ECO-INDUSTRIAL PARK (EIP) SOLUTIONS FOR SULLIVAN COUNTY

Economically & Environmentally viable EIP design proposals

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CONTEXT

Design concept for an Eco Industrial Park (EIP) as part of a sustainable development plan for Sullivan County in the advent of the natural gas drilling industry in the Marcellus Shale Region

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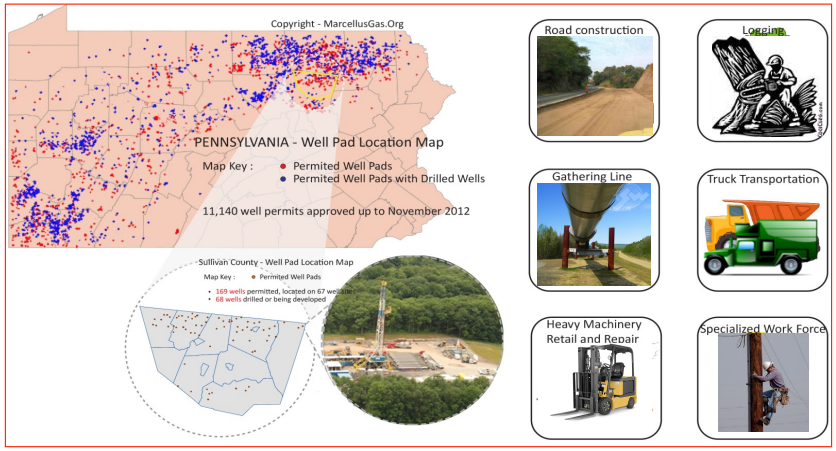
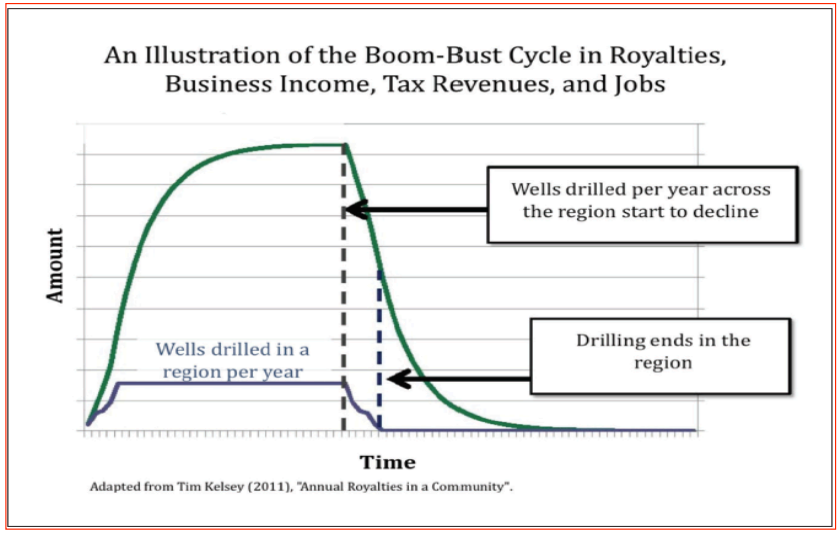




Given the governments' current interest in establishing a national energy independence, and the fact that "hydraulic fracturing is expected to help boost natural gas production by nearly 30 % by 2035" (Biello 2012), there has been a growing popularity of natural gas and the drilling of the Marcellus Shale.

CONSEQUENCES FOR SULLIVAN COUNTY

- Gas wells will be drilled in the area for the next 30 years, as economists predict
- Gas drilling advents come hand in hand with significant impacts typical for the establishment of 1000s of pads
- Each of these pads is going to require activities like ground clearing and removal of vegetative cover, grading, drilling, vehicular traffic, as well as construction and installation of facilities
- Activities conducted in locations other than at the oil and gas well pad site will include excavation/blasting for construction materials (sands, gravels), access road and storage area construction, and construction of gathering pipelines and compressor or pumping stations

ADDRESSING THE BOOM AND BUST CYCLE

- The extraction of non-renewable natural resources such as natural gas follows a characteristic "boom-bust" cycle, in which there is a rapid increase in economic activity followed by a very abrupt decrease.
- The "**boom"** occurs when drilling crews and other gas-related businesses move into a region to extract the resource. During this period, the local population grows and jobs in construction, retail and services increase.
- When drilling ceases because the natural gas source is depleted, there is an economic "**bust"** - population and jobs depart from the region, and fewer people are left to support the boomtown infrastructure.

WHY BUILD AN EIP IN SULLIVAN COUNTY ?

