



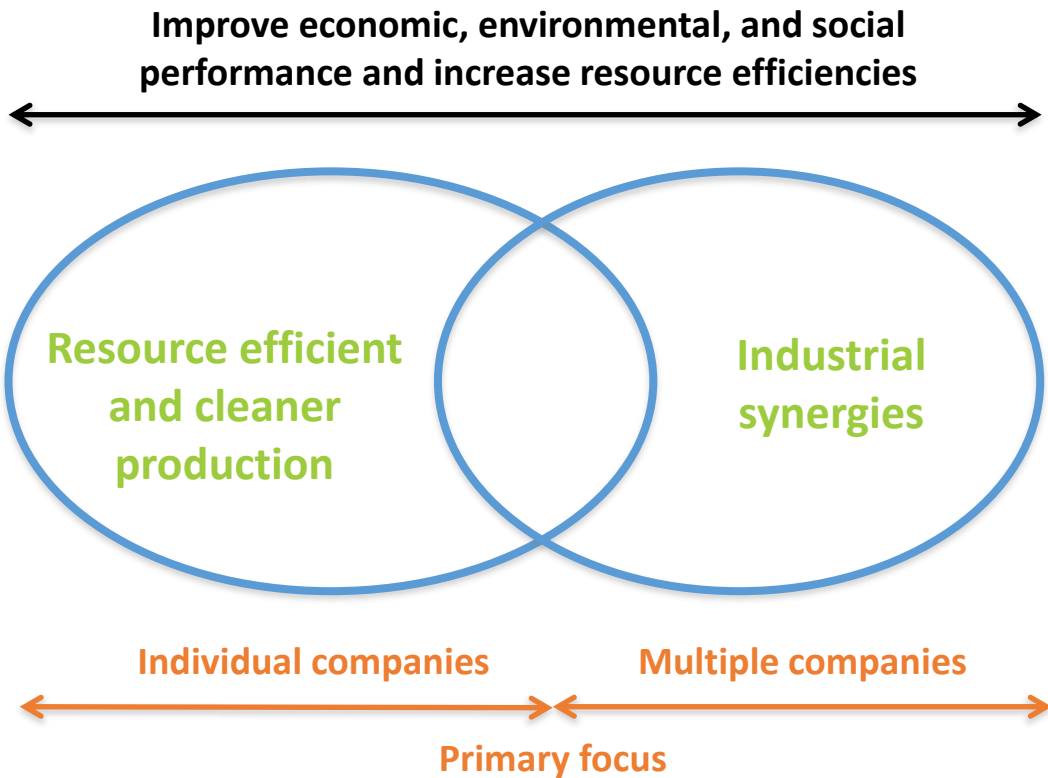
UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

An aerial photograph of a large industrial park with numerous large, interconnected factory buildings, parking lots, and some green spaces. The buildings have various roof colors, including grey, blue, and white. The park is surrounded by roads and some trees.

# Industrial symbiosis concept, its benefits, and advantages; Lessons learned from GEIPP I in Ukraine

# Cleaner production and industrial synergies

## Complementary approaches



- **Utility synergies and infrastructure sharing:** Shared use of utility infrastructure, mainly revolving around water and energy (e.g. water recovery and energy cogeneration).
- **Supply synergies and co-location of suppliers and clients:** Co-location and clustering of companies in the supply and value chains (e.g. producers and suppliers of raw materials, fabricators, manufacturing, business clients).
- **By-product synergies and waste exchanges:** The use of a previously disposed by-product (as solid, liquid, or gas) from one facility by another facility to produce a valuable by-product.
- **Service synergies:** Sharing of services and activities between industries in an industrial parks (e.g. joint training of staff and sharing of maintenance contractors).
- **Urban-industrial synergies:** Interlinkages and collaborations between companies and cities/municipalities on the collection, processing and reuse of materials, wastes, energy and water streams.

[Click here to play short video on Kalundborg Symbiosis Centre](#)

Kalundborg is most published example of industrial synergies.

