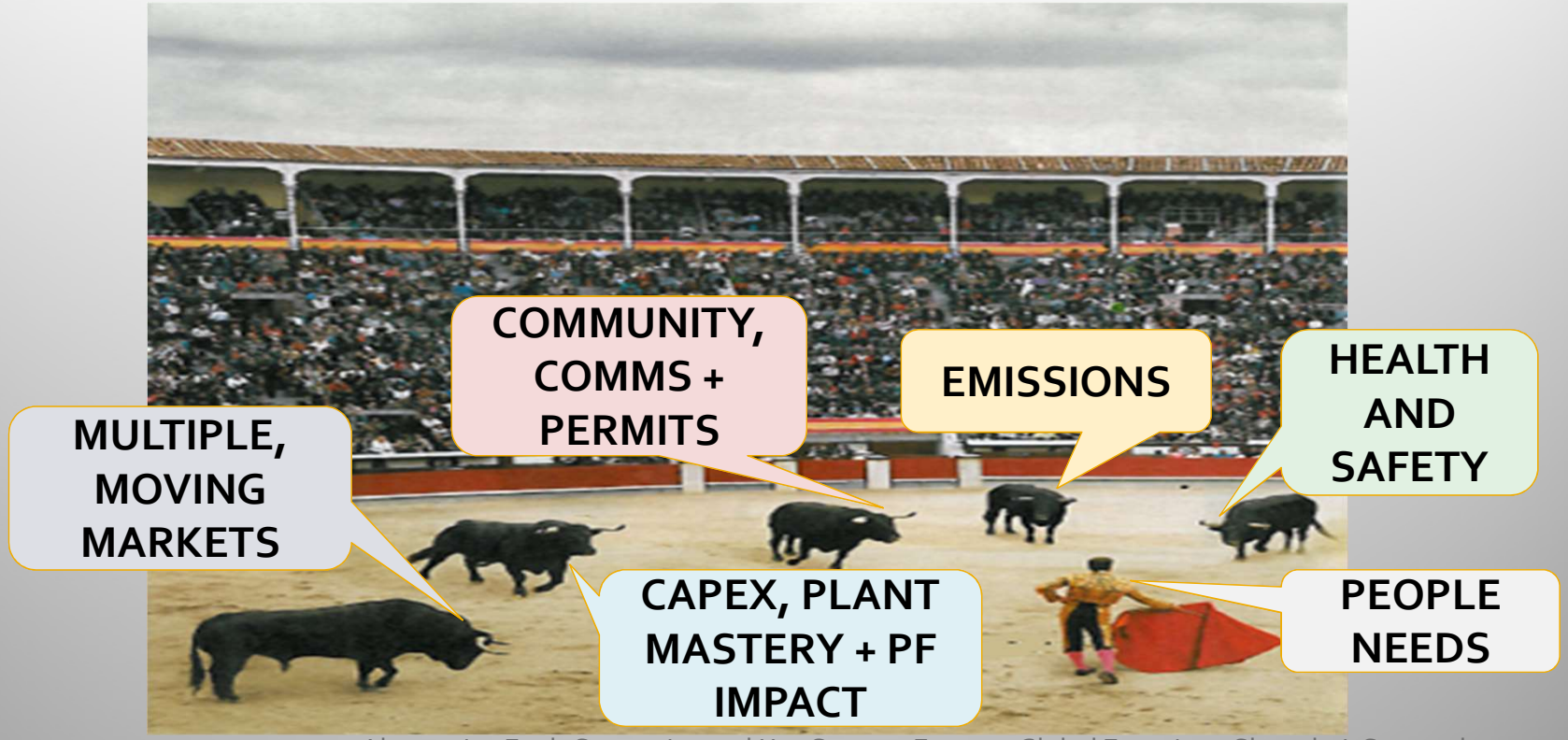
Peter Hoddinott

# ALTERNATIVE FUELS: MULTIPLE WINS

- **WIN #1** = Reduce use of scarce natural energy resources
- **WIN #2A** = Divert waste streams from landfills and…
- **WIN #2B** = Kiln Hi-temp, long residence, turbulent environment => v high % destruction
- **WIN #3** = More competitive cement plant