An EIP literally represents the end of conflict between the economic and environmental aspects of any industrial project generating benefits for the close communities surrounding it in the form of:

ECONOMIC SUSTAINABILITY:

- EIPs Hands-on Training and Research facility will represent an attraction for recruitment
- Successful implementation of initial plans may lead to attraction of additional outside investors
- EIP will diversify the industrial community, stabilizing the regions' economy

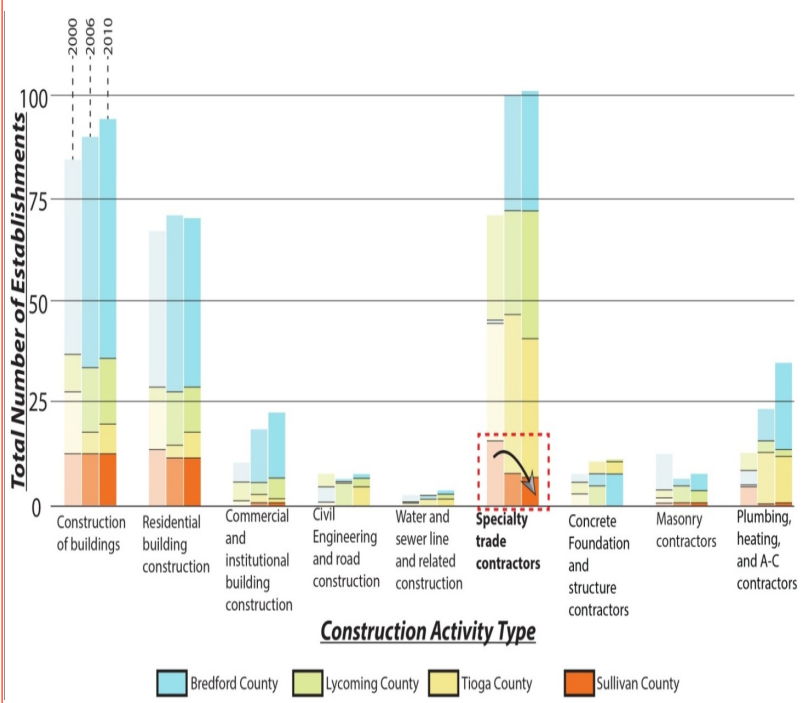
ENVIRONMENTAL SUSTAINABILITY:

- Less of the communities environment will be fragmented by single companies popping up at random places throughout the landscape, each of them representing a potential ecological threat
- Increased use of renewable energy and materials and an overall renewal of natural systems by effective management of landscape
- EIPs could yield a significant reduction in many sources of pollution and decreased demand for natural resources

SOCIAL SUSTAINABILITY:

- Long term steady employment opportunities created
- Provides community with specialized “know how”
- Provides communities a focal point for industrial recruitment activity
- Reduced damage of communal roads deterioration to specific routes that could be repaired for free utilizing products of the park (Recycled gravel and asphalt)

COUNTERACTING A TREND



Compared to other counties, Sullivan County's number of Specialty trade contractors is continuously decreasing. Since these are the primary contractors required by the Drilling Industry, our EIP's training facility is supposed to help counteract this current trend, while creating a more specialized workforce for Sullivan County.

By implementing an EIP we hope to address the increasing demand of construction activity while at the same time providing the region with an opportunity to gain more economic independence, and to generate environmental benefits for the local communities.

• SHORT TERM

We would like to make Sullivan County more competitive in the construction industry, considering that there is going to be an extensive period of heightened construction activity, and there is a clear lack of specialized work forces providing the needed surfaces at a regional level.

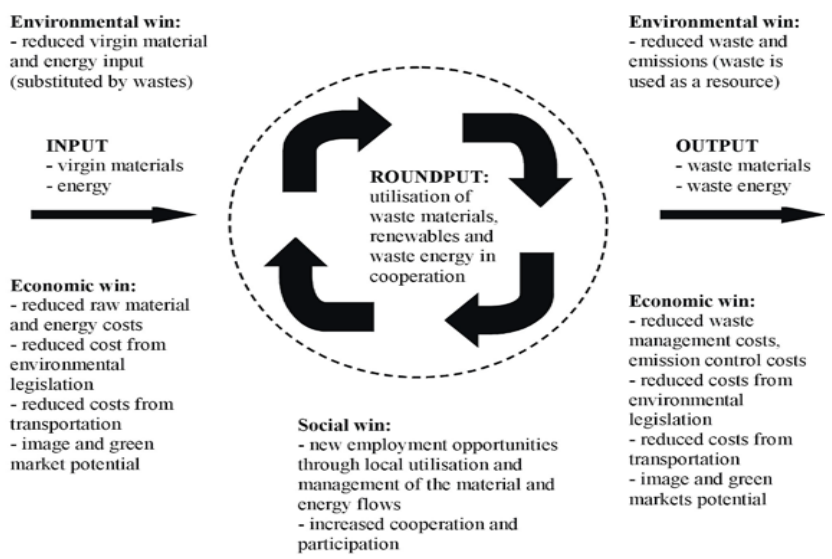
• MEDIUM TERM

By creating a shared workspace for multiple companies we hope that interdisciplinary knowledge exchanges are going to occur which could lead to future projects in the region that are not necessarily related to the natural gas extraction industry.