Kalundborg municipality is truly part of industrial synergies.

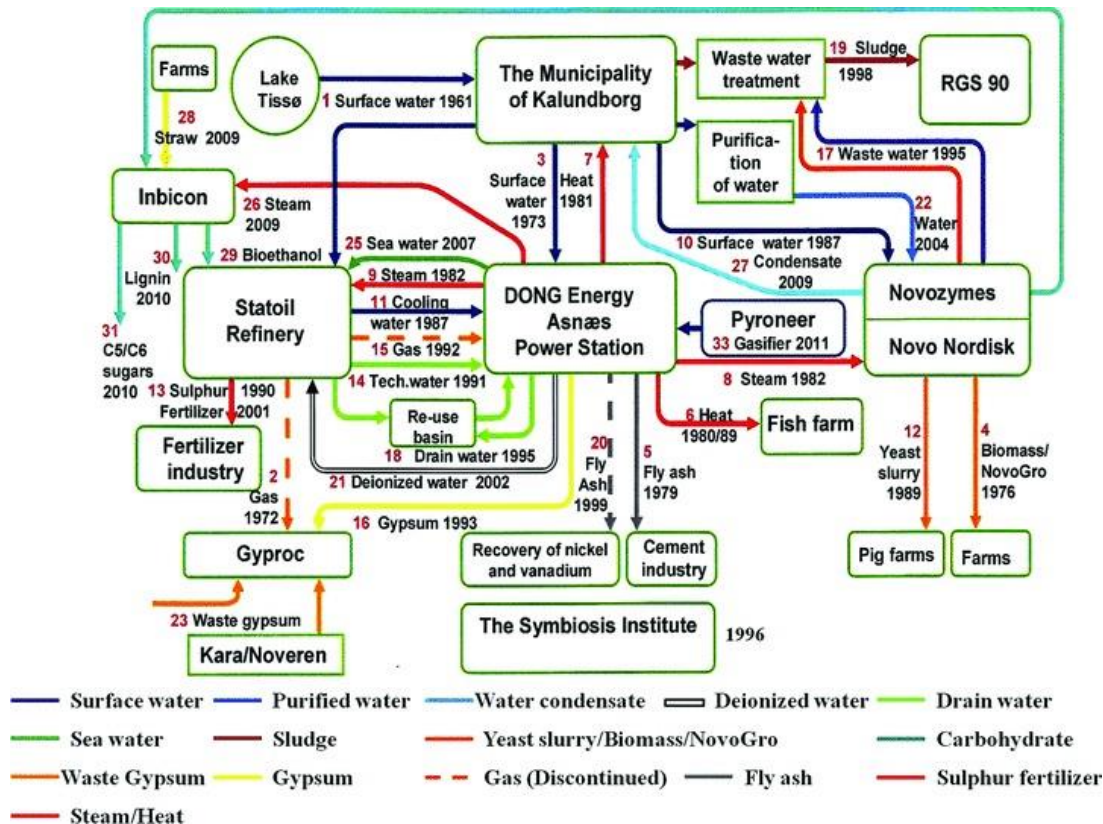


Image: Sonja van Renssen, Nature Climate Change 2, 388–391 (2012)



Practical example

## Kwinana Industrial Area, Western Australia



### Kwinana is Australia's largest heavy industrial area

- Coastal strip of about 1200 hectares, 40 km south of Perth
- Established in 1950s for development of heavy industries in Western Australia
- Direct employment of over 4,000 people

### Co-existence of diverse and non-competing processing industries.

- Resource processing: e.g. alumina, nickel, oil refineries
- Utility: e.g. power, water treatment, co-generation plants
- Manufacturing: e.g. cement, chemical, fertiliser plants

### Kwinana Industries Council

- Established in 1991
- 37 member companies
- Role: coordination, liaison, promotion, long term viability



Further information on the Kwinana Industrial Area: [www.kic.org.au/](http://www.kic.org.au/)



