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Worldwide Waste-to-Energy Market – Where are the Upcoming Projects?

IRRC Waste-to-Energy 2018 Conference

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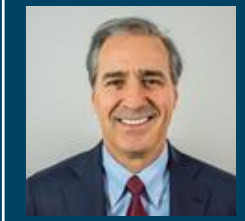
About A. Vaccani & Partners

AVP is an independent international management consulting company located in Switzerland, founded 25 years ago



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Services

- M&A, Fund Raising, Project Finance
- Global Partnering
- Strategy development and implementation

Domain specialties:

- Waste/Sustainability
- Energy
- Water

Footprint

- Europe/CIS/Russia/Middle East
- North America, Mexico
- Japan / China / India / SEA

100 M&A Transactions, mostly cross border, about 50% in Cleantech space, many involving Asian, European and US parties

Over 50 Tech Transfer/Partnering transactions in Cleantech space between Europe/US and Asia

60 Market Entry mandates in Cleantech space, mostly into Europe, Asia, North America

Strategic Partners:

- Umore: China
- Encito: India
- 5Elements Capital: Project development
- ICFG: Global M&A

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Key Discussion Points

1. Background
2. Long Term Waste Scenario to 2030 / 2050
3. Snapshot of WTE Markets Last Three Years
4. Forecast Next 5 Years
5. Example of Regional Market Analysis and Country Level Deep Dive
6. Remarks on Selected Markets and Hot Spots
7. Questions - Comments

The Worldwide Need for Safe Waste Management is Enormous

- World population 7.5 billion and growing at rate of 1.1% (230‘000 per day)
- Total municipal solid waste (MSW) generated approximately 2 billion tons per year in 2016, growing to 3.4 billion tons per year by 2050 (plus 70%), growing at over 40 million tpy annually
- 26 megacities, 410 cities with population over 1 million
- Waste management is expensive: Up to 20% of municipal budgets in low income countries, 10% in middle income, app 4% in high income
- Waste plastic (including microplastics) developing into major environmental problem

Source: World Bank, OECD, AVP Analysis

Waste-to-Energy (WtE) is Well Established and the Preferred Option to Treat Residual Municipal Solid Waste (MSW)

- Over 2'000 EfW plants in operation worldwide with a total capacity of approx. 270 million tpy (app. 13% share)
- High flexibility to treat a wide range of waste, 100% destruction of waste plastic and energy recovery
- Power plants with high reliability
- High efficiency with CHP
- Low environmental impact / up to 50% renewable
- However:
  - High CAPEX
  - Difficult to permit / realize