- **BUT**…Some Challenges…

# ALTERNATIVE FUELS: CHALLENGES…SOME OF THEM



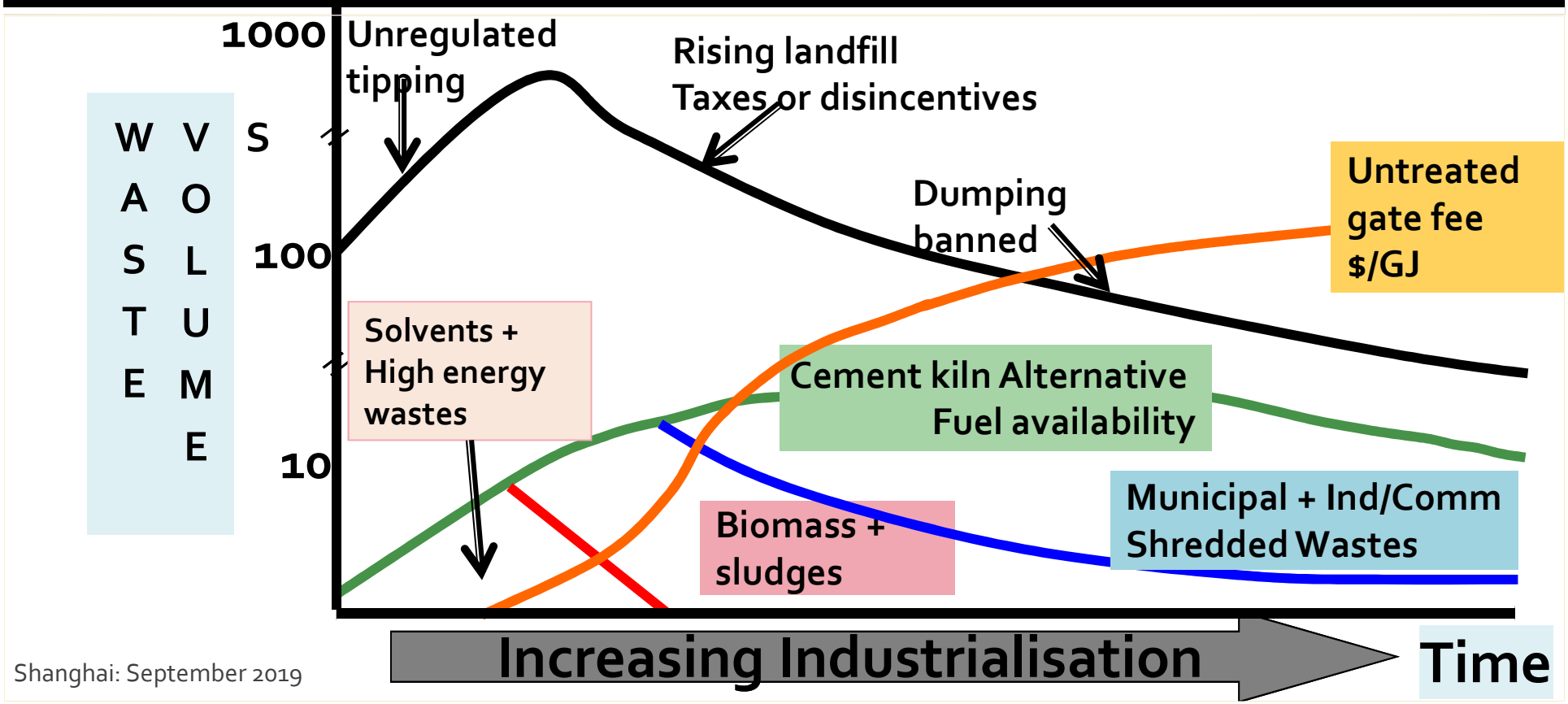
# ALTERNATIVE FUELS CHALLENGES 1

## MULTIPLE, MOVING MARKETS

# MULTIPLE MOVING MARKETS

- Rice husks, Tyres, Municipal/Commercial/Industrial Wastes; Bagasse, PKS, Carbon Black, Animal Meal, Sewage Sludge, Spent Pot Liners, Used Oils, Chicken Litter, Pig waste…List is Endless…
- Availability moves with Competition + Industrialisation…

# ILLUSTRATIVE WASTE TRENDS VS INDUSTRIALISATION




Shanghai: September 2019

# MANY FORCES IN PLAY

- Regulators, Politicians and Society
- Competitors:
  - Incinerators
  - Recyclers (Formal/Informal)
  - Power Generators
  - Specialist Waste Management Companies AND…
  - Other Cement Companies…
- Waste Producers' Efforts to Reduce Costs + Volumes
- ALL COMBINING TO MOVE PRICES…PLUS VOLUME VOLATILITY

**HOLY GRAIL = FUEL FLEXIBILITY/MARKET ADAPTABILITY**

# SOURCING STRATEGIES FOR SECURITY OF SUPPLY

- Deep understanding of players + each waste stream
- Long-term supply contracts to justify investment
- Be prepared to move upstream to collection/treatment to secure source + capture value => need reputable partner(s)
- Be open to value-sharing JVs with waste generators
- Innovate in drying and shredding for "difficult" wastes
- Invest for fuel flexibility => absorb market movements

# AF SOURCING INNOVATION

**Some markets (eg parts of Asia, Sub Saharan Africa) have little high CV waste. What to do?**

# AF SOURCING INNOVATION #1

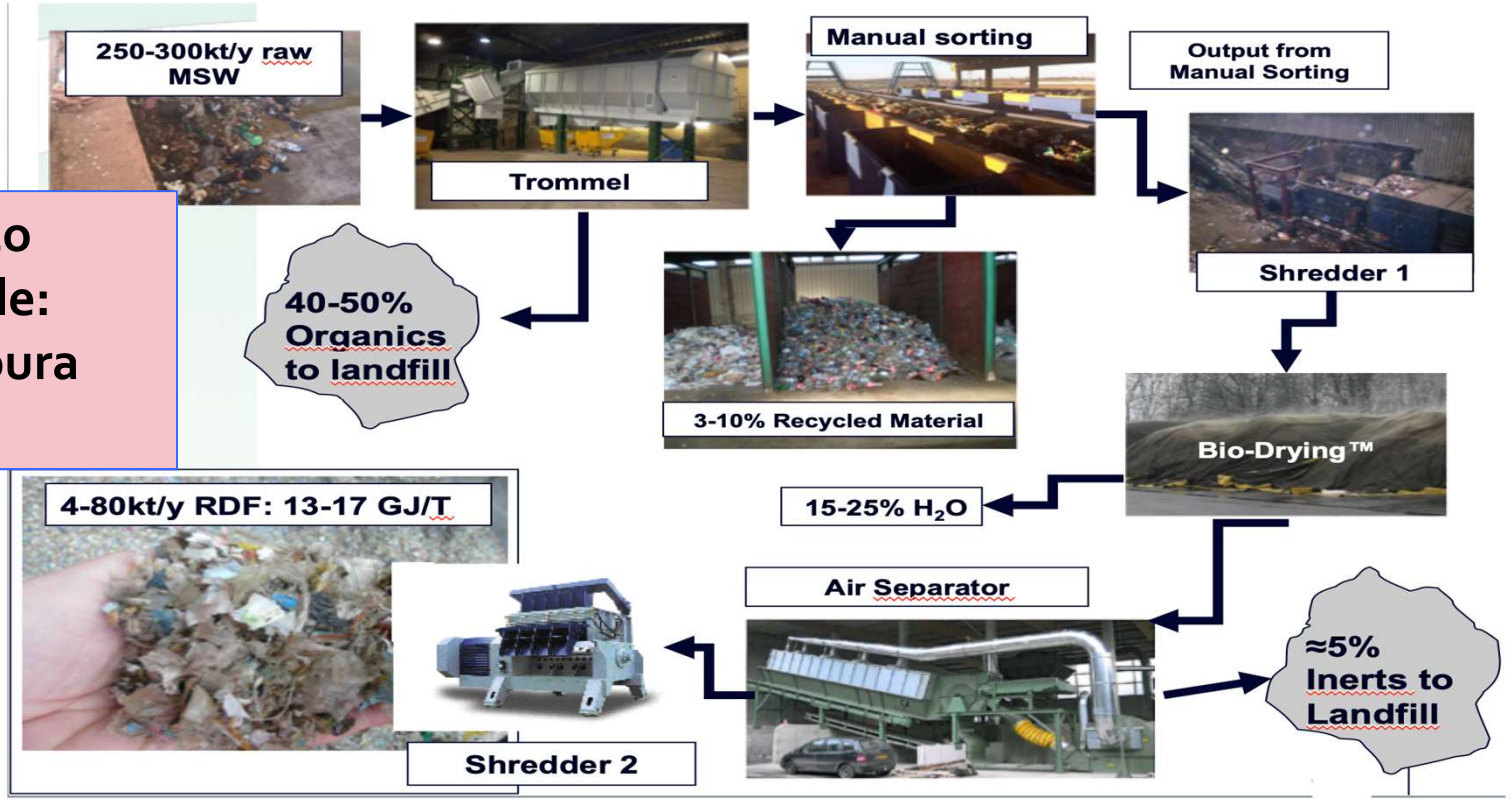
**Turn Focus to widely available waste streams:**

- **Sewage sludge* 10-30kg/capita/y**
- **Municipal Waste* (post "picking") ≈7Bt/y**
- **Mining "Old" Landfills**
- **Agricultural wastes…**