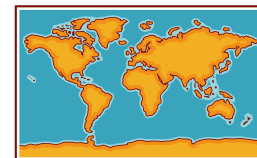
## Existing synergies in Kwinana

- Over 50 supply synergies
- 33 by-product synergies
- 15 utility synergies

## Kwinana compares favourably with other international examples of synergy development

(Bossilkov et al, 2005)

- Greatly exceeds 'business-as-usual'
- Best-practice example of synergy implementation
  - Maturity, diversity, and number of synergies



## Industry commitment to achieve further synergies

- Strategic importance



## By-product synergies:

- Reuse of lime kiln dust for desulphurisation
- Reuse of gypsum for soil amendment



## Utility synergies:

- 2 Cogeneration facilities
- Joint wastewater treatment plant between chemical plant and oil refinery



## Supply chain synergies:

- Air Liquide and BOC Gases supplying gases to multiple industries
- Cement plant supplying cement products to construction companies



## Service synergies:

- Air and water quality monitoring, facilitated by Kwinana Industries Council (KIC)
- Dialogue events with community and government agencies (every 2 months)





Source: Van Beers D. (2008). Capturing Regional Synergies in the Kwinana Industrial Area - 2007 Status Report. Centre for Sustainable Resource Processing, Perth, Australia.

### Kwinana Water Reclamation Plant

- Facility is a joint initiative of the Water Corporation and Kwinana companies
- Facility secures water supply to Kwinana companies. Lack of competitively priced water is a „showstopper“ for large water intensive companies.
- Double benefit of greater overall water efficiency and reduced process water discharges into Cockburn Sound (sensitive marine environment).
- Production of 6,000 ML/year of industry feedwater from treated effluent from municipal WWTP
- Capital cost of A\$ 25 million, invested by Water Corporation. Return on investment through long-term water supply contracts to water intensive companies.



## BENEFITS OF SYNERGIES: BEYOND TRADITIONAL BUSINESS CASE

Synergy	Commercial benefits	Environmental and community benefits
CSBP gypsum re-use at Alcoa residue area 	<ul style="list-style-type: none"> <li>▪ Reduced costs to manage gypsum stockpile (long-term)</li> <li>▪ Lower cost gypsum source for alumina refinery</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduction of stockpiled gypsum onsite at chemical plant</li> <li>▪ Increased soil stability and plant growth at Alcoa residue area</li> </ul>
Air Liquide utilising by-product CO <sub>2</sub> from Kwinana industries 	<ul style="list-style-type: none"> <li>▪ Costs savings for industrial gas company to produce food grade CO<sub>2</sub> from otherwise emitted CO<sub>2</sub> emissions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Proportion of CO<sub>2</sub> emissions from industries are no longer emitted to the atmosphere</li> <li>▪ Avoidance of energy use that would otherwise be required to produce CO<sub>2</sub> from air</li> </ul>
2 Cogeneration facilities (BP, Tiwest) 	<ul style="list-style-type: none"> <li>▪ Increased energy efficiency</li> <li>▪ Reliable source of electricity and superheated steam</li> <li>▪ Sales of electricity and steam from cogeneration plant</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduced greenhouse gas emissions</li> <li>▪ Increased energy efficiency</li> <li>▪ Employment</li> </ul>
Kwinana Water Reclamation Plant (KWRP)* 	<ul style="list-style-type: none"> <li>▪ Water security for industry users</li> <li>▪ Availability of high-grade water for industry</li> </ul>	<ul style="list-style-type: none"> <li>▪ Potable water conservation</li> <li>▪ Redirection of discharges of treated industrial effluent from coastal zone into deep ocean</li> <li>▪ Water quality improvement in sensitive coastal zone</li> </ul>

Source: Van Beers D., (2007). Capturing Regional Synergies in the Kwinana Industrial Area - 2007 Status Report. Centre for Sustainable Resource Processing, Perth, WA, Australia.