• LONG TERM

We anticipate a sustainable future development for the area not succumbing the bust phase after the drilling period.

WHAT DEFINES A SUCCESSFUL EIP?



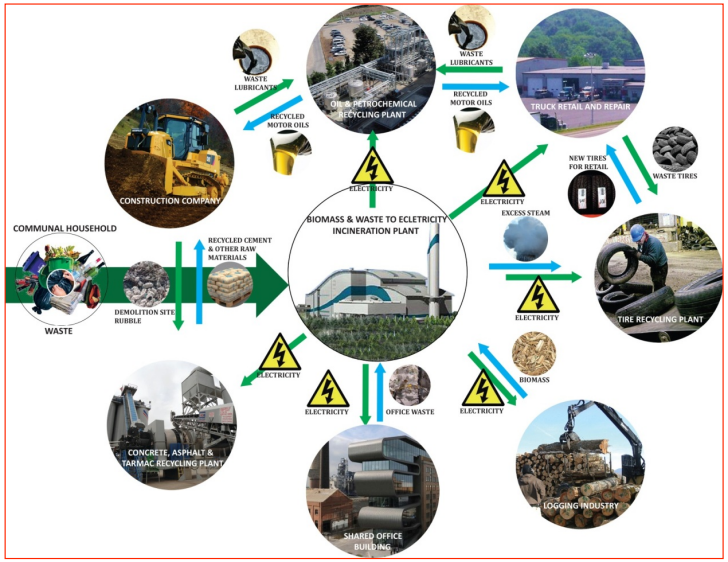
A successful EIP is characterized by:

- Environmental
- Economic and
- Social 'wins'

related to material and energy flows.

According to Saikku (2006) and other case studies in a successful EIP, inputs to and outputs from the system are smaller than the round-put flows within the system between industrial firms, other private and public organizations, agriculture and consumers, which is reflected by the size of the arrows in the diagram.

WHAT DEFINES OUR EIP?



Our EIP is a Type 3 EIP (among co-located firms in a defined industrial area, including materials, waste or energy exchange between partners in close proximity) according to the classification of Chertow (2000). It is characterized by:

1) Industrial symbiosis

Selection of a group of companies that primarily share the same goal of catering to the increasing demands of the construction industry in Sullivan County. With the exception of the Waste to Energy Incineration Facility, all other companies located on site will provide services ranging from equipment rental, construction material recycling and retail, to truck repairs and educational services in form of classes and seminars.

2) Inter-company byproduct exchange

By sharing and reutilizing production wastes amongst the different companies, production costs can be significantly lowered, which could improve the park's companies competitiveness in the domestic market. Furthermore this would also have positive effects on the environment as the companies reliance on resource shipments via truck would see a significant reduction.

3) Shared infrastructure and Services

Reducing the footprint of this industry was one of our design teams' primary goals. By accommodating multiple companies with shared infrastructures such as parking lots, office spaces or storage facilities we significantly reduced the environmental impact on the region. Furthermore being part of this "campus" permits companies to share services such as shipping or waste disposal or facilitated emergency vehicle access.

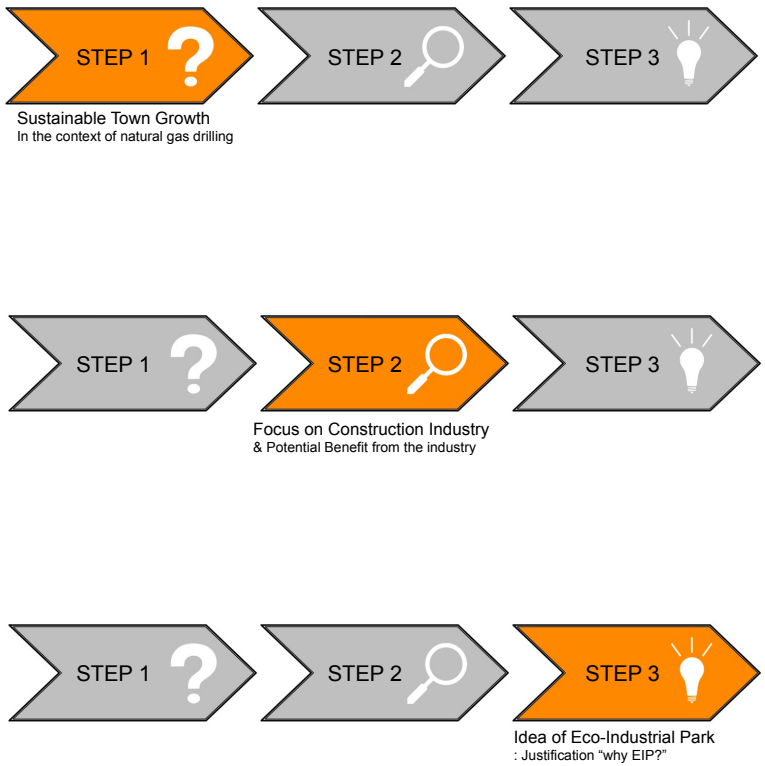
4) Optimization of a waste heat utilization and Waste to Energy Recycling