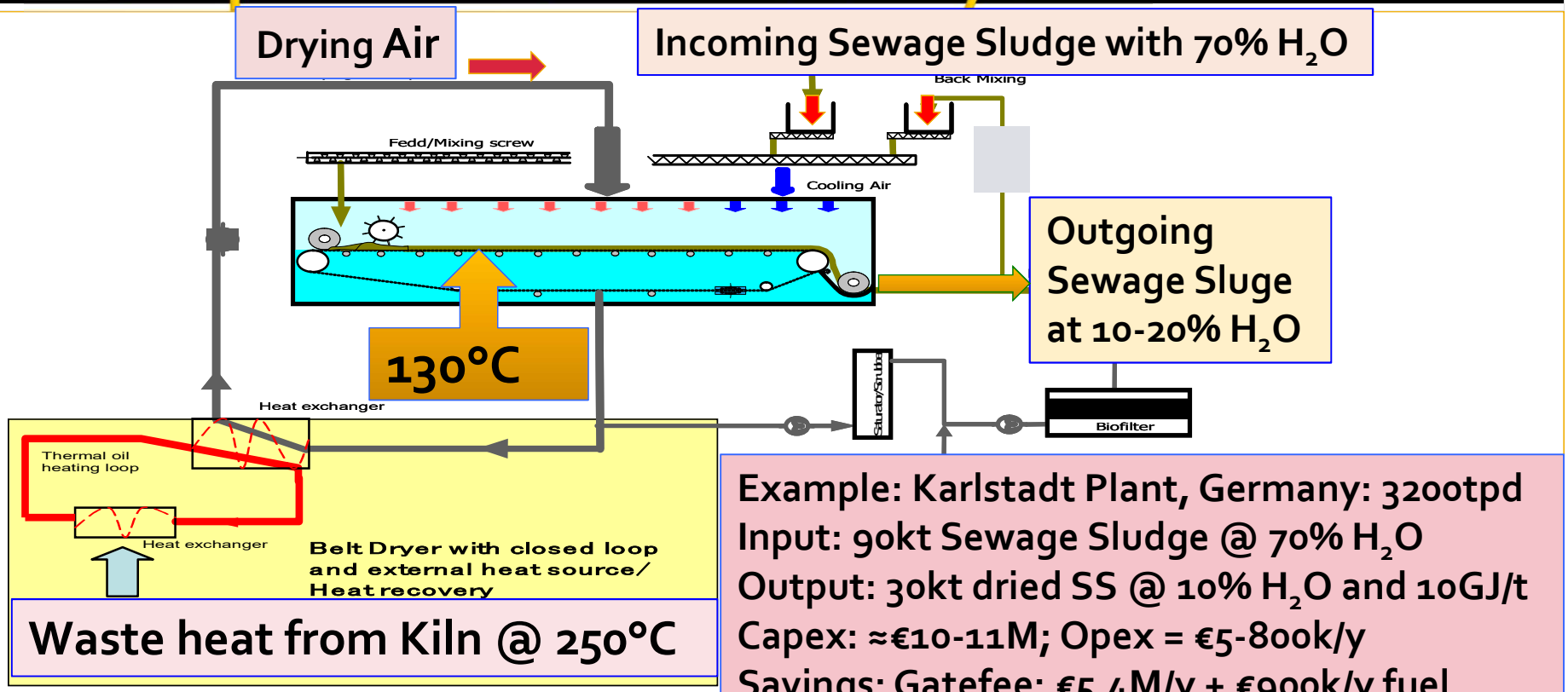
***Ref: "International Best Practices for Pre- Processing and Co-Processing Municipal Solid Waste and Sewage Sludge in the Cement Industry" July 2012***
*Ali Hasanbeigi, Hongyou Lu, Christopher Williams, Lynn Price*

# AF SOURCING INNOVATION #1
# Ex. 1: Convaero™ BioDrying MSW

**Morocco Example: Bouskoura Plant**



# AF SOURCING INNOVATION #1
# Example 2: Andritz Belt Dryer™




Example: Karlstadt Plant, Germany: 3200tpd
Input: 90kt Sewage Sludge @ 70% $H_2O$
Output: 30kt dried SS @ 10% $H_2O$ and 10GJ/t
Capex: ≈€10-11M; Opex = €5-800k/y
Savings: Gatefee: €5.4M/y + €900k/y fuel

# AF SOURCING INNOVATION #1
# Example 3: FLSmidth Hot Disk™

- Hot disk =slow-moving disc furnace in the precalciner
- Up to 8mx9m; 450t; 16tph
- 45 min residence time
- Multiple AF streams: RDF; Whole tyres (up to 1.2m ), dried sewage sludge etc
- Inputs: AF + preheated raw meal + tertiary air
- Outputs: Hot combustion gases, partly calcined raw meal + residues
- 20% to 80% SR achievable

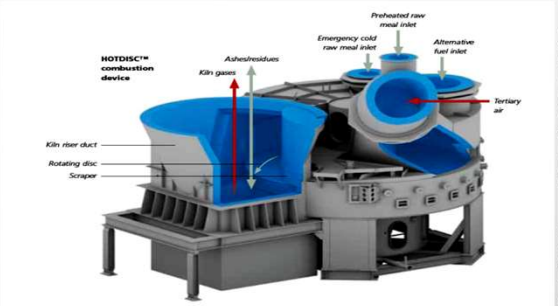
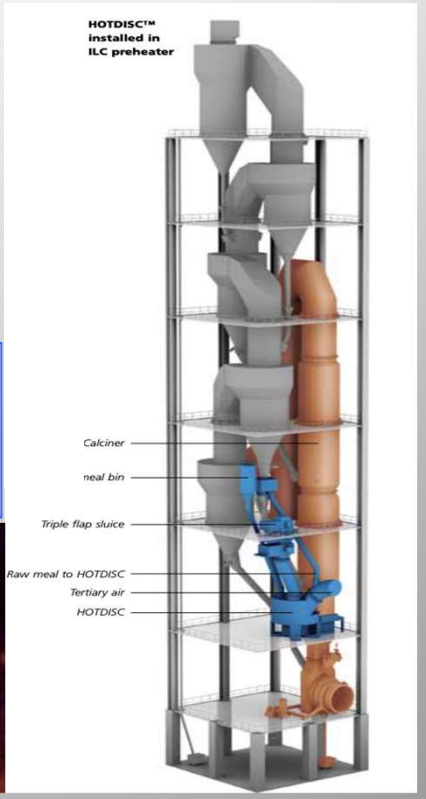
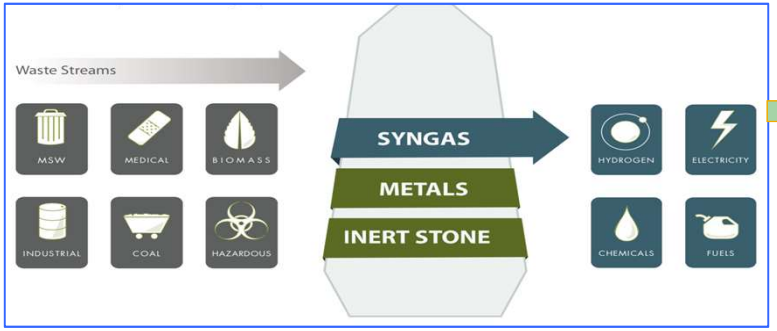