## How did Kwinana become so successful in industrial synergies?

- Kwinana Industries Council (KIC)
  - Member based industry organization
  - Platform for industry and stakeholder collaboration
  - Collective approaches to address regional challenges
- Industry diversity and proximity of industries
- Industry commitment and champions within companies
- Companies' understanding that environmental and social risks are business risks
  - E.g. access to water, community complaints, dusts
- Challenge / opportunity
  - Move beyond “low-hanging fruit” synergies





## Promoting and contributing to the sustainable co-existence of the Kwinana Industry, the Community and the Environment.

Home to industries that pump \$16B into the State's economy annually, and employ around 30,000 workers directly and indirectly.

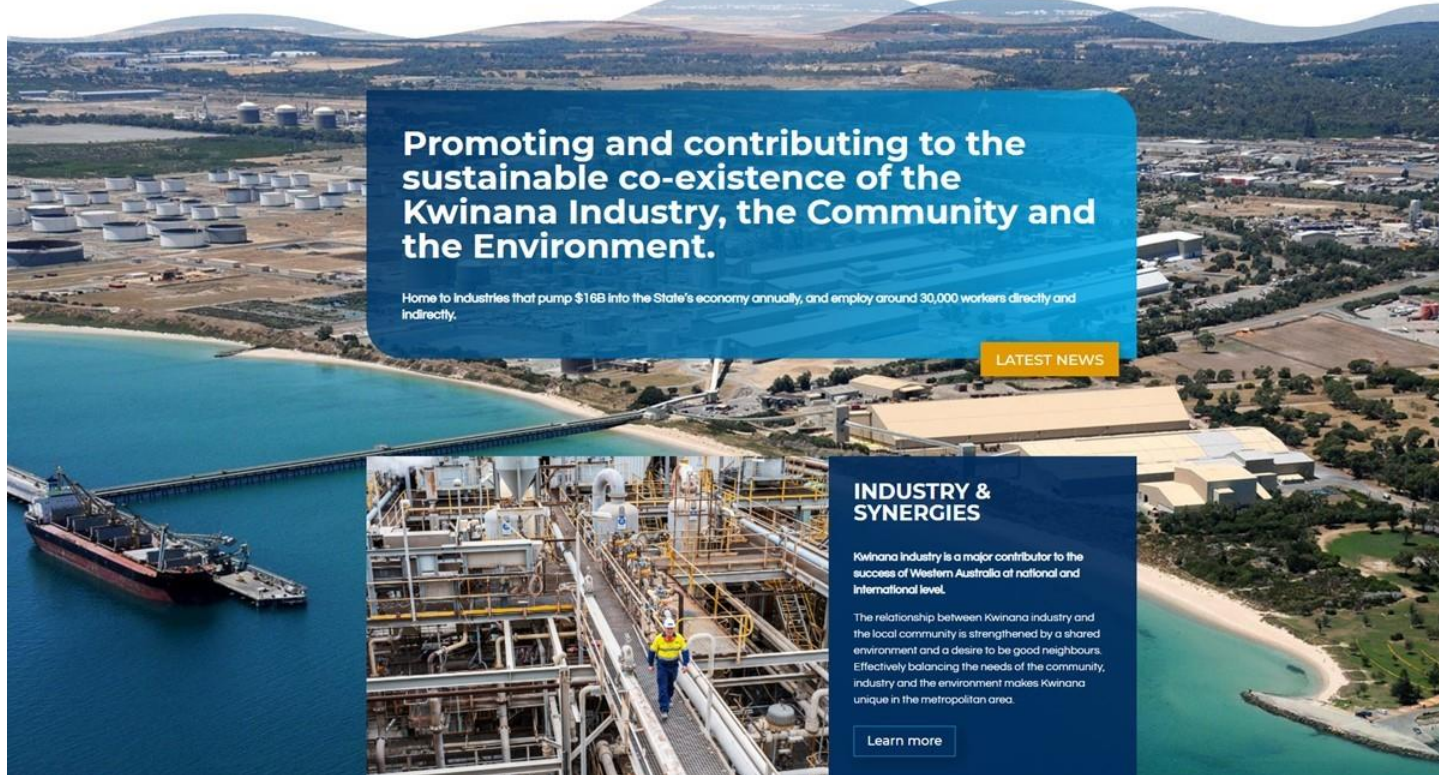
LATEST NEWS

### INDUSTRY & SYNERGIES

Kwinana Industry is a major contributor to the success of Western Australia at national and international level.