An EIP can significantly reduce the environmental burden of existing and new businesses by reducing sprawled discharges, as well as helping companies to remain in compliance with environmental regulations by facilitating the task of proper waste disposal. By utilizing most of the on site waste either in byproduct sharing, building heat exchanges or in the form of waste to energy incineration the companies have a significantly lower energy bill, which ultimately means a lower cost of production.

5) Implementation of renewable energies and local materials

In addition to the waste incineration plant, solar panels and wind mills are implemented on site, in order to supplement the EIP companies energy consumption. Furthermore multiple buildings are equipped with extensive green roofs, that collect and filter storm water on site. Ultimately several buildings are designed to act as built-in local recycled materials.

DESIGN PROCESS



STEP 1:

Having chosen the broad scale topic of Small Town sustainability in the advent of the Natural Gas Drilling Industry, we decided to focus on a variety of aspects ranging from the economical and social issues to the environmental impacts these activities can have on a particular region.

STEP 2:

Having identified that during the "Boom Cycle," which is projected to be around 30 years long, there is strong and continuous demand for construction activities, we researched in depth what the exact construction activities were which could be linked to the drilling industry.

Furthermore we started to think about how it would be possible to mitigate all the negative impacts construction activities have on the landscape.

STEP 3:

Ultimately it became our design team's objective to create unique location that would accommodate the needs of the construction industry throughout all of the county. In this location an Eco-industrial Park would be established, that would provide a common working ground for related businesses.

This "EIP" would primarily cater to the construction industry and would permit to mitigate the dispersal of many environmental nuisances otherwise created by this industry, providing adequate shareable infrastructures and optimizing material flows.

AN EIP DESIGN DRIVEN BY ECONOMIC INTERESTS

Whereas my colleagues' design was focused on creating the most ecologically suitable EIP, it was my intent to establish a master-plan driven by economical aspects, while still safeguarding regional sustainability.

MAIN TOPICS

1) HOW TO **SELECT A SUITABLE LOCATION** FOR EIP
2) HOW TO **DESIGN** AN APPROPRIATE EIP
3) EIP AS A **SHOWCASE FOR RENEWABLE TECHNOLOGIES**
4) WHAT ARE THE **ADVANTAGES** AND **CHALLENGES**

SELECTING A SUITABLE LOCATION

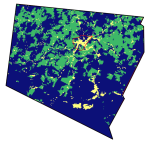
MATRIX CHART

Each criterion was graded: “1”(Good, yellow), “2” (Fair, Green) and “3” (Bad, Blue).

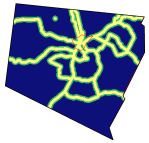
Criteria	Good	Acceptable	Unsuitable
Landuse	Built land, Brownfields, Undeveloped	Agricultural,Rangeland	Forest, Water
Proximity to Interstate 87/220	0-500feet	500-1000feet	>1000feet
Proximity to Residential Area	300-1000feet	1000-1320feet	0-300feet & >1320feet
Proximity to Pipeline	0-1500feet	1500-3000feet	>3000feet
Proximity to Sensitive Habitats	>1000feet	600-1000feet	0-600feet
Proximity to Stream	>300feet	100-300feet	0-100feet
Proximity to Water Source	100-1500feet	>1500feet	0-100feet
Proximity to Waste Treatment Facilities	0-1320feet	1320-2640feet	>2640feet
Soil Types	Sand & Gravel	Medium & Hard Clays	Soft Silts & Peat
Slope Degree	0-2.5%	2.5-12%	>12%
Land Owner	County Residents	County Non-Residents	State Owned
Agricultural Soils	Secondary Agricultural Soils	N/A	Agriculture Security Lands & Prime Agricultural Soil s In Use

Based on the matrix, a map for each criterion was calculated.

