Power Plants in Asia

Challenges in Delivering Sustainable Water Treatment Solutions
A global leader able to cover the entire range of environmental solutions

€29.4 billion revenues
77 countries
331,266 employees

WATER
The global benchmark for water services
€12.1 billion

WASTE MANAGEMENT
The global benchmark for waste management and resource recovery
€9.1 billion

ENERGY SERVICES
The global benchmark for energy optimization
€7.3 billion

VEOLIA
ENVIROGENT
Veolia, the world leader in Environmental Services – Water, Waste, and Energy

2012 revenues by business

<table>
<thead>
<tr>
<th>Business</th>
<th>Revenues (% of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>41%</td>
</tr>
<tr>
<td>Waste</td>
<td>31%</td>
</tr>
<tr>
<td>Energy</td>
<td>26%</td>
</tr>
</tbody>
</table>

**Water – #1 provider of water solutions**
- Leading water DBOM supplier in major industries and municipalities
- >300 power generation references worldwide
- >100 million people provided with drinking water and >70 million people connected to wastewater treatment plants
- >8,000 (waste-)water production plants managed

**Waste – Specialist in product recovery and waste treatment**
- 570,000 corporate clients (excl. industrial maintenance)
- Over 47 million residents served on behalf of municipalities
- 25.7 million tons of material and energy waste recovered
- 686 treatment facilities operated

**Energy – Dalkia, largest Energy Service company in Europe with deep operational experience**
- 800 district and local heating and cooling systems managed
- Cooling and heating networks in 133,000 energy plants and 4,600 industrial facilities operated and optimized

**Veolia Water capabilities involve:**
- **Engineering capabilities:**
  Design and build state-of-the-art water treatment plants around the world
- **O&M capabilities:**
  - **Operations:**
    Take-over of full responsibility for water of municipalities and industrials
  - **Maintenance:**
    Execution of efficient (preventative) maintenance schemes
- **R&D capabilities:**
  Worldwide coverage of local R&D and expert knowledge
- **People:**
  Network of experts to generate unique competitive advantage

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1 Excl. industrial maintenance
A global leader in water treatment

€2.4 billion revenue
10,805 employees

Solutions & Technologies

PEOPLE

Europe excluding France 3,438
France 2,163
South America 1,548
Africa-Middle East 1,405
Asia-Pacific 1,241
North America 1,010

MARKET SEGMENT

Industrial 55%
Municipal 45%

TYPE OF SERVICE

Design & Build 54%
Solutions 37%
Operations 9%
Key industrial markets

**Oil & Gas (Upstream & Downstream)**
- Technip/Petrovietnam (VN), HHI/Total (NG), Modec/Petrobras (BR), Foster Wheeler/Shell (SG), Air Liquide/Soxal (SG), ABB/Shell (SG), SBM/Encana (CA), Petronas (MY), Emery (MY), Sinopec (CN)

**Power**
- Siemens Power (Phu My 3 BOT, VN), Siemens Power (Panglimar, MY), Alstom Power (Keppel Merlimau, SG), Formosa Heavy Industries (Taiwan – Philippines),

**Pharmaceuticals & Healthcare**
- Wyeth (SG), Johnson & Johnson (CN, MY), Alcon (SG), Baxter (SG), Menicon (SG), GSK (SG), L'Oréal (ID), Procter & Gamble (VN), Ciba Vision (ID), Lilly (CN), Merial (CN), Astra Zeneca (CN)

**Food & Beverage**
- Pepsico (VN), Mafipro (MY), Nestle (PH), ThaiBev (TH), PT Sari Husada (ID), SATS (SG), Liaoning Huishan Holdings (CN), Friesland Campina (ID), Procter & Gamble (VN)

**Pulp & Paper**
- Thaikraft (TH), Thai Paper (TH), Anhui Shanying Paper (CN), Henan (CN), Xinxian Xinya Group (CN)

**Microelectronics/Photovoltaic**
- Webel Solar (IN), Showa Denko (SG), STM (SG), IMFS (SG), Soitec (SG), Konica Minolta (MY), REC(SG), Sunpower (MY), FCI (SG), Molex (CN), TSMC (TW), Chimei Innolux (TW), Seagate (SG, MY), UMC (SG), Truly (CN), AUO (TW)