The relationship between Kwinana industry and the local community is strengthened by a shared environment and a desire to be good neighbours. Effectively balancing the needs of the community, industry and the environment makes Kwinana unique in the metropolitan area.

[Learn more](#)



## ACA Threads, a sewing thread manufacturer in Cape Town, purchases back empty thread spools from their customers.

- This is mutually beneficial as it generates extra income for the customers and reduces their waste.
- The empty spools are cleaned and re-used in the production process at ACA Threads, reducing their costs as they do not have to purchase new spools.
- Damaged spools are sold to the injection moulder to be reground.

### Benefits from this initiative over a 5 year period

- The company has saved more than R460,000 through recovering and re-using units
- ACA Threads has managed to generate new sales from customers interested in the sustainable approach
- ACA's customers have saved more than R55,000 by landfill diversion
- ACA Threads has paid more than R41,500 back to their customers
- 7 tons of non-biodegradable polypropylene diverted from landfills
- Spools are cleaned by 2 charitable associations, generated income of R120,900.



## Clariter plastics recycling facility in the East London Industrial Development Zone, South Africa

- 80 tpa pilot plastic recycling facility to produce solvents, oils, waxes
- Industrial development opportunity
- Development of downstream SMMEs to produce polishes, cleaning products and candles, that can use up to 50% of Clariter's product



**CONTRIBUTION TO SUSTAINABLE CITIES**

**COUNTRY HIGHLIGHT**  
SOUTH AFRICA

**DEVELOPMENT OF URBAN-INDUSTRIAL SYNERGIES BETWEEN BUFFALO CITY METROPOLITAN MUNICIPALITY & THE EAST LONDON INDUSTRIAL DEVELOPMENT ZONE**

**KEY INTERVENTIONS**

- Waste management and value recovery from municipal solid waste, recyclables, organic waste and hazardous waste are key priorities of the Waste Management Department of the Buffalo City Metropolitan Municipality (BCMM).
- A number of initiatives, amongst others involving BCMM and East London Industrial Development Zone (ELIDZ), are in the pipeline to advance waste management in East London.
- The National Cleaner Production Centre of South Africa (NCP-C-SA) assisted with coordinating these efforts and establishing partnerships to drive forward its implementation.

**OUTCOMES & IMPACTS**

- An opportunity exists for the development of an urban-synergy opportunity for a new company in ELIDZ (Clariter ZA) to recycle the waste plastics collected by the Buffalo City Metropolitan Municipality.
- This synergy could significantly reduce the amount of plastic waste going to landfill and could serve as a valuable resource material for a recycling process.
- The stakeholders involved are considering a one-year trial to test and further develop a system to process the city's plastic waste.

**STAKEHOLDER ENGAGEMENT**

Urban-industrial synergy opportunities highlight the importance of multi-stakeholder engagement and a need for an impartial facilitator (NCP-C-SA in this case) to connect the different initiatives and key players.

**SUCCESS FACTORS**

- Commitment from relevant stakeholders to address waste management challenges in East London.
- Focus on win-win solutions that deliver benefits to all stakeholders, including the community.
- A facilitative role was undertaken by an independent institution (NCP-C-SA) to bring stakeholders together and to coordinate the next steps.