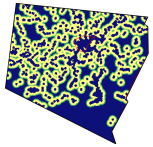
Landuse



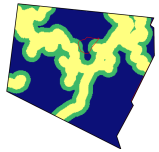
Road Vicinity



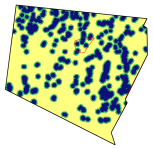
Residential area



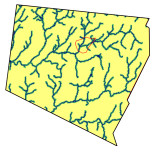
Pipe-Line



Sensitive Habitat



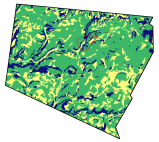
Stream Proximity



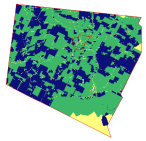
Water Source

Waste Treatment

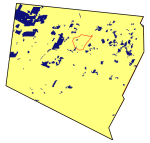
Soil Type



Residence Type

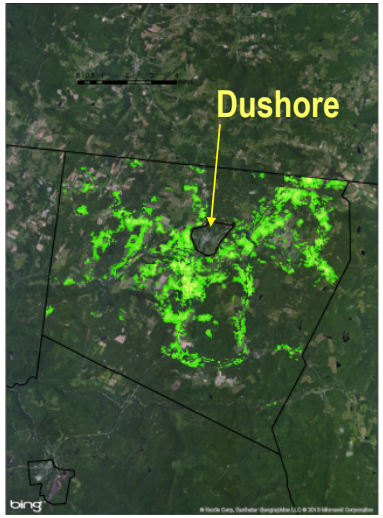


Agricultural Soil



In the defined color range yellow represents the most suitable location according to the matrix criteria

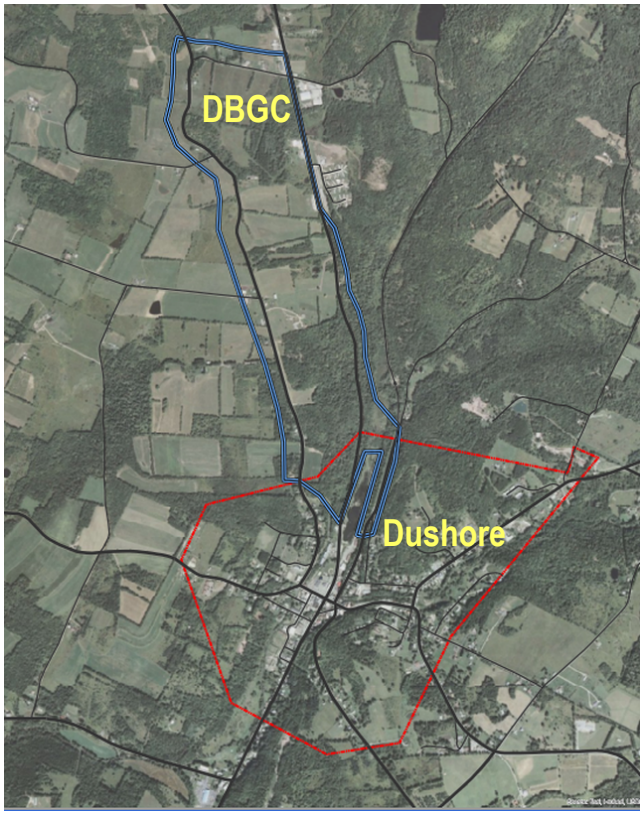
By compiling a list of criteria we were able to identify the most suitable locations for an EIP within **Cherry Township, in the neighborhood of Dushore**



Ultimately this site was found to be most suitable for the establishment of the EIP for multiple reasons, offers several advantages (see pg 12)

SELECTING A SUITABLE LOCATION

Original site: North of Dushore



The SULLIVAN COUNTY COMPREHENSIVE PLAN (Draft – September, 2010) designated the area marked in blue as Dushore Business Growth Corridor (DBGC) and foresees the installation of a sewage treatment plant.
However, the originally designated area for Industry Development offers several shortcomings for the establishment of our EIP

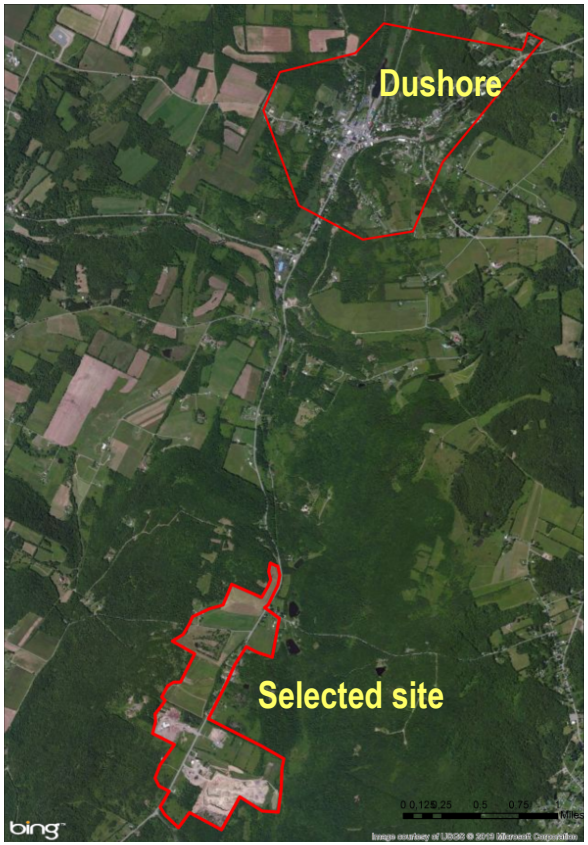
1. The area north of Dushore is covered with forest and is topographically more difficult to make accessible

