**Use of Blueprints for Industrial Symbiosis Detection – The Case of Heat Integration Between a Refinery anda District Heating Network.**

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**Highlights**

* Utilisation of blueprints for the detection of industrial symbiosis opportunities
* Heat integration between a refinery and a District Heating Network

**1. Introduction**

Industrial Symbiosis (IS) is at the heart of the European Union’s (EU) strategy to transition towards a lower carbon and more circular economy. It focuses on the cooperation of large and small enterprises in industrial or district clusters for exchanging materials, energy and waste (co-product) [1] as well as services, technologies or even knowledge and information [2], [3]. However, data confidentiality is still a barrier, preventing the discovery of new IS opportunities. The concept of blueprints [4], developed in the framework of the EPOS project [5], is a solution for sharing information across industry sectors. In this abstract, the blueprints’ thermal energy profiles of a refinery and a District Heating Network (DHN) are combined in order to find heat integration opportunities between a petrochemical site and a nearby community.

**2. Methods**

|  |  |
| --- | --- |
| (a) | (b) |

**Figure 1.** Refinery (a) and DHN (b) blueprints’ thermal profiles

The blueprint’s thermal energy profile includes the hot and cold requirements of a given process [4], represented by Pinch Analysis composite curves [6]. The refinery’s blueprint consists of 10 interconnected process units comprising: a crude distillation unit, a gas plant, three hydrotreatment units, a catalytic reformer, an isomerisation unit, a vacuum distillation unit, a visbreaker and a fluid catalytic cracker with a total capacity rate of is 35’000 tcrude/d. The DHN blueprint is available for four different climate locations, obtained using the European heating and cooling indices [7]. In this work, the distribution network is located in the Northern Zone (Zone 5) with a population of 10’000 inhabitants. The refinery and DHN thermal profiles are respectively displayed in figure 1.

**3. Results and discussion**

Table 1 shows the DHN’s thermal power consumption before and after heat integration with the refinery. The DHN’s energy consumption is decreased by ~50% (-9.57 MW) after the integration with the refinery. It shows that there is an interesting potential for creating a synergy between a refinery and an urban area. Nevertheless, it should be noted that the distance between the refinery and the DHN is not considered (no heat losses and no pressure drop) as well as the related investment costs.

**Table 1.** DHN thermal power consumptions before and after integration with the refinery

|  |  |  |
| --- | --- | --- |
|  | **Power Business as Usual (kW)** | **Power after integration (kW)** |
| **Refrigeration** | 200 | 200 |
| **Centralised heating** | 142.2 | 0 |
| **Electrical heating** | 47.84 | 0 |
| **Heating District Hot Water** | 2’031 | 2’031 |
| **Space heating** | 7’446 | 7’446 |
| **Boiler** | 9’380 | 0 |
| **TOTAL** | 19’247 | 9’677 |

**4. Conclusions**

The use of blueprints is a powerful tool for overcoming the burden of industrial data confidentiality. The case of heat integration between a refinery and a DHN demonstrates that blueprints can be used for the identification and evaluation of new IS opportunities. When integrated with the refinery, the DHN’s energy consumption is reduced by 50%. This case can also be replicated for other geographic zones, different population sizes and for various capacity rates of the refinery. A complete thermos-economic study should also be carried in order to take into account all the costs.

**References**

1. M. R. Chertow, ‘INDUSTRIAL SYMBIOSIS: Literature and Taxonomy’, Annu. Rev. Energy Environ., vol. 25, no. 1, pp. 313–337, Nov. 2000.
2. G. Van Eetvelde, ‘Industrial Symbiosis’, in Resource Efficiency of Processing Plants, John Wiley & Sons, Ltd, 2018, pp. 441–469.
3. D. R. Lombardi and P. Laybourn, ‘Redefining Industrial Symbiosis’, J. Ind. Ecol., vol. 16, no. 1, pp. 28–37, 2012.
4. H. Cervo et al., ‘Virtual Sector Profiles for Innovation Sharing in Process Industry – Sector 01: Chemicals’, in Sustainable Design and Manufacturing 2017, 2017, pp. 569–578.
5. EPOS, 2018. [Online]. Available: https://www.spire2030.eu/epos.
6. B. Linnhoff and E. Hindmarsh, ‘The pinch design method for heat exchanger networks’, Chem. Eng. Sci., vol. 38, no. 5, pp. 745–763, Jan. 1983.
7. S. Raluca, K. Ivan, B. Hur, G. Luc, and M. Francois, ‘Geographically parameterized residential sector energy and service profile’, Chem. Eng. Trans., pp. 709–714, 2018008.