Source: AVP Analysis

1st Generation 1917 – 1969

Sanitation

2nd AVI Noord: 1969 – 1993

Heat Recovery

3rd AVI West 1993 – present

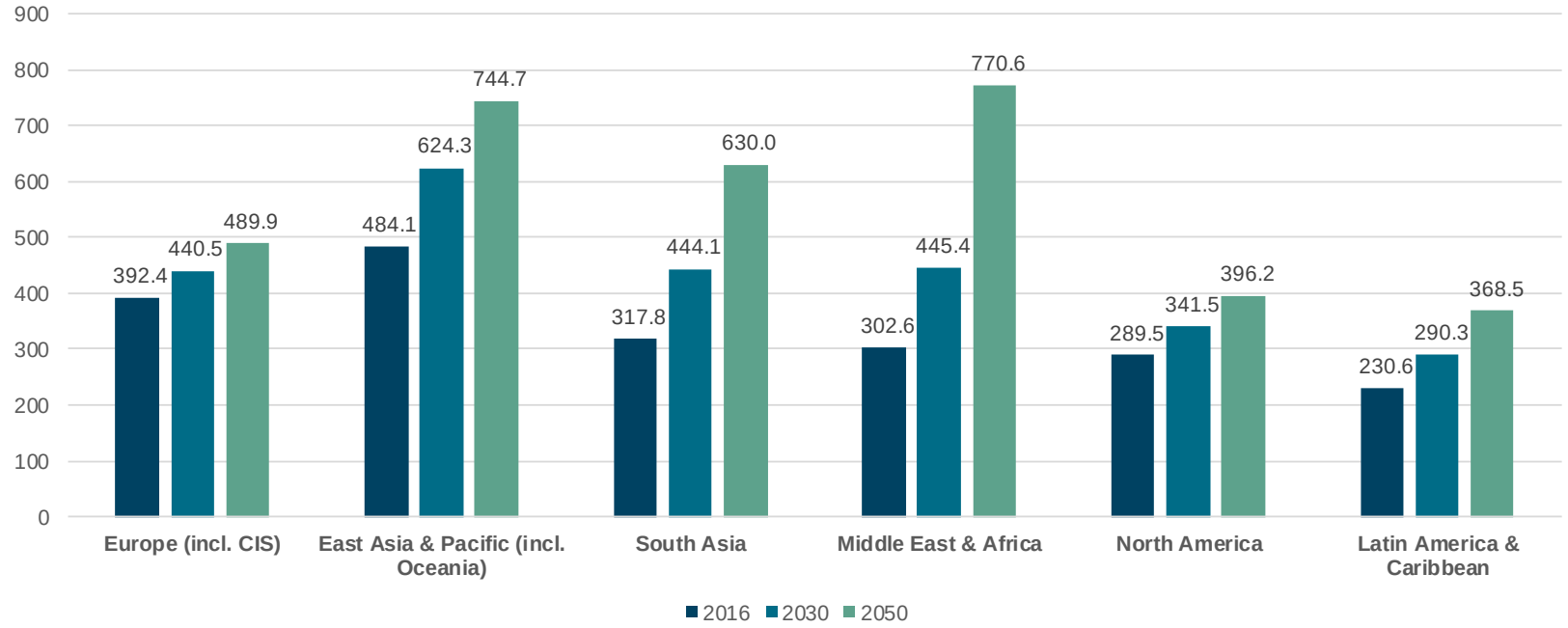
Advanced Flue Gas Cleaning

4th WFPP 2007 – present

Waste-fired Power Plant
(highest el. efficiency world wide > 30%)

Source: AEB

Regional Waste Growth and WTE Build-up Scenario to 2030 / 2050



Waste growth						
▪ 2030	12%	29%	39%	47%	18%	26%
▪ 2050	25%	53%	98%	155%	36%	60%
EfW Share (%)						
▪ 2016	25%	30%	0%	0.25%	10%	0%*

Source: World Bank, AVP Analysis * rounded

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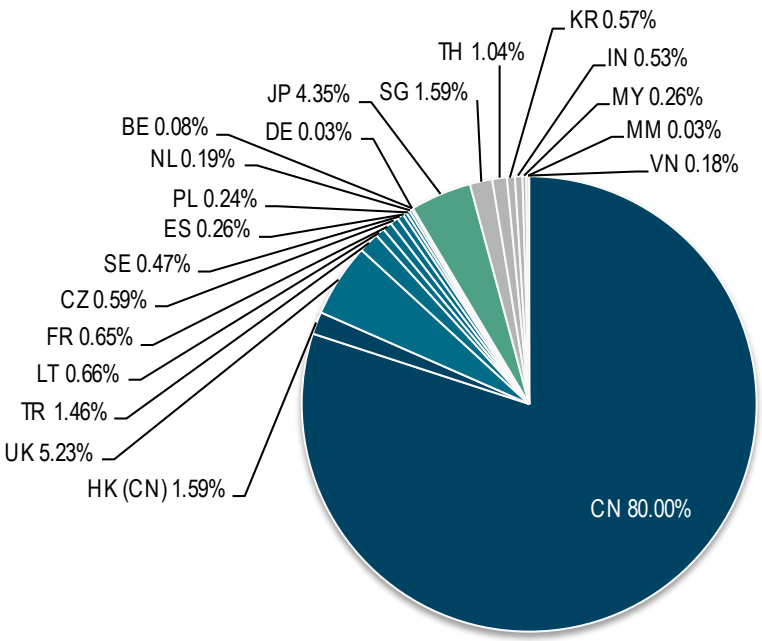
Global WTE Markets: Analysis of Awards 2015 – 2017 (last 3 years)