*"Urban-industrial synergies and multi-stakeholder collaborations can make a significant contribution to creating win-win solutions for both the public and the private sectors."*

**MS. NOMPHELE DANIEL**  
General Manager of Solid Waste Management  
Buffalo City Metropolitan Municipality

Clariter waste plastics processing facility in ELIDZ →

**Renewable energy opportunities are driven by demands from tenant companies for the supply of up to 100% renewable energy in next 2-3 years**

Feasible EIP opportunities	Financial benefits		Environmental benefits CO <sub>2</sub> savings
	Revenue	Simple payback period	
50 MW solar farm	US\$ 4.7 million per year	6 - 7 years	77,963 tons per year
22 MW rooftop installations	US\$ 2.7 million per year	± 6 years	33,932 tons per year
8 MW ground-mounted installations	US\$ 0.75 million per year	± 7 years	12,474 tons per year
1.8 MW wind farm	US\$ 0.40 million per year	10 - 11 years	6,184 tons per year

**ELIDZ is in discussion with IFC to finance these opportunities**

## Implemented initiative

- Centralised handling, storage and collection of multiple small volume wastes generated by companies
- Lead batteries, light bulbs, computer equipment, household appliances, packaging, medications

## Who

- Coordinated by management entity of ZF del Cauca
- Contracts with specialised waste companies
- 32 participating companies

## Benefits

- Efficient and easier regulatory compliance for tenant companies
- Separation and recovery of 6 tonnes wastes per year
- Creating economies of scale on waste management



## Business case of synergies

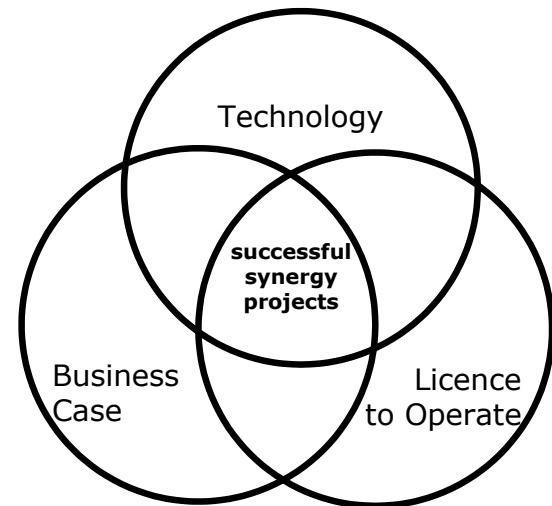
- Need to understand and demonstrate broader sustainability benefits

## Industry champions

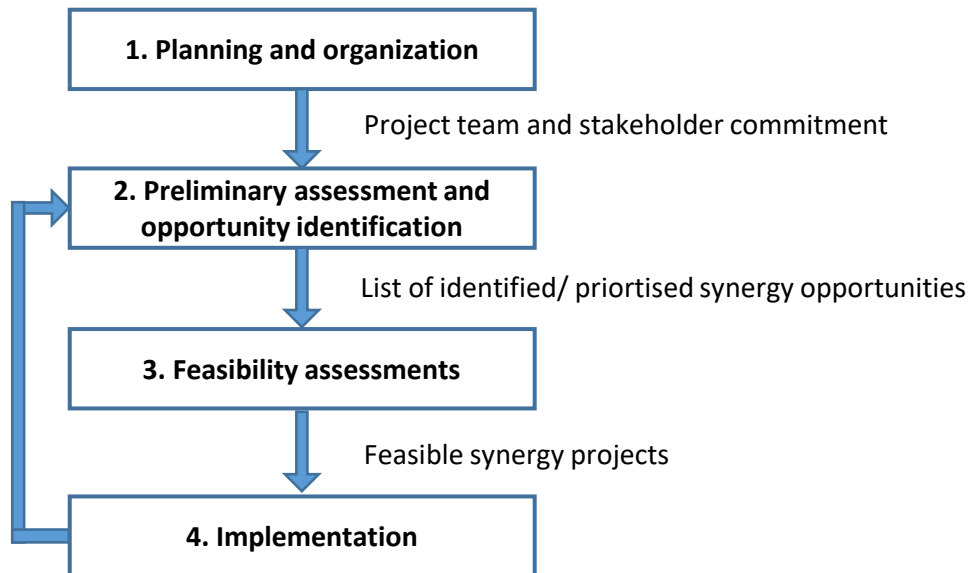
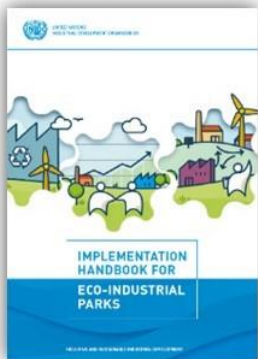
- Crucial for synergy development

## Key role for park management

- Platform for industry collaboration



## Role of management entity: Facilitate, facilitate, facilitate!



Source: UNIDO (2018). Implementation Handbook for Eco-Industrial Parks.

