Overview of Brick Kiln Sector in the country
Global brick production: 1.5 trillion bricks/annum

<table>
<thead>
<tr>
<th>Country</th>
<th>Production %</th>
<th>No. Billion P.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>66.67%</td>
<td>1,000</td>
</tr>
<tr>
<td>India</td>
<td>13.33%</td>
<td>200</td>
</tr>
<tr>
<td>Pakistan</td>
<td>3.00%</td>
<td>45</td>
</tr>
<tr>
<td>Vietnam</td>
<td>1.67%</td>
<td>25</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1.13%</td>
<td>17</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.40%</td>
<td>6</td>
</tr>
<tr>
<td>Rest of Asia</td>
<td>0.47%</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total Asia</strong></td>
<td><strong>86.67%</strong></td>
<td><strong>1,300</strong></td>
</tr>
<tr>
<td>USA</td>
<td>0.53%</td>
<td>8</td>
</tr>
<tr>
<td>UK</td>
<td>0.37%</td>
<td>4</td>
</tr>
<tr>
<td>Australia</td>
<td>0.13%</td>
<td>2</td>
</tr>
<tr>
<td>Rest of World</td>
<td>12.40%</td>
<td>186</td>
</tr>
<tr>
<td><strong>Total Rest of World</strong></td>
<td><strong>13.33%</strong></td>
<td><strong>200</strong></td>
</tr>
<tr>
<td><strong>Total World Production</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>1,500</strong></td>
</tr>
</tbody>
</table>
South Asia - 2nd Largest Brick Producing region of Fired Clay Bricks after China

- South Asia Annual Production 250-300 billion bricks/year
- Coal Consumption ~50 million tons/year
- 60-70,000 FCBTKs in the Indo-Gangetic Plains
8 times increase in production in last 40 years (India)
Brick demand likely to increase by 3-4 times by 2047

Between 2012 to 2047, building stock in India to increase by ~500%.
‘Under-construction’ agenda

• Massive “Under-Construction” agenda for countries of the south.

• 70 percent of India is yet to be built.

• Homes, offices and factories require large quantities of building material.

• Cheapest building material so far has been – BRICKS!

• Standard practice
  – - Dig clay/mud from the field
  – - Mould them into bricks
  – - Fire them in inefficient furnaces using different fuel source

• Kilns operate from China to Peru, burning anything cheap.
Concern about rising pollution

- \( \text{CO}_2 \) emissions
- Black Carbon emissions
- PM10, PM 2.5, CO, SOx,

Outside Dhaka

Kathmandu Valley
Brick making process

Mining of clay
(Clay is excavated/collected from agricultural fields, ponds, river banks)

Preparation of wet clay-mix
(Homogenous wet clay mix is prepared by adding water and additives to clay)

Moulding of bricks
(Wet clay-mix is put in moulds to shape into bricks)

Drying
(Bricks after moulding are dried in the open or under shed)

Firing
(Bricks are fired in a kiln to a temperature of 800–1100 °C)
Resource intensive sector

• **Major fuel**: Coal, firewood, heavy oil
• Coal Consumption by Asian Brick Kilns - 110 million tonnes/year
• Highest consumer – China (50 million tonnes/year)
• Kilns have huge variation in efficiency
• Coal consumption varies between 11-70 tonnes coal per 100,000 bricks.

• Clay consumption:
  - China: 1 billion m$^3$
  - India: 350 million tonnes
  - Bangladesh: 45 million tonnes
Brick sector in India

- **Second largest producer – India** (200 billion bricks/year).
- 65% of these made by burning fertile alluvial Indo-Gangetic plains.

<table>
<thead>
<tr>
<th></th>
<th>FCBTK</th>
<th>6500 (N), 17000 (E), 400 (C) 7500 (W) and 1000 (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zigzag</td>
<td>15 (E)</td>
</tr>
<tr>
<td></td>
<td>High Draft</td>
<td>50 (N), 2000 (E)</td>
</tr>
<tr>
<td></td>
<td>Hoffman</td>
<td>500 (S)</td>
</tr>
</tbody>
</table>

- Huge environmental cost associated with this BM:
  - Black carbon emissions
  - Local air pollution
  - Loss of fertile top soil
- Black carbon emissions: as high as 9% of the India’s annual black carbon emission total.
Brick sector in India: Labor issues

• Employs 10 million laborers: unacceptable working conditions
  - Migratory workers
  - Seasonal employment
  - Wages on the basis of number of bricks produced
  - Occupational hazards – no PPE
  - Child labor
  - Non-implementation of Factories Act provision
Technology: Varied & Outdated

Firing Technologies

- Traditional Intermittent
  - Up-Draught
  - Down-Draught
  - Bull’s Trench Kiln
  - Scove Kiln
- Newer Continuous
  - Moving Fire
  - Zig-Zag Kiln
  - Bull’s Trench Kiln (VSBK)
- Moving Ware
  - LCBK/ Clamp Scotch
  - Tunnel Kiln
## Technology vs Workforce

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Kiln</th>
<th>No. of Kiln</th>
<th>No. of Bricks Produced (in billion/year)</th>
<th>No. of People employed</th>
<th>No. of Bricks produced per employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Hoffman Kiln &amp; Tunnel Kiln</td>
<td>80,000</td>
<td>1,000</td>
<td>5 million</td>
<td>200,000</td>
</tr>
<tr>
<td>India</td>
<td>FCBTKs, Clamp</td>
<td>&gt;100,000</td>
<td>200</td>
<td>10 million</td>
<td>20,000</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Clamps &amp; MCBTKs</td>
<td>12,000</td>
<td>45</td>
<td>9 million</td>
<td>5,000</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Tunnel &amp; VSBKs</td>
<td>10,000</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>FCBTKs, zigzag</td>
<td>8,000</td>
<td>17</td>
<td>1 million</td>
<td>17,000</td>
</tr>
<tr>
<td>Nepal</td>
<td>Clamps &amp; BTKs</td>
<td>700</td>
<td>6</td>
<td>140,000</td>
<td>42,857</td>
</tr>
</tbody>
</table>
Technology: Varied & Outdated!