Figure 39. FLSmidth's HOTDISC (FLSmidth 2011)

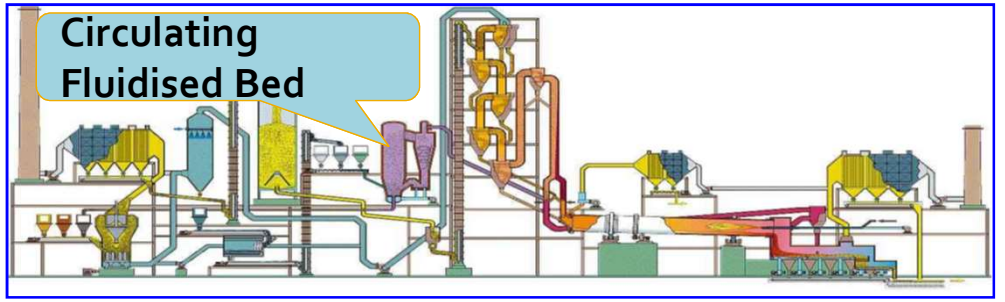
Example: Hongshuile Plant, Guangxi. 300tpd MSW 40-70% H2O and 6GJ/t



# AF SOURCING INNOVATION #1
# Other Examples




Sierra Energy Corp FastOx™ process
MSW + O2 + Steam => Hot gases + H2 + inert residues usable for cement raw material
5tph demo unit in California



Wanqiang Technology
Dried MSW gasifiers, >130 installed, up to 60tpd Produces "syngas" 8-12 MJ/Nm$^3$
1t MSW => 12.5GJ "syngas"

# AF SOURCING INNOVATION #2

**Turn Focus to creating own energy:**

- **Biomass farming**
- **Potential social benefit => cash crop**

- **Many grasses available**
- **Choose according to climate, soil etc**
- **Can harvest 75-300t per hectare per year**
- **7-9GJ/t with 40-50% moisture**
- **Need feasibility study in each case**
- **Note potential social upsides and downsides**

# AF SOURCING INNOVATION #3

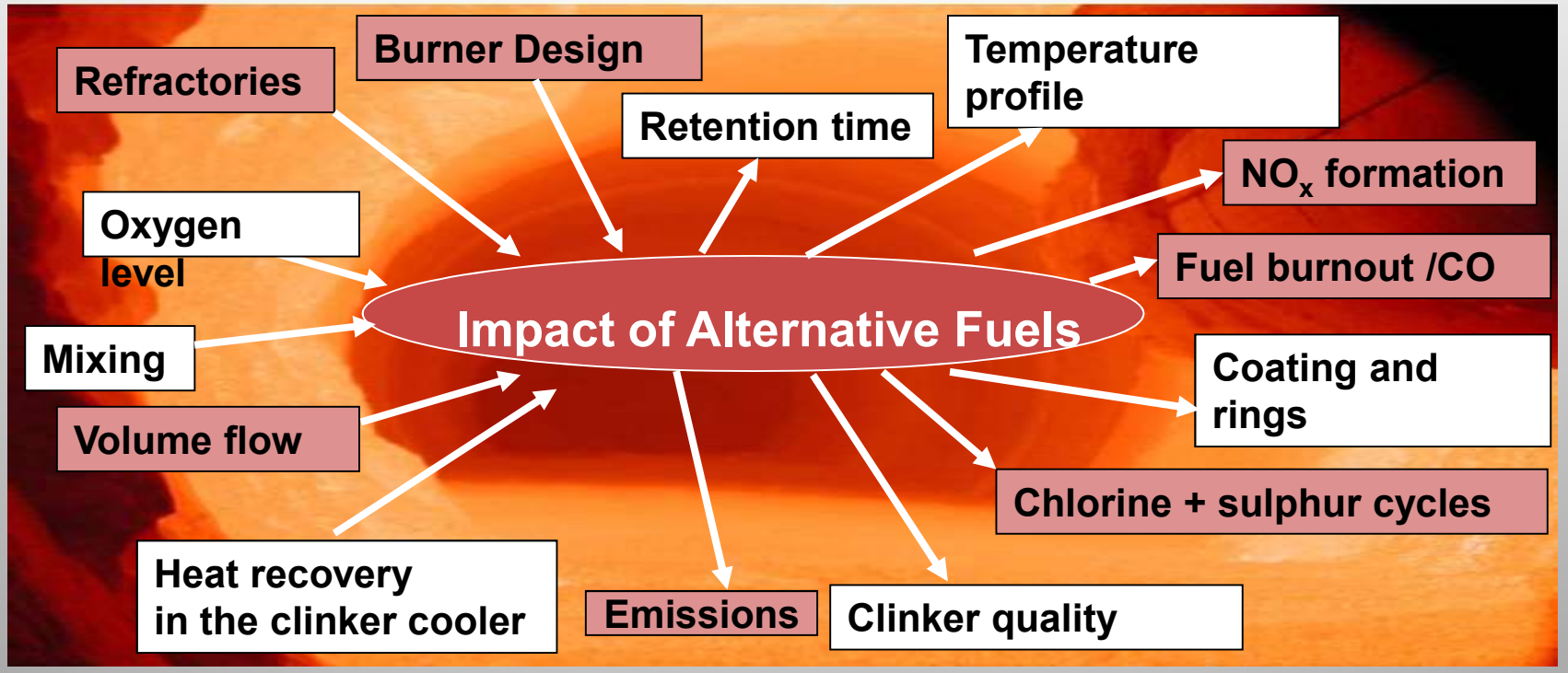
## Turn Focus to High Price, difficult wastes

