ABB were asked by an ammonia manufacturer to generate and review options for increasing capacity of their existing facility by 35%.

ABB developed a structured approach in order to ensure the study generated options that met all of the required criteria.

- Name plate capacity 600 mtpd
- Operational capacity 640 mtpd
- Target production 810 mtpd

Other constraints on the project were:

- The need to increase CO₂ availability to allow for increase in urea production
- Reducing or at least maintaining specific energy consumption

Other issues that were necessary to consider were the steam balance; the plant was firing the convention section tunnel burners as well as auxiliary boilers in order to generate sufficient steam for the process and turbine requirements. An additional factor was that gas burned in the auxiliary boilers was taxed at a higher rate than the gas used on the process plant, hence, it was desirable, that the revamp option removed the need for firing the auxiliary boilers.

Solution
The first step was to undertake a detailed examination of the current process and plant operation. A detailed model was constructed using simulation software. This data was reviewed and rationalised to ensure that a thorough and complete understanding of current operations was gained, before further study was undertaken.

Because of this investigation, the process was fully optimised and decisions could be made early in the study as it was identified that several equipment items, including reformer burners, reformer risers and syngas compressors would require replacement as all were bottlenecks to further rate increase. Other items were identified as constraints as they were giving high pressure drops.
The process options that were reviewed as part of the study were:

- **Base case**  
  Current process optimised

- **Case 1**  
  Feed change to lean gas and existing plant optimised

- **Case 2**  
  Pre-reformer addition

- **Case 3**  
  Addition of pre-reformer and hydrogen recovery unit

- **Case 4**  
  Addition of pre-reformer, hydrogen recovery and naphtha injection to increase CO₂ available for downstream urea production

- **Case 5**  
  Addition of flue gas recovery to case 4 in order to increase CO₂ available for downstream urea production

Constraints were reviewed for each of the options studied, and required modifications identified, as shown in the table below. The new items were then costed in order to generate a preferred option for further study.

The selected option was taken on to FEED and then detail design and was ultimately installed by the operator. The objectives were all met, with the new flowsheet not requiring additional steam from the auxiliary boilers, this gave a significant financial operating saving to the asset.

**Benefits**

- Project delivered on time and to a tight timescale
- Production increased by 35%
- Reduced production costs
- Increased production and plant flexibility because of improvements made by removing significant production bottlenecks
- Using ABB expertise enabled the client to continue to focus on core production activities. ABB’s experts were able to quickly identify the root cause of the performance problems and implement improvements to bring about an initial increase in performance
- Compliance with safety requirements
- Meeting industry best practice for process safety

<table>
<thead>
<tr>
<th>Equipment required</th>
<th>Base case</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
<th>Case 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphtha purification HDS &amp; ZnO / ultra-purification vessels</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>New ultra-purification vessel</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-reformer</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Primary reformer tubes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Primary reformer risers</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Primary reformer burners</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Synthesis gas booster compressor and cooler</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Stack CO₂ recovery system</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Convection section</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HRU</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>