Geographic

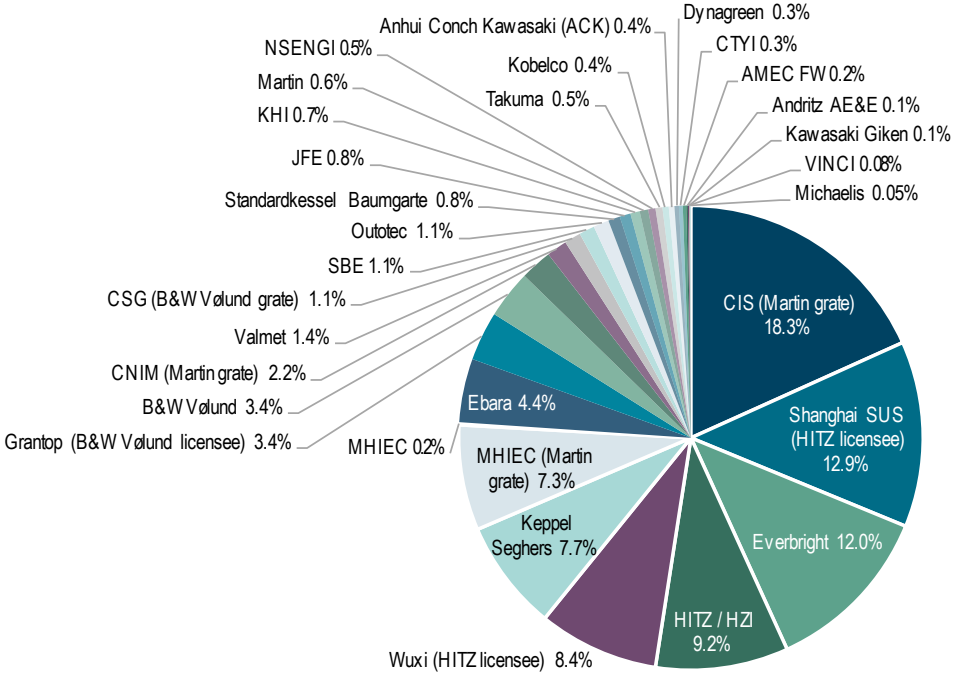


Total: 226’440 tpd

Regions:

- China: 81.6%
- EMEA: 9.9%
- Japan: 4.4%
- Asia excluding CN & JP: 4.2%
- N. & S. America: 0%