- Conveyor belts
- Mobile plant tyres
- Hazardous/Medical wastes

# ALTERNATIVE FUELS CHALLENGES 2

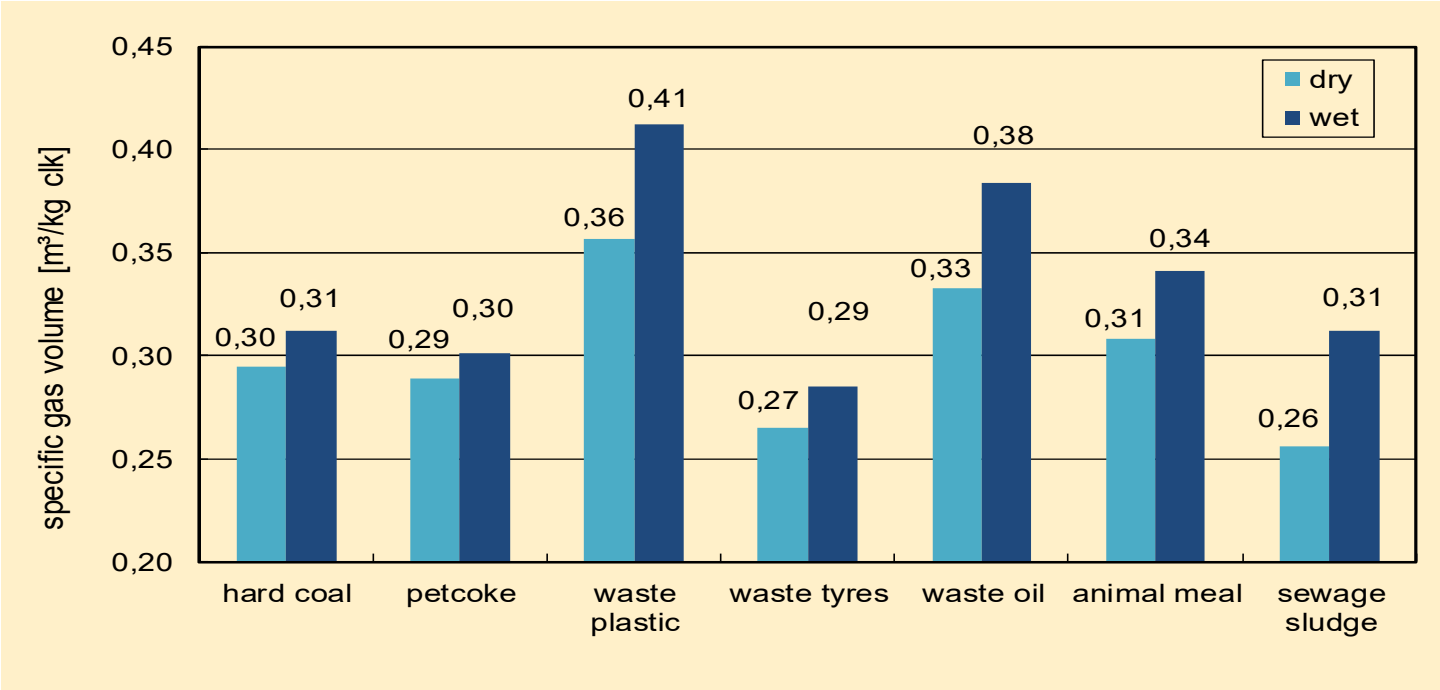
## CAPEX,
## PLANT MASTERY &
## PRODUCTION IMPACT

# IMPACTS OF ALTERNATIVE FUELS



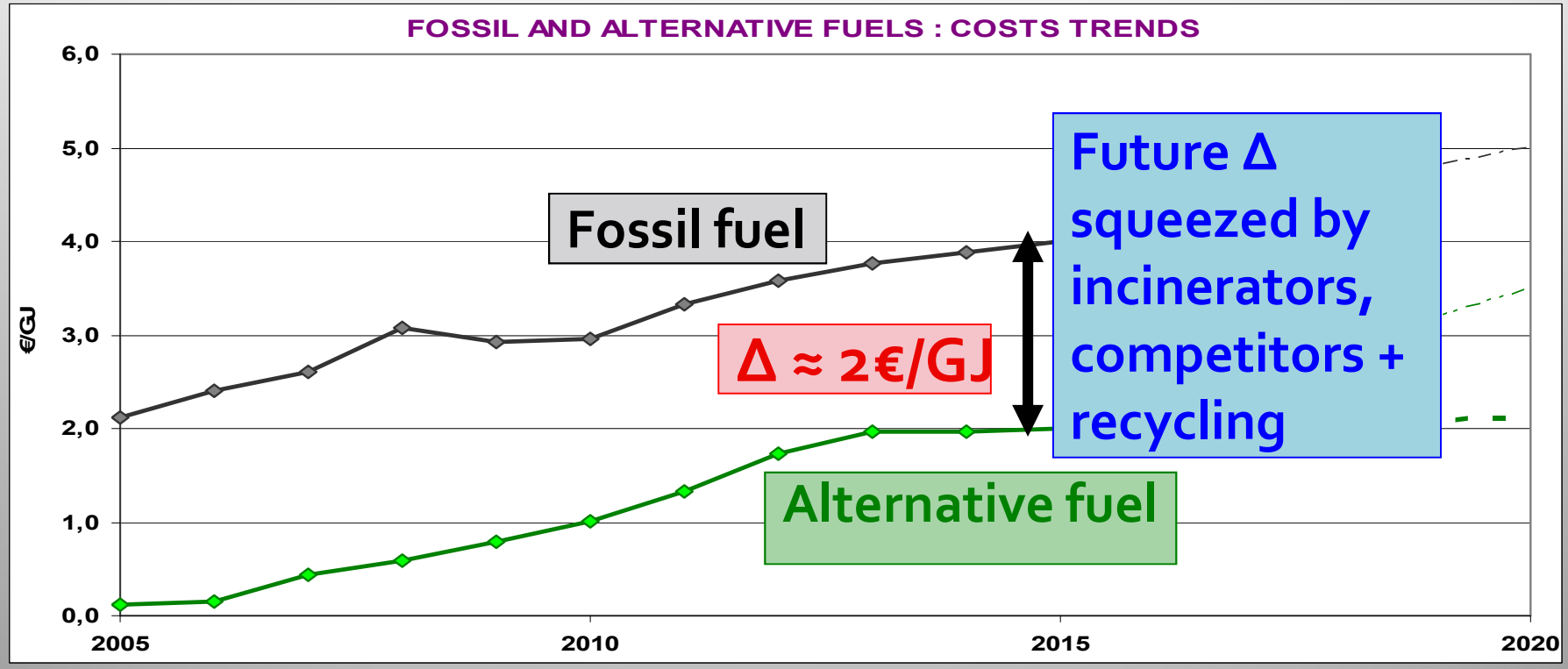

** Ref: "Kiln Reviews to Improve Efficiency, Output and Production Costs" Hoenig, V. of VDZ: Cemtech Feb 2017*

# SOME AFs => HIGHER GAS VOLUMES => LOWER KILN OUTPUT




** Ref: "Kiln Reviews to Improve Efficiency, Output and Production Costs" Hoenig, V. of VDZ: Cemtech Feb 2017*

# JUSTIFYING AF PROJECTS



# AF: BONANZA OR BUST?

IMAGINE: TWO IDENTICAL 1MT/Y CLINKER CAPACITY LINES BURNING PETCOKE/COAL MIX AT COST OF $3.70/GJ OR $13 /TCLINKER. C/K RATIO = 1.3. FIXED COSTS = $22M/Y. VARIABLE COSTS = $36/T CEMENT. S,G&A = $7M/Y. CEMENT PRICE EX PLANT = $90/T

CAPACITY UTILISATION: 100%
SALES: 1.3MT/Y
TURNOVER: $117M/Y
EBITDA: $41.2M/Y

CAPACITY UTILISATION: 60%
SALES: 0.78MT/Y
TURNOVER: $70.2M/Y
EBITDA: $13.1M/Y

# AF: BONANZA OR BUST?

TECHNICAL + SOURCING TEAM ANNOUNCE THAT THEY HAVE FOUND A MIX OF AF WITH A COST OF $0/GJ AND THAT THEY CAN REPLACE 30% OF THE CONVENTIONAL MIX. BUT…5% REDUCTION IN CAPACITY + NON-FUEL VC INCREASES BY $0.5/T CEMENT AND FC BY $0.25M/Y…AND NEED $4M CAPEX

ELDORADO PLANT

GO

OR

NO GO??