- Clamp technology is equally polluting but without the initial setting up cost (due to no fixed structure).

- That also makes regulation enforcement difficult for these moveable kiln.

- Zigzag kilns are better than FCBTK.

- Air travels in a zigzag path resulting in the reduction of pollutants and black carbon, and is more energy efficient.

- PM emissions: **FCBTK – 250 to 1250 mg/Nm³**
  **Zigzag - Less than 250 mg/Nm³**
Energy efficient technology

• Vertical Shaft Brick Kiln is even a better technology.

• Tunnel Kiln is much more expensive to set up but requires less man power compared to FCBTK & Zigzag.

• Best technology available so far for large scale production for brick production in industrialized country.

• The advantages of using Tunnel Kiln are:
  - It can fire a wide variety of products.
  - Good control over the firing process.
  - Ease of mechanization, thus reducing the labor requirement.
  - Has large production volume.
Technology comparison

Black Carbon (g/kg fired brick)

Conventional
- Downdraft
- FCBTK

Alternate
- VSBK
- Zigzag HD
- Zigzag ND
- Tunnel
Environmental impacts

**Emission**
- Particulate matter
- SO\(_x\), NO\(_x\)
- GHG
- Black carbon
- Toxics emission

**Clay mining**
- Unregulated mining
- Land degradation
Class exercise
<table>
<thead>
<tr>
<th>Country</th>
<th>Emission standard (mg/Nm³)</th>
<th>Stack height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>1000</td>
<td>37</td>
</tr>
<tr>
<td>Nepal</td>
<td>400-700</td>
<td>15-30</td>
</tr>
<tr>
<td>India</td>
<td>250-1200</td>
<td>12-30</td>
</tr>
<tr>
<td>Vietnam</td>
<td>No emission standard</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>Clamps: Ambient air quality standard</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>No standards for brick kiln, ambient air quality standard applies</td>
<td></td>
</tr>
</tbody>
</table>
## Problem in implementation

<table>
<thead>
<tr>
<th>Size</th>
<th>Kiln capacity</th>
<th>Stack height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Less than 15,000 bricks per day</td>
<td>Minimum stack height 22 metre [OR]</td>
</tr>
<tr>
<td></td>
<td>(less than 15 ft trench width)</td>
<td>Induced draught fan operating with minimum draught 50 mm WG with 12 metre stack height</td>
</tr>
<tr>
<td>Medium</td>
<td>15,000 to 30,000 bricks per day</td>
<td>Minimum stack height 27 metre with gravitational settling chamber [OR]</td>
</tr>
<tr>
<td></td>
<td>(15 ft to 22 ft trench width)</td>
<td>Induced draft fan operating with minimum draft 50 mm WG with 15 metre stack height</td>
</tr>
<tr>
<td>Large</td>
<td>More than 30,000 bricks per day</td>
<td>Minimum stack height 30 metre with gravitational settling chamber [OR]</td>
</tr>
<tr>
<td></td>
<td>(More than 22 ft trench width)</td>
<td>Induced draft fan operating with minimum draft 50 mm WG with 17 metre stack height</td>
</tr>
</tbody>
</table>
2\textsuperscript{nd} largest industrial consumer of coal

- **Steel**: 20% (47 TPA)
- **Bricks**: 15% (35 TPA)
- **Cement**: 125 TPA (29 TPA)
- **Others**: 53% (125 TPA)

Total: 236 tonnes per annum (TPA)
Clay Mining

• Run majorly by informal players

• Regulations are lax- comes under ’eco-friendly mining’ (No blasting, less manpower)--- CTO obtained easily from SPCB

• No specific guidelines on working depth

• Nexus between brick manufacturers and farmers: Brick manufacturer procures clay from unregistered farmlands also--- goes unrecorded
Siting Guidelines

• India, Bangladesh and Nepal has

- Distance from human settlement, hospitals, school
- Distance between two kilns
- Distance from water body, forest
- Water sprinkler, paved approach road, housekeeping,
- A Sign Board showing the name, address and capacity of the brick kiln as well as validity of the consents should be displayed at the entrance of the site

• Rarely followed
Challenges with the sector

• Run by informal players

• **Cheap traditional kiln**: cost of conversion is not small.

• **Low cost of labor**: hindrance to mechanization

• Conservative building material

• Lack of R&D
Policy interventions

• Nepal: Banned the movable bulls trench kiln
• Europe: Tall chimney because of acid rain issue
• Bangladesh: Banned FCBTK, moving towards zigzag, Hoffman kiln and VSBK, banned use of agricultural soil
• India: Banned Moving bulls trench kiln in 1996 and introduced emission standard for VSBK kiln
• South Africa: Government incentive to move from energy inefficient clamps to cleaner technology, carbon tax on brick sector
Policy interventions

• Vietnam
  • Department of building Materials
  • Vietnam Construction Glass and Ceramic Corporation

• China
  • Organised sector: Township and Village enterprises & State Owned Enterprises
  • Easy to regulate
  • 1999: Banned the use of solid clay bricks in coastal cities
  • 2004: Controlled use of solid clay brick in small towns and rural areas
  • 2005: 170 cities
  • 2007: Phasing out outdated technologies