Suppliers



Total: 226’440 tpd

Source: AVP Global Market Share Analysis

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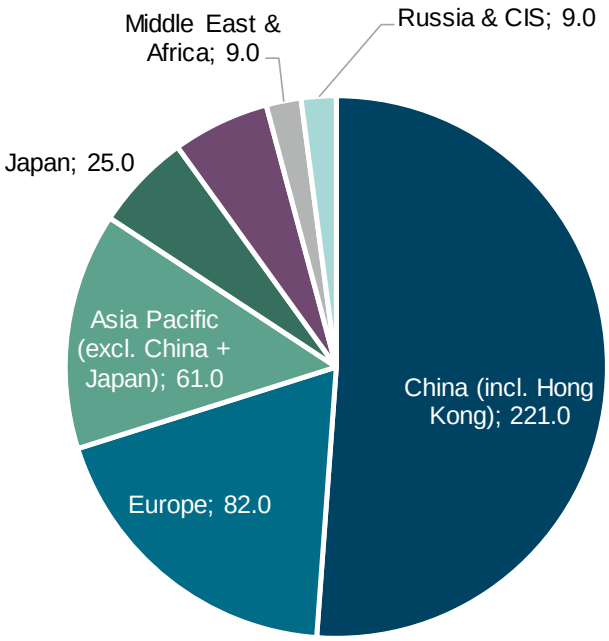
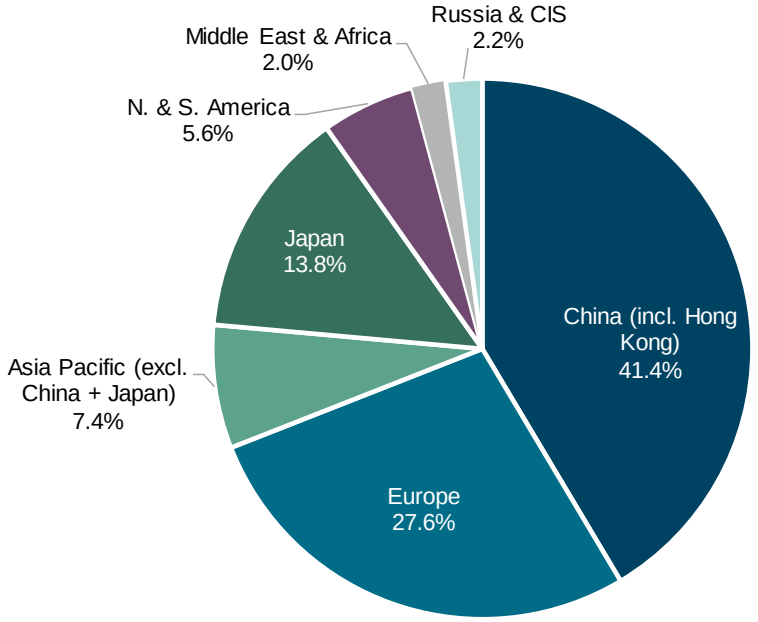
AVP Market and Project Forecast 2019 - 2023

Ordered WTE Capacity



Total: 334 projects
With 17.940 mtpy capacity per year

EPC Market Value



Total: 6.53 M€/year

Source: AVP Global WTE Market Forecast 2018 - 2023

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Example of Regional Analysis – Market Assessment and Evaluation

Market Profile	Thailand	Vietnam	Hong Kong	Singapore	Indonesia	Macau (CN)	Malaysia
Country Indicators							
- Income level	LMI	LI	HIC	HIC	LMI	HIC	UMI
- GDP per capita ($)	5'816.40	2'111.10	42'422.90	52'888.70	3'346.50	78'585.90	9'766.20
- Political stability (-2.5 weak 2.5 strong)	-0.91		1.13	1.23	-0.37	1.21	0.34
- Ease of doing business (1 (easy) -189 (difficult))	49	90	5	1	109	n.a.	18
- Corruption Index (0 (highly corrupt)-100 (very clean)	38	31	75	85	36	n.a.	50
Population / MSW Generation							
Current situation							
Total Urban Population	22'453'143	24'001'081	6'977'700	4'839'400	117'456'698	466'162	14'429'641
MSW Generation per Capita (kg/year)	642	533	726	544	190	537	555
Total urban MSW generation (mtpy)	14.42	12.79	5.07	2.63	22	0.25	8.01
2025 Projection							
Total Population	68'803'000	106'357'000	8'305'000	5'104'000	271'227'000	535'000	33'769'000
Urban Population	29'063'000	40'505'000	8'305'000	5'104'000	178'731'000	535'000	27'187'000
Percentage of urban population	42%	38%	100%	100%	66%	100%	81%
Urban Population growth (%)	29%	69%	19%	5%	52%	15%	88%
MSW Generation per Capita (kg/year)	712	657	730	657	310	639	694
MSW Generation per Capita growth (%)	11%	23%	1%	21%	63%	19%	25%
Total urban MSW generation (mtpy)	20.69	26.61	6.06	3.35	55.45	0.34	18.85
Total urban MSW generation growth (%)	43%	108%	20%	27%	149%	37%	136%
EfW Market Development							
Awards last 5 years AVP data base (plants)	yes (2)	yes (1-2016)	no	yes (2)	no	no	yes (1)
AVP Market Forecst 2017-2021 (plants/likelyhood)	yes (10/75%)	yes (2/60%)	yes (1/80%)	yes (?1/80%)	yes (3/60%)	yes (1/60%)	yes (3/60%)
EfW Market Development Phase	growth	growth	growth	growth	emerging	established	emerging
Government attitude towards EfW	+++	++	+++	+++	+++	+++	++
Regulatory Framework							
Waste Management Plan	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Feed in Tariff	Yes		no		Yes		yes
Other incentives	Yes		not evident		Yes		yes