OLVIDADO PLANT

CAPACITY UTILISATION: 95%
FUEL SAVING: $3.90/TKK ($3.7M/Y)
SALES: 1.235MT/Y
TURNOVER: $111M/Y
EBITDA: $40.5M/Y DOWN BY $0.7M/Y!!

CAPACITY UTILISATION: 60%
FUEL SAVING: $3.90/TKK ($2.34M/Y)
SALES: 0.78MT/Y
TURNOVER: $70.2M/Y
EBITDA: $14.8M/Y UP BY $1.7M/Y

# AF: CASE STUDY: GO OR NO GO?

- No brainer => GO! for non-sold out plant
- Wise to question AF profitability for sold out plants. In this case => NO GO! But…
- Potential technical solutions to return towards 100% PF eg increase ID fan capacity, pre-dry AF, chlorine by-pass, enriched $O_2$ etc
- Economics can also be affected in some regimes if AF is partly/totally carbon neutral or if extended working is permitted if burning some AFs (eg China)

# AF DEVELOPMENT NEEDS #1

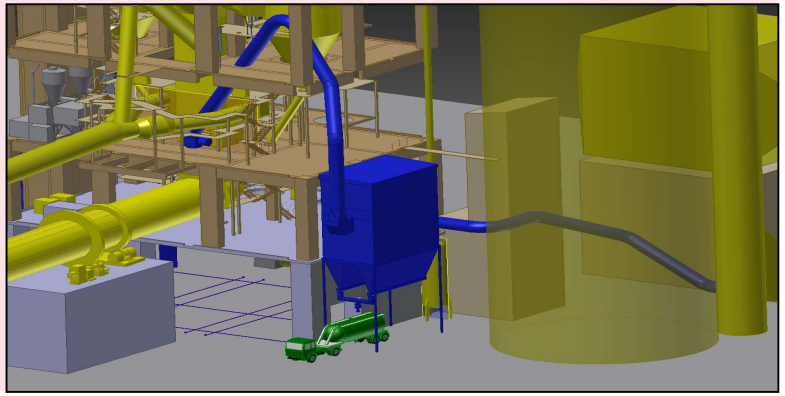
**Drive down pre-treatment costs:**

- **Burn or gasify directly untreated wastes => Chinese technology leading**
- **Drying: Utilise kiln waste heat, flash dryers, torrefaction, membrane-drying etc**
- **Shredding: Develop technology for common difficult wastes: eg dumper tyres, conveyor belts**
- **Sorting demolition waste for AF**
- **Minimisation of emissions eg Dioxins, furans, VOCs, heavy metals etc**

# AF DEVELOPMENT NEEDS #2

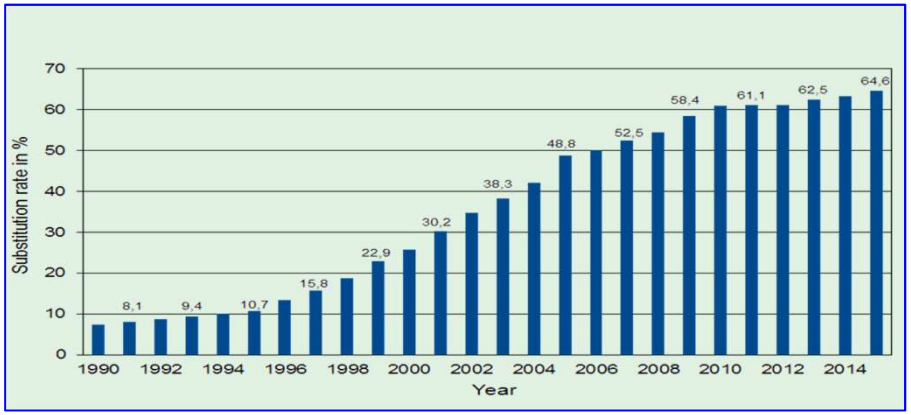
Drive down capex costs:

- Start small, prove the concept, invest/scale up
- Seek low capex solutions: Low cost <$2.5M Chlorine Bypass, dust washing etc
- Low cost storage buildings
- Improve PF/SR:
- AF quality–target blending
- Inject low cost combustion $O_2$



# AF POTENTIAL: GERMAN EXAMPLE*

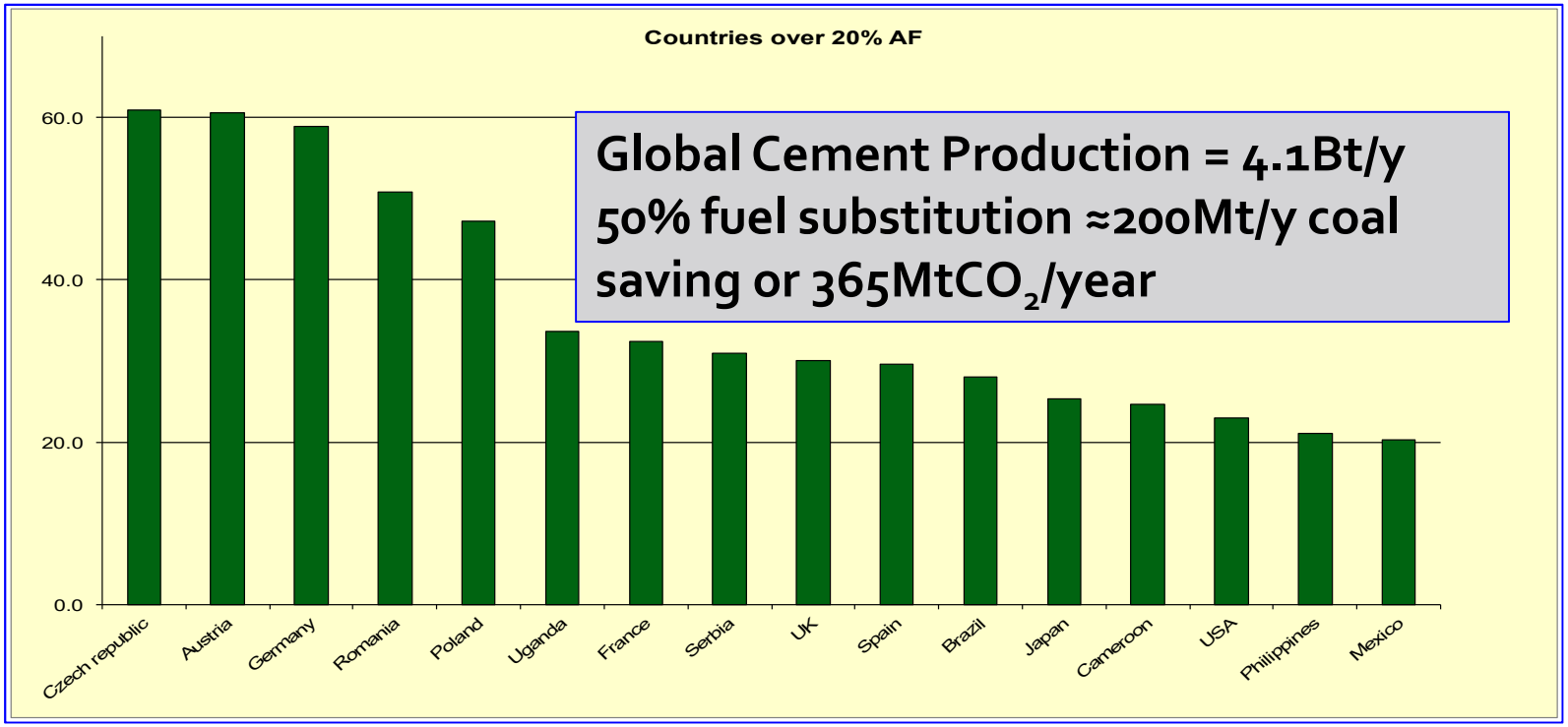
- German Cement Industry has proven the AF WIN-WIN-WIN:
- AF => 53.5 Million GJ in 2014, saving > 2Mt coal
- Sub'n now at 64.6%!




