CHAPTER 15

Procedure for Industry in Attaining Zero Pollution

Planning for an EBIC

In planning for an environmentally balanced industrial complex (EBIC), several subjects and associated steps must be considered and taken prior to starting the system. They include, at a minimum, the following 11 subject steps:

1. Select and educate the EBIC developer
2. Location
3. Compatibility
4. Optimize production sizing of participating plants
5. Hold an informational meeting with participating plants and regulatory officials
6. Design the flow diagram for the complex
7. Develop a computer program of varied inputs and operating conditions
8. Perform a “dry run” (on paper) of the complex including all potential variations
9. Review architectural and engineering plans of the EBIC
10. Participate and observe construction of EBIC
11. Observe and consult with plants during startup of the EBIC

1. At the onset, the developer and/or purveyor of the land must be sought out and *indoctrinated* with the principles of an EBIC. Preferably, the developer should be shown schematic diagrams of industrial plants operating at separate locations with associated environmental damages. Then, he or she should be shown a schematic overlay of the same industrial plants located adjacent to each other in the EBIC, with no adverse environmental damages. At the very least, the developer should also be shown examples of EBICs with proven economic advantages of lowered real production costs (see Chapter 16B). The developer should be convinced to seek suitable industries to relate the economic and environmental advantages of his or her EBIC. The developer is then fortified as a seller of a more advantageous land-utilization system

2. The *location* of the proposed complex is an extremely vital component of the plan. The site must be acceptable to each of the industrial participants. Each will have its own preferences depending on many components such as source of raw materials, market for its products, and availability of economical utilities. Compromises by all participants will be necessary to arrive at a site agreeable to all of them. One thing that is certain, however, is that no longer will the managers of industrial plants need to be concerned with the effect of their wastes on the environment. This factor has been eliminated by the use of the EBIC. In fact, now the plants may be able to locate at a site more favorable to other production and marketing decisions. For example, a site adjacent to a metropolitan or residential area may be selected, because pollution of the city or homes is stopped by using an EBIC. A site may eventually be selected that will be less costly to purchase or operate on once concern for external pollution is relieved.
3. *Compatibility* between plants will be sought. The developer must select proper industrial plants that fill the needs for raw materials of each other. Their wastes must be reasonably suitable for raw materials for each other with little or no alteration. All plants should produce wastes that need reusing by others to avoid environmental contamination. The incentive—both moral and financial—would then exist for locating in an EBIC. In fact, economic incentives are major driving forces for such industries, with social environmental incentives secondary for most industries. It is important to remember that all industries exist to produce a useful product at a profit.
4. The developer must *search and obtain plants of the proper size* so as to optimize production quantities of the participants. It will not do to select an industry that produces more waste (as a normal operation) than can be used by another participant (also as a normal requirement). Naturally, there will be times when one participant will produce an excess of waste because of market demands for its product. The other industry should recognize this and be prepared to either increase its production or prepare to store some waste for future use. It is vital, however, that all of one plant's waste be used eventually by another plant in the complex.
5. An *informational meeting* between all complex parties and the proper state environmental regulatory authorities should be held before the decision to locate, build, and operate the EBIC. At this meeting, it should be made clear to the state that the concept of no wastes reaching the environment is new and binding upon all plants in the EBIC. Flow diagrams, mass balances, and even production data may have to be prepared ahead of time and explained to the state. The concept of waste utilization rather than waste treatment must be explained and defended to all regulatory authorities. These latter will facilitate receiving a state permit to operate.
6. It falls on the consulting engineer for the EBIC to design the *flow diagram* and to prepare and present each plant's flow diagram of its product, water, and wastes (air, water, and solids). The engineer will have to work first with each industry separately and then with personnel of all plants jointly in this venture. It must be explained to all participants that no wastes can be left out and all wastes must be reused by another plant. The consultant must substantiate that all wastes are reusable by another plant. Proof of these assertions may come from the literature,

the experiences of other plants, or even pilot plant studies, if necessary. The consulting engineer's new role is that of designing a mass balance flow diagram that guarantees full waste utilization within the complex. In some cases, it may be necessary for the engineer to design certain waste alteration or amelioration systems to provide a directly acceptable and reusable waste for one of the plants.