[www.unido.org/sites/default/files/files/2018-05/UNIDO%20Eco-Industrial%20Park%20Handbook\\_English.pdf](http://www.unido.org/sites/default/files/files/2018-05/UNIDO%20Eco-Industrial%20Park%20Handbook_English.pdf).

## Collecting and connecting company inputs and outputs

- What outputs from companies (e.g. effluent streams, wastes / by-products, emissions, waste heat) could be used as input for another company?

## Bilateral discussions with park management and tenant companies

- When explaining them the industrial synergies concept, they will often come up with ideas directly themselves

## Review of international experiences

- Industrial synergies happen in many industrial parks around the world.

## Opportunity identification workshops

- This usually involves bringing together park management and tenant companies for half-day, and identify and prioritize synergy opportunities through facilitated group discussions

## Use of automated tools

- e.g. UNIDO's Industrial Symbiosis Identification Tool

**Tool objective:** Support the identification of industrial symbiosis opportunities (by-product and waste exchanges) between companies.

Tool identifies **“top-of-the iceberg”** opportunities and serves as a starting point to identifying synergy opportunities and having constructive discussions with park management and tenant companies.

- Tool is not all inclusive!

Tool is part of UNIDO EIP toolbox available from:  
<https://hub.unido.org/eco-industrial-parks-tools>

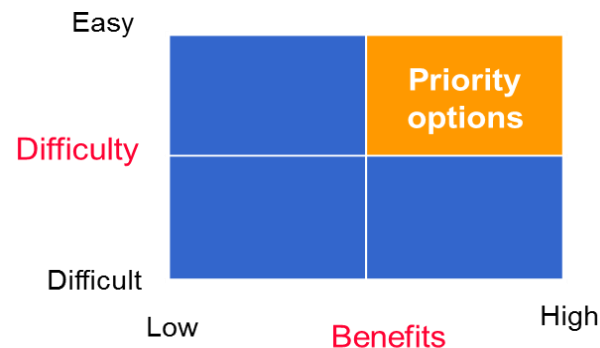
The screenshot shows the tool's interface with a search bar and a table of results. The table has the following columns: By-product / Waste, Similar by product(s), Possible providers, Possible users, Practical examples, and Comments. The 'Wood residues' row is highlighted in yellow.

By-product / Waste	Similar by product(s)	Possible providers	Possible users	Practical examples	Comments
Wood residues	Lignocellulose Sawdust chips Pulps Waste paper sludge/dregs Bark	Effluent plant Sawmill industry Paper industry Wood industry	Coal power plant Biomass power plant Distillery factory Pretreatment/Export plant Cement factory & construction Fertilizer	Kraft-milling Textile Orange Chilling Syrup Kerosene	

Not all synergy opportunities identified will be of high interest or great value!

It is therefore important to prioritize the opportunities based on:

- Their achievability
- Their anticipated benefits
- Interest from park management and tenant companies to assess further



This is not a feasibility assessment

- It is just an exercise to assist in the selection of opportunities for follow-up or pre-feasibility assessment