2. If any noise and smell disturbances were to be anticipated by the industrial activity, a further distance form the habited town center would be preferable

3. As the name implies DBGC already, the site is a long strip with limited potential for expansion in the future

SELECTING A SUITABLE LOCATION

Selected site: South of Dushore

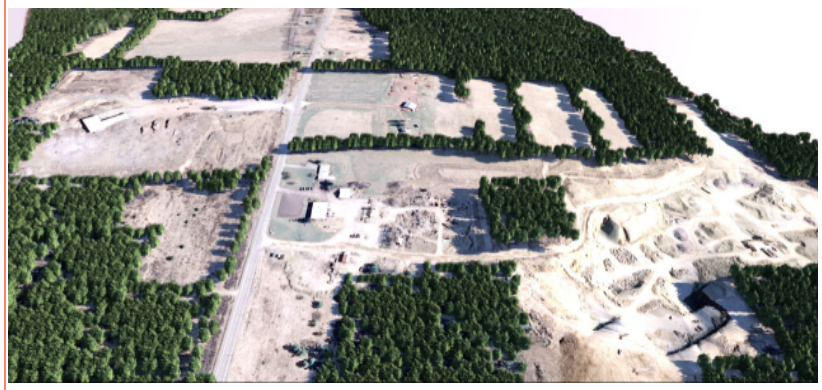


The proposed site offers several advantages for the establishment of the EIP:

- Vicinity to existing drilling well pad site
- Located on important interstate route (220)
- Already active infrastructure site south of the borough to be considered a brownfield
- The site provides suitable soil types for construction (sand, sandy loam, gravel) and is topographically plane
- The site does not require forest clearings
- EIP has sufficient setback distance to effectively protect the inhabited town center, while still in a convenient proximity for planned (SCCP) bicycle and pedestrian commuting trails
- The site offers the option for expansion in the future

CRITERIA FOR DESIGNING AN "EIP" WITH ECONOMIC FOCUS

A **Present Day Site Conditions**



B **Phase 1 of EIP to be implemented within 10 year period**

On the original site (A) four primary criteria were relevant for the selection of companies to be built during the first phase of the EIP (B):

1. Increased energy supply

Wind park

Biomass incineration plant

Timber mill

2. Increased work supply required by drilling and construction industries in the region during the boost phase

Tire remolding factory

Truck and heavy machinery repair / retail shop

Oil/petrochemical recycling facility

Covered storage facilities

Waste water treatment plant

3. Outreach work/Training Center

Visiting center

Café and Outdoor Recreation

Office buildings

Hands-on construction /training facility

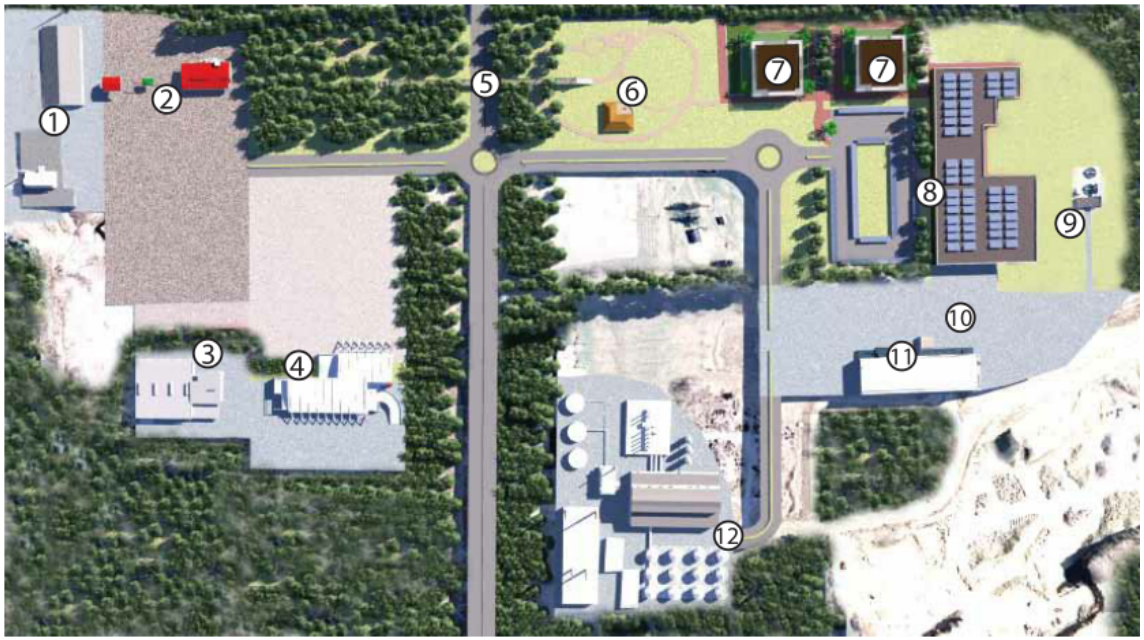
4. Future utilization capacities to support the region in the bust phase