Greenfield Potential							
Brownfield Potential							

Strong market potential Good market potential Low market potential

Key Criteria for Market Screening

- Country Indicators
- Urban population and growth
- Urban waste volume
- Waste composition
- Waste growh
- Maturitiy of waste management system
- Last 5 year awards
- Forecast next 5 years
- EfW development phase
- Government attitude towards WtE
- Waste management plant
- Incentives, feed in tariff

Source: AVP Structural Market Analysis SEA

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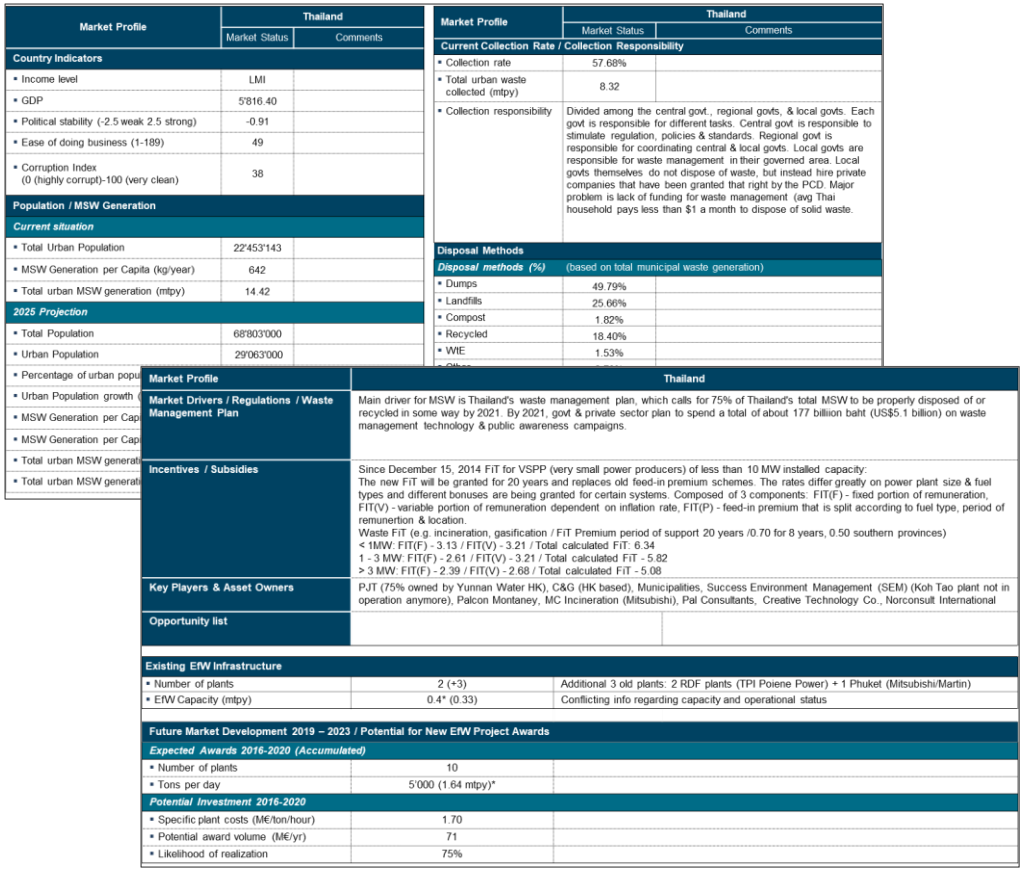
Example of Country Level Deep Dive