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**GEIPP**

GLOBAL ECO-INDUSTRIAL PARKS PROGRAMME



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

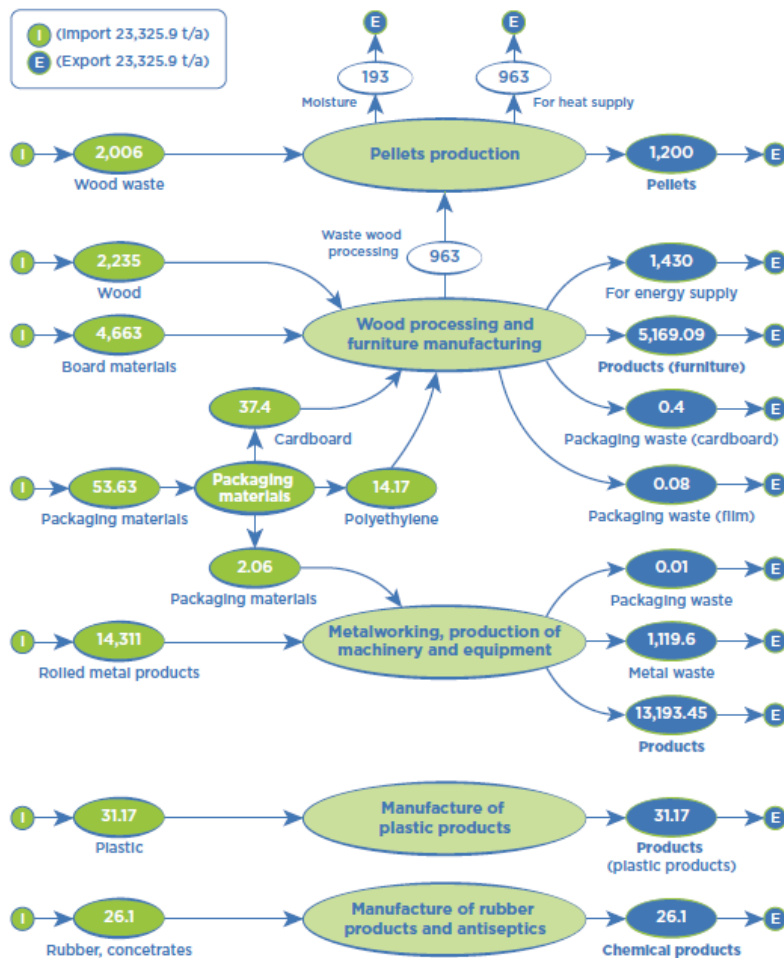
Federal Department of Economic Affairs,  
Education and Research EAER  
State Secretariat for Economic Affairs SECO

Swiss Confederation



## The results of the GEIPP I in Ukraine for BVAK

# Material, energy and water balance at the park level.



## EIP interventions proposed including IS options (IP BVAK)

1. **Using waste heat for wood drying during the off-season and warm seasons**
2. **Using waste heat to heat a shared paint booth**
3. **Solar power plants on a cooperative basis to reduce dependence on outside power suppliers**
4. **A single system of industrial waste management within the park, i.e. the creation of an interactive system of available waste**
5. **Joint procurement system**
6. **The shared delivery system for manufactured products**
7. **Collecting rainwater for further irrigation and partial replacement of water from the water supply system**
8. **Promoting the use of electric and bicycle transport through the creation of charging stations and covered bicycle parking lots**
9. **Opportunities to provide chemical leasing services within the entire park through:**
10. **Painting/dyeing processes**
11. **Lubricating the parts of mechanisms and machines**
12. **Disposal of fallen leaves to produce animal feed**

# Nitrogen-generating plant "Energy System Innovations and Metal Industry", LLC.

- Due to the ongoing war, there have been disruptions in the supply of nitrogen. To address this issue, the company decided to buy a nitrogen station which was put into operation in **May 2023**.
- The investment was **240,000 euros**.
- The company could potentially save 92,500 euros annually. The simple payback period for this investment is **2.6 years**.



*Nitrogen-generating plant equipment*

- 4,170 Liters of diesel fuel consumption (equivalent to 187.65 GJ energy and **13.9 tons of CO<sub>2</sub>** emissions).
- At the same time, the capacity of the plant greatly exceeds the needs of the company, so they will offer nitrogen to other metalworking companies in the park/region



**Thank you!**

Branko Dunjic

EIP Expert

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