Energy supply sector

Waste water treatment plant

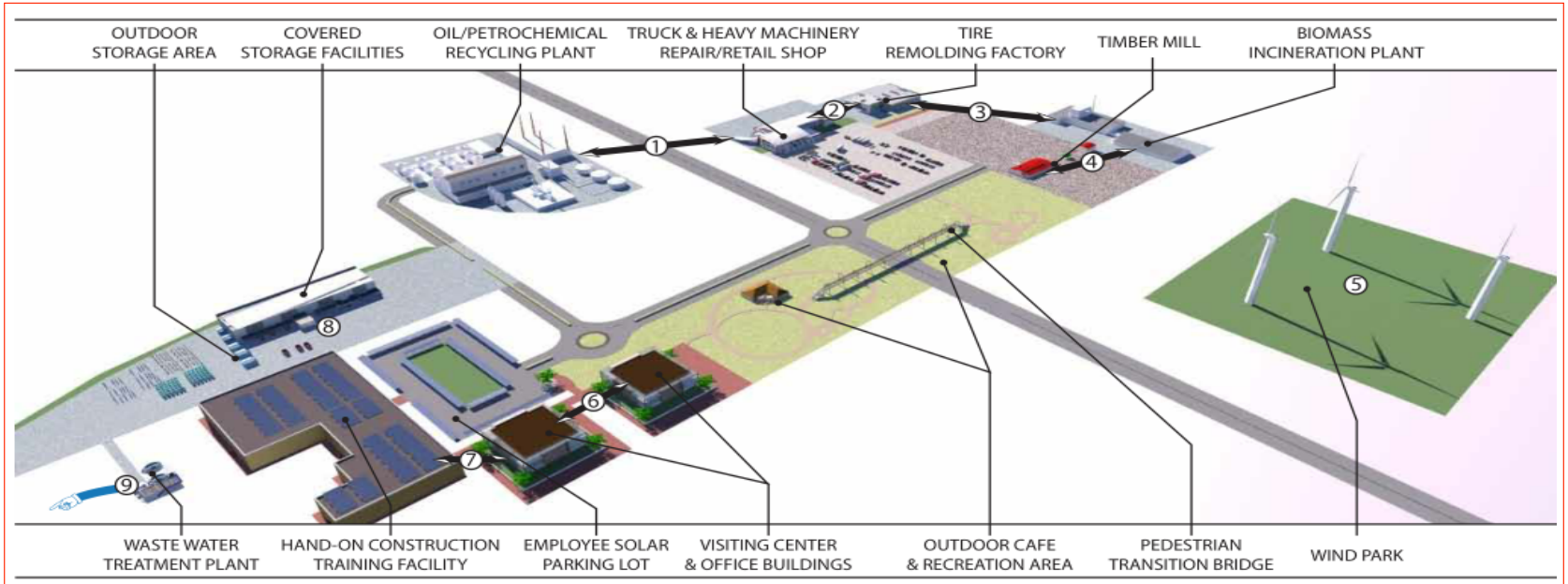
Covered storage facilities for novel applications

SITE OVERVIEW PLAN



1. BIOMASS INCINERATION PLANT
2. TIMBER MILL
3. TIRE REMOLDING FACTORY
4. TRUCK AND HEAVY MACHINERY REPAIR/RETAIL SHOP
5. PEDESTRIAN TRANSITION BRIDGE
6. OUTDOOR CAFE AND RECREATION AREA
7. VISITING CENTER AND OFFICE BUILDINGS
8. HAND-ON CONSTRUCTION TRAINING FACILITY
9. WASTE WATER TREATMENT PLANT
10. OUTDOOR STORAGE AREA
11. COVERES STORAGE FACILITIES
12. OIL/PETROCHEMICAL PLANT

BUILDING INTERACTION DIAGRAM



① Waste oils will be recycled by petrochemical plant and provide new cheaper energy sources on site as well as for the overall region

② Used tires collected at the repair shop will be recycled into new tires by the remoulding factory

③ Production waste can be incinerated for energy generation

④ Wood chips from timber mill serve as biomass for energy generation

⑤ In addition to the biomass plant the wind park will provide onsite companies with affordable energy