**Palm Oil Mill Effluent (POME)**
- Felda Palm Industries (MY), Prolific Yield-Mistral Engineering (MY), Sime Darby (MY)

**Others**
- Automotive: Michelin (CN)
- Primary metals: Chengde Steel (CN)
> Overview

Power Market – South East Asia
Key Highlights

- International Energy Agency forecast: SEA becomes a key global energy market & future growth driver
- Energy and power consumption will nearly treble by 2030
- Singapore, Malaysia, Indonesia, Thailand and Vietnam, these five countries accounted for 86% of ASEAN’s total GDP in 2010

- SEA is a key exporter of oil, natural gas and coal
  - Indonesia: world’s 2nd largest coal exporter
  - Vietnam: World’s largest gas pipeline (combined gas and liquid flow)
  - Malaysia: 3rd Largest LNG (liquefied natural gas) exporter
Energy consumption in ASEAN Countries:
CAGR 6.5% (2010-2020)

* Million Tonnes of Oil Equivalent
Most of the power generated in Southeast Asia is from Coal which is the most water intense fuel.

Coal plants, like most other steam-producing electricity-generating plants, typically withdraw and consume water from nearby water bodies, such as lakes, rivers, or oceans, to create steam for turning their turbines.
Key Highlights

- Indonesia, Malaysia and Vietnam have the most ambitious power plant expansion plans.
- Vietnam, Indonesia, Thailand and Malaysia consume far more energy per GDP output compared to developed countries such as the US, UK, Germany and Japan.
- These ambitious energy expansion plans, rapid energy consumption growth in the region will put a strain on efforts to ensure reliable energy supply on a continuous basis.
# Energy Efficiency laws and initiatives - SEA

<table>
<thead>
<tr>
<th>Country</th>
<th>Targets</th>
<th>Policies/Programmes</th>
</tr>
</thead>
</table>
| Singapore| • Reduce energy intensity by 20% by 2020 and by 35% by 2030 from the 2005 level | • Sustainable Singapore Blueprint (incentives for EE investments in different industrial sectors) – 2009  
|          |                                                                         | • Environmental Protection and Management Act (mandatory energy labeling for HVAC, etc) – 2008  
|          |                                                                         | • Building Control Act (energy labeling for new buildings) – 2008                   |
| Malaysia | • Reduce final energy consumption in the industrial, commercial and residential sectors by 10% from 2011 to 2030 | • Malaysian Industrial Energy Efficiency Improvement Programme (removing barriers to EE in industry) – 2002 |
| Indonesia| • Reduce final energy consumption by 1% per year from the business-as-usual scenario | • National Energy Conservation Master Programme (incentives to reduce energy by 1% p.a. until 2025) – 2005 |
| Thailand | • Save 22% of total energy in 2030 relative to the business-as-usual scenario | • Energy Conservation Act (promotions for conservation investments in building sector) – 1992 |
| Vietnam  | • Reduce energy consumption by 3-5% by 2010 and between 5-8% by 2010-2015 | • Vietnam National Efficiency Programme (gradual savings of 3-10% national energy consumption by 2015) – 2006 |
> Challenges versus Solutions
Creating Water Solutions for the Power Industry

1. Pre-treatment
   - Ground water, surface water, grey water
   - Seawater desalination
     - Screening
     - Flocculation, sedimentation
     - Settling, clarification
     - Combined clarification
     - Filtration
     - Membrane technologies
     - Softening
     - Electro-chlorination
     - Desalination

2. Boiler Feed Water
   - Reduction of impurities
   - Water demineralization
     - Filtration
     - Reverse osmosis
     - Demineralization
     - Continuous Electro-Deionization
     - Combined pre-treatment
     - Mixed bed ion exchange
     - Water Treatment Chemicals

3. Condensate Polishing
   - Remove impurities from condensate steam
   - Iron and silica removal
     - Resin regeneration
     - Candle filters
     - Pre-coated filters
     - Filtration
     - Mixed bed ion exchange
     - Deaerating feedwater heaters
     - Separate beds condensate polishers

4. Cooling Tower Sidestream
   - Reduce scaling and deposition
   - Minimize microbial activity
   - Increase concentration cycles
     - Water treatment chemicals
     - Side-stream filtration
     - Full-stream filtration
     - Electro-chlorination
     - Turbine inlet cooling

5. Cooling Tower Blow Down
   - Minimise water
   - Zinc and chromates removal
   - Carbonate removal
     - Clarification
     - Filtration (media filtration, media membrane)
     - Zero Liquid Discharge