7. It is now necessary to *develop a computer program* that contains the various inputs and operating conditions of the EBIC. There are many possible computer programs that can optimize the efficiency of the EBIC, but all of them contain the objective of eliminating all unused wastes. A simple example can be expressed by the following equation:

$$(P1+P2)\ (W1+W2) = (P1+P2)W3,$$

where

P1 = production units of Plant 1,
P2 = production units of Plant 2,
W1 = wastes of Plant 1 used by Plant 2,
W2 = wastes of Plant 2 used by Plant 1, and
W3 = total wastes unused (not reused) from both plants,plus the reused wastes (W1+W2).

By increasing or decreasing P1 and P2, both W1 and W2 will increase or decrease accordingly. The goal of a perfect EBIC will be to produce no excess waste (W3) within the complex, regardless of the levels of P1 and P2. This can be accomplished only when W1 + W2 = W3.

For example, suppose Plant 1 when operating normally produces 100 units of goods and 20 units of wastes, while Plant 2 produces 50 units of goods and 10 units of wastes with no unused wastes. Then

$$(100+50)\ (20+10) = (100+50)\ (30)$$

or

$$150 \times 30 = 150 \times 30$$

and

$$4{,}500 = 4{,}500.$$

And now Plant 1 increases its production to 150 units and 30 units of waste. If Plant 2 does not also increase its production by 50%, then

$$(P1+P2) \times (W1+W2) \neq (P1+P2) \times W3$$

$$(150+50)(30+10) \neq (150+50)50$$

$$200 \times 40 \neq 200 \times 50$$

$$\text{and } 8{,}000 \neq 10{,}000.$$

Thus, Plant 2 must also increase its production to reuse all the waste from Plant 1. The program will reveal how much production each plant must have in order to completely reuse all of the wastes from both plants.

8. Before an agreement of the participants in the EBIC is made, they should engage in a "dry run" on paper including all potential variations of possibilities. Each plant participant would begin by revealing its planned starting production quantity and raw materials needed, along with amounts of liquid and solid wastes expected to occur from that production. At this level of operation, each plant would then agree on the amount of each plant's waste that would be acceptable as a replacement for a portion of its raw material. Ideally, all waste quantities could be used to replace part or all of the raw material requirements of other plants in the EBIC. This would then result in zero discharge of any waste external to the EBIC.

   If and when the proportions of wastes to raw material is not an exact match, participating plants must make adjustments in production quantities so that all wastes are reused. If adjustments in productions cannot be made satisfactorily, participants have to agree on how to store or handle the wastes rather than discharge them externally.

   Regardless, discussions should ensue concerning all potential variations in production possibilities. These should include no production situations, as well as greatly accelerated rate of production requirements. All potential situations should be discussed at this session so that no surprises or unusual events will occur under real conditions.

   Emphasis should be placed on making certain that no situations arise in which unusable waste cannot be handled without discharging outside the complex.

9. *Architectural and engineering plans* for the EBIC are now in order. The engineering consultant for the EBIC should prepare preliminary plans for the location of the piping, plumbing, and mechanical and electrical equipment of the plants. These should be coordinated with those of the architect/engineer for each of the plant participants. The latter people have the responsibility to prepare the design and specifications and location for all production equipment of the plants. The engineering consultant, on the other hand, is responsible for all piping, pumping, and other treatment units for the water supplies and liquid and solid wastes arising from the production of manufactured goods in the complex. The two groups of consultants should work together closely, especially where production and wastes locations interface. In that manner, decisions involving responsibilities for design and rationale for location of equipment can be discussed and agreed upon. The final output from these two groups should provide a master plan containing the entire complex's layout of production and wastes reuse, piping, pumping, and equipment.