| AF TYPE | % GERMANY 2014 |
|---|---|
| INDUST'L/COMM'L WASTE | 69% |
| TYRES | 11% |
| MUNICIPAL WASTE | 9% |
| ANIMAL MEAL | 5% |
| SEWAGE SLUDGE | 3% |
| WASTE OIL | 3% |

** Ref: "Kiln Reviews to Improve Efficiency, Output and Production Costs" Hoenig, V. of VDZ: Cemtech Feb 2017*

# >50% SUBSTITUTION IS ACHIEVABLE



# ALTERNATIVE FUELS CHALLENGES 3

## EMISSIONS AND HEALTH

# EMISSIONS AND HEALTH 1

- AF can contain many compounds, which vary from source to source and with time.
- Key to protect site team and community => extensive and continuous AF testing+ lab. Seek health experts' advice.
- Need extensive baseline testing + plume modelling + trials + emissions testing for a wide range of compounds => Enviro Impact Study
- Online emissions monitoring for many new species
- <u>This is NOT business as usual</u>

# EMISSION AND HEALTH 2

Remember: ANY chemical compound sounds scary!

Example: Di-Hydrogen Oxide

AF Programmes can be derailed by community resistance, activists and costly permitting/permits

# ALTERNATIVE FUELS CHALLENGES 4

## COMMUNITY, COMMUNICATIONS + PERMITS

# COMMUNITY, COMMUNICATIONS AND PERMITS: EXPECT RESISTANCE!

Shanghai: September 2019

- Not just a technical issue!
- Years in advance - open the plant to the community/media - engage - be transparent - build trust
- Get your unions and workforce onside
- Pressure Groups = well organised, informed, internet-linked
- Hire comms experts => In the battle of emotions vs rationality, emotions win
- Plant closure & employment are <u>not</u> potent arguments
- Expect + respect fears and mistrust
- Keep cool, persist

# COMMUNITY, COMMUNICATIONS AND PERMITS 2

- Securing permits = special skill set
- Baseline monitoring data years in advance
- Major management effort
- Dedicated project leader
- Access to regulators for online emissions data
- Need risk capex for trials
- Permits = lengthy – don't overcommit in budgets
- Keep supplier on side throughout

# ALTERNATIVE FUELS CHALLENGES 5

## PEOPLE NEEDS

# PEOPLE NEEDS

- Common thread: AF programmes need skills beyond those of the average cement engineer:
  - Communications => community engagement
  - Waste market => waste sourcing + strategy
  - Commercial => deal making
  - Health => some waste streams
- AF Programme consumes management time => need dedicated project leader(s)

# CONCLUSIONS

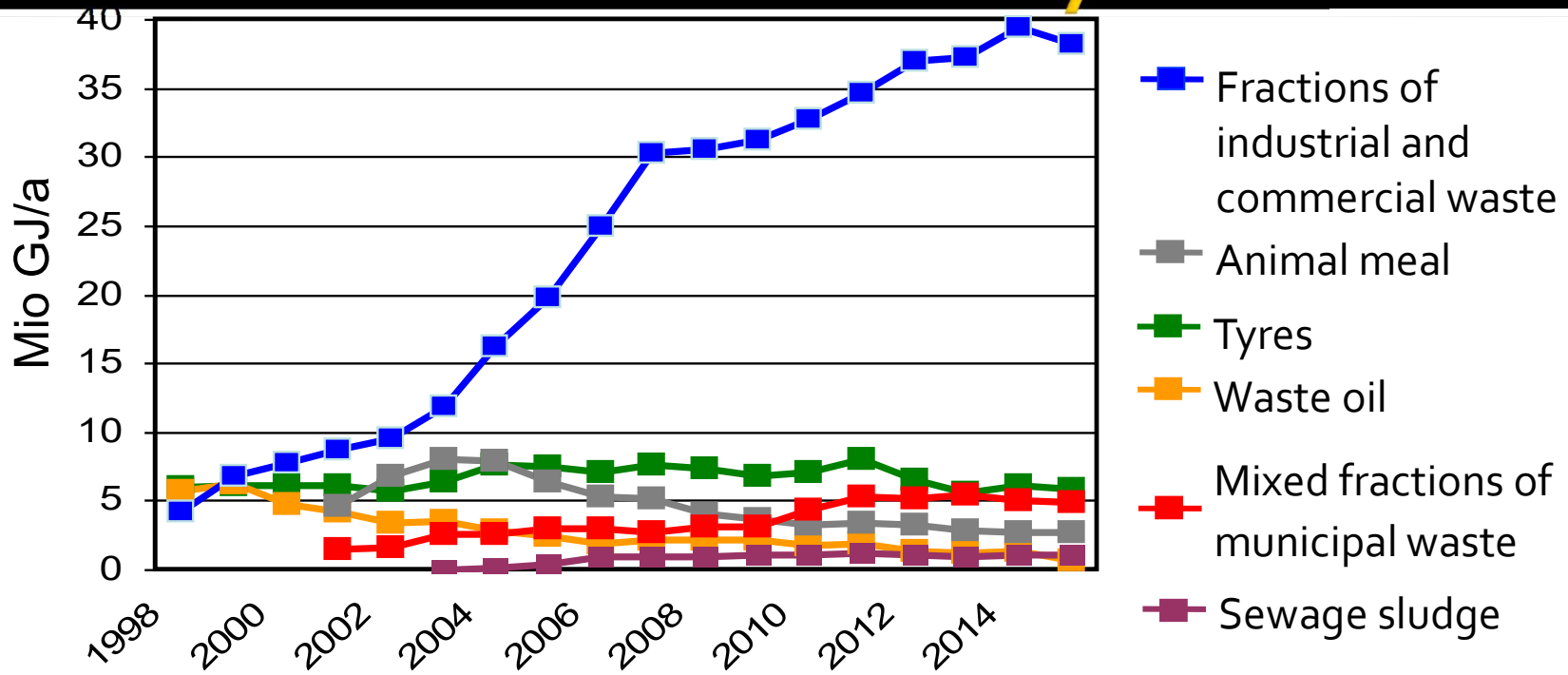
- Cement plant AF programmes can make a real + positive difference:
  - Environment + Society + Competitiveness
- Many challenges, overcome by professional, multi-disciplinary approach:
  - In addition to plant mastery, adaptable mindset needed => burn what the market offers and work with waste management culture
  - Constructive, trusting relationships with communities and regulators
  - Security of supply is key => multiple strategies
  - Major project with hidden costs => rigorous economic feasibility.
  - Special skills and dedicated resources needed