6. Wastewater Treatment
   - Water footprint
   - Metals removal
   - Particle matters and Gypsum desaturation
   - Environmental Impact
   - Flue gas desulfurization
     - Forced circulation crystallizer with vacuum system
     - Evaporation
     - Cristallization
     - Membrane technology

7. Services
   - Total validated system lifecycle compliance
     - Service contracts
     - Re-validation of existing plant
     - 24/7 service and support infrastructure
     - Remote monitoring of installations
     - Local support staff
     - Spare parts and consumables
     - Replacement media
     - Water analysis service
     - Equipment leasing
     - Service Deionisation
     - Expansion and modification of treatment plants
     - Refurbishment & update of validated systems
     - Site audits
     - Mobile and temporary solutions
     - Water treatment chemicals
     - Complete water cycle management & outsourcing
Veolia support model has the potential to unlock significant benefits in 3 main dimensions

<table>
<thead>
<tr>
<th>Key benefits</th>
<th>Examples of key enablers</th>
<th>Veolia solution (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease cost for water</td>
<td>Reduce water consumption of power plant</td>
<td>Efficient re-use technologies like microfiltration and reverse osmosis</td>
</tr>
<tr>
<td>Decrease cost for chemicals</td>
<td>Reduce need for chemicals in processes</td>
<td>Continuous De-ionization to fully avoid chemical usage</td>
</tr>
<tr>
<td>Improve process performance</td>
<td>Reduction in operating costs</td>
<td>Operations improvement</td>
</tr>
<tr>
<td></td>
<td>Reduce maintenance need</td>
<td>Solid build-up prevention to extend maintenance intervals</td>
</tr>
<tr>
<td>Improve yield of power plant</td>
<td>Use exhaust gases to regenerate power</td>
<td>Condensate polishing system for impurity removal from gas</td>
</tr>
<tr>
<td>Increase uptime</td>
<td>Apply systems for continuous water feeding</td>
<td>Continuous demineralization to ensure water flow</td>
</tr>
<tr>
<td></td>
<td>Outsource water supply responsibility to experts</td>
<td>Deep experience in O&amp;M of water treatment in Power</td>
</tr>
<tr>
<td>Fulfill strictest environmental regulations</td>
<td>Refurbish and upgrade existing water treatment processes</td>
<td>Refurbishment of plants and equipment</td>
</tr>
<tr>
<td>Secure reliable access to high-quality water for all stakeholders</td>
<td>Use alternative water sources and re-use effluent</td>
<td>Wastewater treatment facilities to free-up water for population</td>
</tr>
<tr>
<td></td>
<td>Prevent environmental pollution</td>
<td>Zero-liquid discharge plants to enable operations in water critical locations</td>
</tr>
</tbody>
</table>

Additional benefits could be realized after a detailed audit
## Distinct tools and solutions to create value

<table>
<thead>
<tr>
<th>Diagnose and build business cases</th>
<th>Create water operational excellence road map</th>
<th>Implementation planning</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditing of power station water usage and efficiency across the fleet to benchmark</td>
<td>Operational excellence road map allows for...</td>
<td>4 delivery models possible in which Veolia offers for new assets (including refurbishments) to...</td>
<td></td>
</tr>
</tbody>
</table>
| **True Cost of Water approach**, taking into account direct, indirect and risk-related costs | **Cost reduction**  
- Decrease costs for *water* usage  
- Decrease cost for *chemicals* spending by e.g. Continuous Electro-Deionization  
- Improved *process performance* (e.g. operations improvement and reducing maintenance needs) |  
- Design, build/operate and maintain  
- Build, own, operate and transfer  
- Operate and maintain | |
| Water cost/benefit curves as a basis to define improvement potential and investment decisions | **Revenue increase**  
- *Yield* improvement of power plants  
- *Uptime* increase via continuous water supply |  
- Acquire, operate and maintain | |
| **Ensurance of license to operate**  
- *Fulfillment* of strictest environmental regulations  
- Secure *reliable access to high-quality water* for all stakeholders | | | |
Eliminate chemicals usage and significantly reduce water consumption by introducing tailored four step process

**What was the situation faced?**

- **Millmerran Coal Power Station** – QLD, Australia
- Usage of **low-sulfur coal** in combination with advanced technologies
- **Dependence on one single water source**
- **Customer needs:**
  - Maintaining competitive position in electricity market
  - Reduction of dependence on single water source