Market Profile	Thailand	
	Market Status	Comments
Country Indicators		
• Income level	LMI	
• GDP	5'816.40	
• Political stability (-2.5 weak 2.5 strong)	-0.91	
• Ease of doing business (1-189)	49	
• Corruption Index (0 (highly corrupt)-100 (very clean)	38	
Population / MSW Generation		
Current situation		
• Total Urban Population	22'453'143	
• MSW Generation per Capita (kg/year)	642	
• Total urban MSW generation (mtpy)	14.42	
2025 Projection		
• Total Population	68'803'000	
• Urban Population	29'063'000	
• Percentage of urban popu		
• Urban Population growth (		
• MSW Generation per Cap		
• MSW Generation per Cap		
• Total urban MSW generati		
• Total urban MSW generati		

Market Profile	Thailand	
	Market Status	Comments
Current Collection Rate / Collection Responsibility		
• Collection rate	57.68%	
• Total urban waste collected (mtpy)	8.32	
• Collection responsibility	Divided among the central govt., regional govts, & local govts. Each govt is responsible for different tasks. Central govt is responsible to stimulate regulation, policies & standards. Regional govt is responsible for coordinating central & local govts. Local govts are responsible for waste management in their governed area. Local govts themselves do not dispose of waste, but instead hire private companies that have been granted that right by the PCD. Major problem is lack of funding for waste management (avg Thai household pays less than $1 a month to dispose of solid waste.	
Disposal Methods		
Disposal methods (%)	(based on total municipal waste generation)	
• Dumps	49.79%	
• Landfills	25.66%	
• Compost	1.82%	
• Recycled	18.40%	
• WtE	1.53%	
• Others		

Market Profile	Thailand
Market Drivers / Regulations / Waste Management Plan	Main driver for MSW is Thailand's waste management plan, which calls for 75% of Thailand's total MSW to be properly disposed of or recycled in some way by 2021. By 2021, govt & private sector plan to spend a total of about 177 billiion baht (US$5.1 billion) on waste management technology & public awareness campaigns.
Incentives / Subsidies	Since December 15, 2014 FiT for VSPP (very small power producers) of less than 10 MW installed capacity: The new FiT will be granted for 20 years and replaces old feed-in premium schemes. The rates differ greatly on power plant size & fuel types and different bonuses are being granted for certain systems. Composed of 3 components: FIT(F) - fixed portion of remuneration, FIT(V) - variable portion of remuneration dependent on inflation rate, FIT(P) - feed-in premium that is split according to fuel type, period of remunertion & location. Waste FiT (e.g. incineration, gasification / FiT Premium period of support 20 years /0.70 for 8 years, 0.50 southern provinces) < 1MW: FIT(F) - 3.13 / FIT(V) - 3.21 / Total calculated FiT: 6.34 1 - 3 MW: FIT(F) - 2.61 / FIT(V) - 3.21 / Total calculated FiT - 5.82 > 3 MW: FIT(F) - 2.39 / FIT(V) - 2.68 / Total calculated FiT - 5.08
Key Players & Asset Owners	PJT (75% owned by Yunnan Water HK), C&G (HK based), Municipalities, Success Environment Management (SEM) (Koh Tao plant not in operation anymore), Palcon Montaney, MC Incineration (Mitsubishi), Pal Consultants, Creative Technology Co., Norconsult International
Opportunity list	

Existing EfW Infrastructure		
• Number of plants	2 (+3)	Additional 3 old plants: 2 RDF plants (TPI Poiene Power) + 1 Phuket (Mitsubishi/Martin)
• EfW Capacity (mtpy)	0.4* (0.33)	Conflicting info regarding capacity and operational status

Future Market Development 2019 – 2023 / Potential for New EfW Project Awards		
Expected Awards 2016-2020 (Accumulated)		
• Number of plants	10	
• Tons per day	5'000 (1.64 mtpy)*	
Potential Investment 2016-2020		
• Specific plant costs (M€/ton/hour)	1.70	
• Potential award volume (M€/yr)	71	
• Likelihood of realization	75%	