# Questions…

# ANNEX

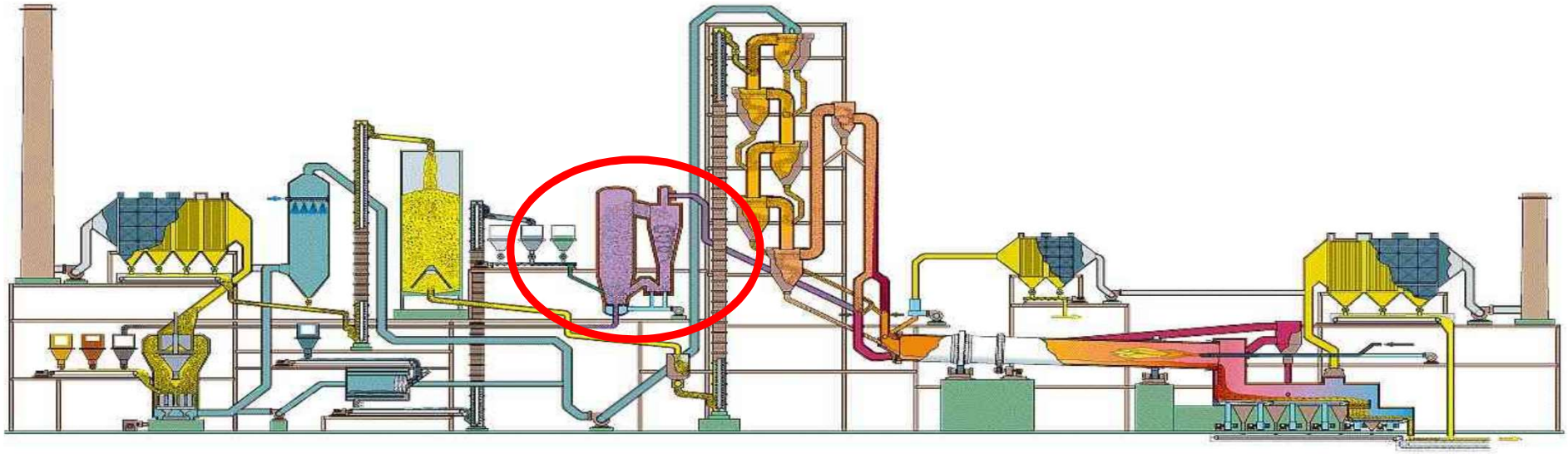
## AF TECHNICAL CHALLENGES

# AF substitution rate: Example German cement industry




** Ref: "Kiln Reviews to Improve Efficiency, Output and Production Costs" Hoenig, V. of VDZ: Cemtech Feb 2017*

# CFB – Circulating Fluidized Bed



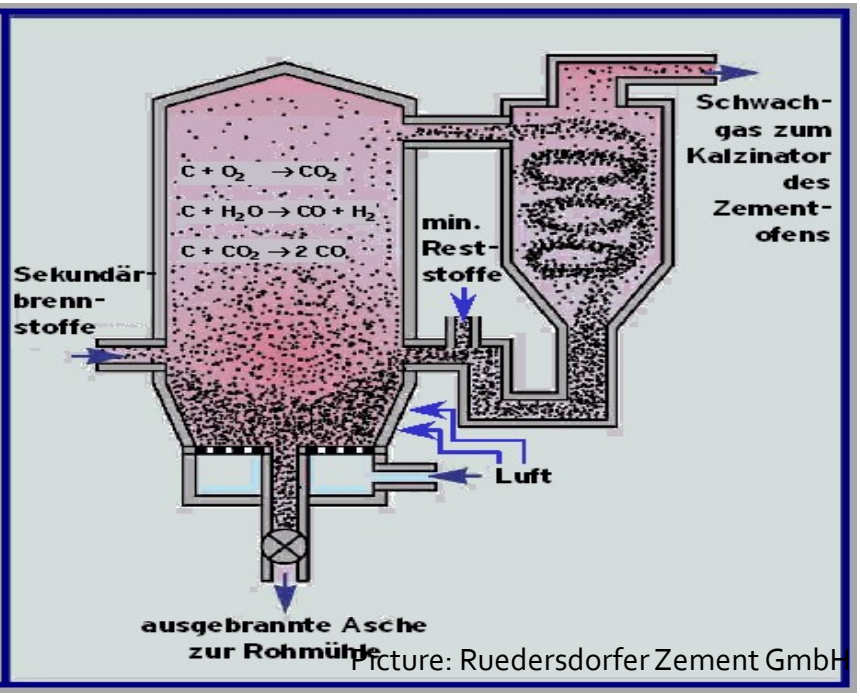
Picture: Ruedersdorfer Zement GmbH

Investment cost (est.): ca. 20.000 kEUR

# CFB – Functional Principle

**Kenn- und Leistungsdaten**

| | | |
|---|---|---|
| Leistung therm. | | max. 100 MW |
| Reaktor: | Durchmesser | 3,5 m |
| | Gesamthöhe | 23,5 m |
| | Rostfläche | 2,3 m² |
| Brennstoffe: | C-haltige Asche | 5 - 15 t/h |
| | Sekundärrohstoffe | max. 10 t/h |
| | Kohlenstaub | max. 6 t/h |
| | oder | |
| | Sekundärbrennstoff | 20 - 25 t/h |
| Produktgas: | Menge | 50.000 m³/h (i.N.) |
| | Heizwert | 3.000 - 5.000 kJ/m³ (i.N.) |
| | Temperatur | 950 °C |
| | Verweilzeit | 4 sec. |




Picture: Ruedersdorfer Zement GmbH

# WASTE SOURCING: PEOPLE FOR SECURITY OF SUPPLY

- Special Skill Set => Highly Commercial + Regulatory. Need dedicated people
- Waste management industry = different culture
- Rock solid quality contractual specs and testing every shipment are key
- Move plant mindset to burning what the market has to offer
- Close teamwork between sourcing and plant teams