**Veolia’s solution**

- Generation of **high-purity water in a four-step process**
  1. Raw water clarification and softening
  2. Gravity filters suspending solid material
  3. Two-Pass Reverse Osmosis
  4. Continuous De-ionisation process (CDI) ensuring consistent water quality without usage of chemicals and non-stop availability
- Combination of technologies for **reduced water consumption and high-purity water provision**

**Impact for the client**

- Cost savings due to...
  - Elimination of chemical spending for de-ionisation process
  - Reduced water consumption by 90%
- Efficiency increase by elimination of regular downtimes for regeneration in de-ionisation process
- **Independence of single water source** by opportunity to use water for production from a sewage treatment plant
- No water taken from surface water or groundwater resources

**Water consumption**

<table>
<thead>
<tr>
<th>Water consumption In percent</th>
<th>Before</th>
<th>After</th>
<th>Conventional</th>
<th>CDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>-90%</td>
<td>100</td>
<td>10</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

**Chemicals in de-ionisation**

<table>
<thead>
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<th>Chemicals in de-ionisation In percent</th>
<th>Before</th>
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<td>-100%</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
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</table>

SOURCE: Veolia, Intergen
Operations and maintenance of power site in mining significantly reduced operating costs

What was the situation faced?

- Power plant upgrade for coal mine client
- Client objectives were to increase efficiency in power, heat and compressed air:
  - **Outsource entire operations of mining site** (~ 1,000 GWh electricity, ~1,000 TJ heat, ~1,6 billion m³ compressed air, ~300 km transmission lines)
  - **Guarantee price and availability of electricity, heat and compressed air generation** (net of input prices)
  - **Improve safety track record**

Veolia’s unique approach

- **20 year contract to operate** the *electricity, heat and compressed air generation and transmission* infrastructure.
- Targeting **labor efficiency** through Veolia’s best practices and training; current workforce composed 99% of former operator’s staff
- Targeting **O&M cost improvements** through Veolia *purchasing network and proprietary maintenance know-how*
- Targeting **generation efficiency** improvement through replacing cogeneration by tri-generation plant and updating compressor network and better regulation

How did it help the customer?

- **Reduced operating cost** of power plant by ~20% from 2010 to 2012
  - Labor reduced by 25%
  - O&M cost (excl. labor) by 15%
- In addition, **increased output through 15% efficiency improvement** and higher uptime over 2 years

Total O&M and labor costs

<table>
<thead>
<tr>
<th>EUR millions</th>
<th>2010</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
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</tbody>
</table>

**~20%**
Provide continuous water supply & prevent environmental damage

What was the situation faced?

- **Eraring Energy**, 2,640 MW coal power station, New South Wales, Australia, supplies 25% of New South Wales power consumption
- **Intermittent existing water supply** and **competition with domestic needs**: need to find a drought-proof water supply for its power station

Veolia's solution

- **15-year contract** between Hunter Water Corporation and Eraring Energy to provide a maximum of 5,300 m3/d secondary treated wastewater
- Re-use the secondary treated effluent from the Dora Creek wastewater treatment plant to provide a drought-proof water supply and to allow **Zero Liquid Discharge** (ZLD)
- Secondary treated sewage from Dora Creek fed to: continuous Microfiltration (CMF) units, 3 Reverse Osmosis (RO) units
- CMF Backwash is sent to Eraring Energy’s on-site wastewater treatment facility and recycled back into the process

Impact for the client

- Water treatment facilities reduced **potable water consumption** to a minimum to free up resource for community
- **Prevention of environmental pollution** in a sensitive area by avoiding wastewater discharge
- **Cost savings** of $1.5 million per year in water and operational costs (reclaimed water cheaper than potable water and fewer regenerations required due to higher purity of reclaimed water) – expected payback period: 6-7 years

Potable water consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption (ML/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>8.4</td>
</tr>
<tr>
<td>1994</td>
<td>4.0</td>
</tr>
<tr>
<td>2010</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Source**: Veolia, Eraring Energy
Emergency response: Contaminated water

**FUKUSHIMA PROJECT**

**The challenge: deliver a plant in 3 months (50 m³/hr)**

Target: treat salt water accumulated in the basement buildings, mainly contaminated with Cesium (Cs) & Strontium (Sr)

**Technical principle:**
- Adsorb radio-nuclides on specific adsorbents
- Settle adsorbents in seawater at high flow-rate

**Equipment:**
- Use Actiflo™ technology, with heavy metal adsorbents to remove Cs & Sr
- Extract sludge & store in a pit before final conditioning
Thank you to our clients
Creating Water Solutions

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