   It is recommended that all plant engineers and/or managers be present at meetings with the two groups of consultants. After the final master plan has been presented and approved by all plant administrators, these plant managers would be familiar with reasons for and operations of all manufacturing units. This is extremely important if and when any unforeseen EBIC changes in operations are necessary.

The overall aim is to produce a team of EBIC plant managers capable of making and following through on all production and environmental decisions for all plants in the complex.

10. *The participation and observation* of the construction of the complex is of utmost importance. Once the master plan for the complex has been prepared and approved, construction permits must be obtained from local governments and state environmental agencies. The environmental consultant and engineers for all participating industries in the complex should supervise its overall construction.

    Of prime importance during this phase of the project is that of making certain that the construction follows the plans accurately. The flow of all liquids and solids to and from all plants should exist as designed. Pipe and pump sizes should be ample to carry waters and wastes several times that of average flows. The consultant should pay special care that no liquids overflow or seep into the ground in the complex, and that no solid wastes be placed on bare ground while awaiting movement to be reused within the complex. Without any doubt, construction should ensure that neither liquid nor solid wastes arising from the participating plants can possibly escape the complex into the external air, land, or water environment.

11. The startup of operation should be *observed by all plant key operating personnel*. The environmental consultant should be on-site during the initial startup of the plants in the EBIC. Timing has to be such that all plants begin production simultaneously. Questions of waste reuse and utilization by the plants will be expected to occur. The consultant's presence provides assurance that these wastes, regardless of quality concerns, will be used entirely within the complex. Modifications may be necessary during the startup period to meet these requirements. Despite all previous planning, innovations may be deemed necessary. For example, some solid wastes may have to be altered or divided among production locations before acceptable reuse. Some liquid waste may require filtering, heating, disinfection, and so on so that production can proceed properly. Once again, the environmental consultant is on hand to answer questions and offer suggestions, but most of all to make sure that no external environments are affected by accidental or purposeful discharge of wastes.

Realistic Implementation of the EBIC System

Perhaps the most important step and most difficult to instigate is that of implementing the EBIC system. I propose that it is most likely to commence in any of the following manners:

1. State statute
2. Business acumen of a property developer
3. Either of the above, but with the aid of local governmental provision of tax-free land and/or services

There have been precedents for all of the above in environmental matters. However, some discussion of each of these procedures is in order.

1. The states have administered water-quality standards since the last half of the twentieth century. These include not only establishing the standards, but also advising and reviewing the planning and procedures, as well as enforcing the rules and regulations. In our case, states would have to be empowered to require all waste-producing industries to locate their plants in complexes so that their wastes are reused as raw materials by ancillary plants. The states would then be assured that no wastes from these industries would reach the environment outside the complex.
2. Ambitious entrepreneurs may acquire a large piece of property and seek and induce compatible industries to build and operate within the property complex. Such property owners/managers must understand and be champions of environmental protection. They must also be able to find and convince these industries that their manufacturing costs would be minimized within this complex, while eliminating their environmental pollution concerns. The support and encouragement of local and state governments would enhance land developers in obtaining industries for the complex. They might even join forces with environmental engineers to advise these industries on waste utilization and water quality. This would be a selling point for the developer and permit him or her to lease at a premium industrial property within the complex.
3. The enactment of state statutes and/or the enterprise of entrepreneurial land developers would be greatly beneficial as local inducements to industry. In the 1940s to 1960s, it was common practice among small governmental jurisdictions to set aside tax-free land to induce desirable industrial plants to build there. Often, they also provided utilities such as water and sewage at reduced rates. They also built pipelines to accept their wastes and roads or railroad spurs to facilitate transporting of raw materials and finished products. Obviously, the combination of 1 and 2 with 3 above would be the most desirable approach to implementing the EBIC concept.

From a practical standpoint, however, it will probably take a catastrophe of some kind before the logical use of EBICs will commence. *Industrial enlightenment* usually occurs as a result of critical situations such as dangerous environmental pollution or disastrous economic conditions. When these occur, and coupled with the three procedures listed earlier, we will see the day of the natural EBIC begin as “standard operating practice.”