Deep Dive for Market Assessment

- Base data regional screen
- Waste management system, collection, etc.
- Disposal methods
- Details and assessment waste management plan
- Responsibilities and decision making
- Key players
- Local partners
- Project opportunities
- Financing community and bankability

Source: AVP Global Market Share Analysis

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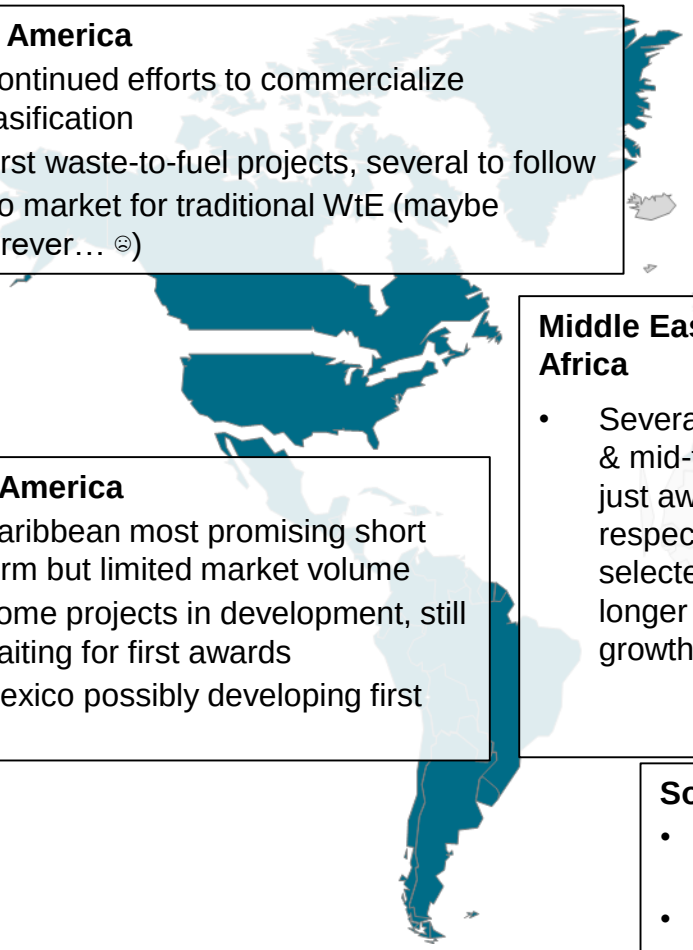
Selected Regions and Hotspots



North America

- Continued efforts to commercialize gasification
- First waste-to-fuel projects, several to follow
- No market for traditional WtE (maybe forever… ☹)

China

- Largest world market for over 15 years
- Continued growth for another 5 years
- Thereafter, gradual slow down
- Players need to move from construction/EPC to O&M
- Many Chinese players trying to internationalize

Middle East & North Africa

- Several projects short & mid-term. Dubai just awarded, respectively supplier selected. Mid and longer term strong growth area.

India

- Enormous market need triggered by Swacch Bharat Clean India Mission
- Largest single market potential
- Short-term pipeline over 50 projects
- However, problems setting realistic project goals, defining adequate technical requirements, managing proper procurement process and achieving financeability
- Even lower CAPEX level than China

Latin America

- Caribbean most promising short term but limited market volume
- Some projects in development, still waiting for first awards
- Mexico possibly developing first

South-East Asia

- Immediate opportunities in Singapore and HK decided (gone)
- Best prospects: Indonesia, Thailand, ev. Malaysia
- Several other markets emerging
- On-going project market in Korea

Australia

- "Minihype"! Several projects in development, however, project realization and market size questionable

Selected Regions and Hotspots

Summary

- Safe and sustainable waste management is one of the major global challenges
- WTE has huge and sustainable long-term global market potential
- WTE projects are everywhere, but only a small fraction is realized at any given time
- Market requirements vary in different regions and will also shift gradually
- Strategic marketing and organizational agility are needed for “smart market focus” and on-going technology and service adaptation

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Thank you for your attention!
Comments – Questions?

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