⑥ On site companies share not only by-products but also exchange excess heat through proper building insulation and HVAC system

⑦ Workforce & knowhow exchanges will occure between trainees and onsite companies encouraging discovery of new technologies & processes

⑧ Shared storage facilities reduce cost and facilitate service to different companies

⑨ On site waste water will be cleaned prior to being discharged into wetlands below site

EIP AS A SHOWCASE FOR RENEWABLE TECHNOLOGIES

Detail 1: Wind park installation on site provides additional energy

1. Wind energy is free and once wind turbines are built the energy produced does not cause green house gasses or other pollutants
2. In consecutive steps of investment an increasing number of windmills can be installed (scale up)
3. Provides energy even during wind still phases, if coupled with a new energy storage technology. Intermittency is a major challenge for wind power and a key hurdle to the widespread deployment of renewable energy. General Compression (MA) builds Dispatchable Wind farms designed to deliver renewable electricity to customers on demand.

Detail 2: Solar-panel installation on roof and car park

1.89 acres of solar-panels over parking lot and on building roofs

1. Generates approx. 2000 Mwh per year (10ft x 10ft of solar panel generates 2737 kwh per year), supplementing the parks energy consumption
2. Reduces use of fossil fuels for energy generation
3. Park acts as showcase site for new renewable technologies
4. EIP offers a set of electric cars to the employees powered at the central car park to permute to the homes

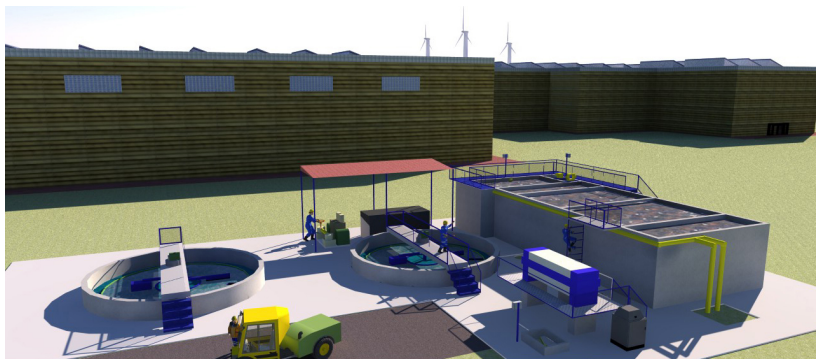
EIP AS A SHOWCASE FOR RENEWABLE TECHNOLOGIES

Detail 3: Energy from wood waste incineration

Of PA's 28 million acres (MA) 17 MA (~60%) are forests. The timber and forest product industry is one of the largest manufacturing sectors in PA, employing over 80,000 workers in 2,500 firms. The value added contribution to PA`s economy by the forest sector is over 5 b $/year (USDA).

1. Biomass energy is available at low cost in form of forest waste
2. With an increase of clearcuts due to pipeline construction throughout the entire region we anticipate an increased availability of wood waste for incineration
3. Due to the importance of the forest sector in the region this investment will certainly persist in the bust phase

Detail 4: Waste water treatment facility



1. Improves on-site water quality
2. Sludges can be recycled either as fertilizers for agriculture or as landfill material
3. Unsuitable waste can be incinerated in the biomass incineration plant nearby

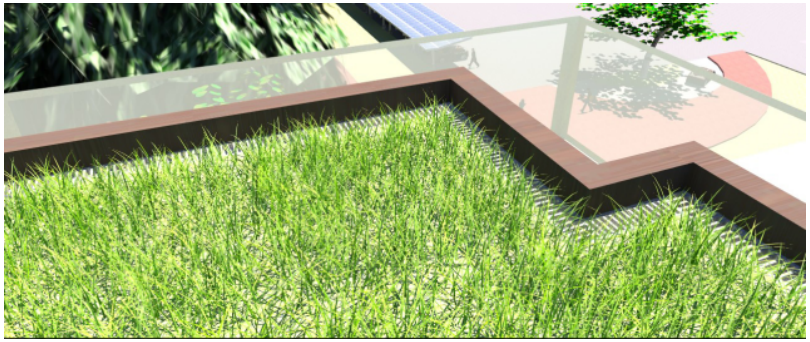
EIP AS A SHOWCASE FOR RENEWABLE TECHNOLOGIES

Detail 5: Design of a passive recreation area to improve amenity

Passive recreation area on approx. 8 acres of land

1. Provides esthetically pleasing outdoor recreation opportunities
2. Improves communication between employees of different companies
3. Improves health of employees of different companies
4. Supports regional plant/animal diversity
5. A footpath along the wetlandzone as a recreation area to confirm the ecological safety of the EIP

Detail 6: Green-roof installation improves water re-use



Green-roof installation on 1.63 acres

1. All buildings are equipped with “extensive” green-roofs
2. Reduces storm-water volume (up to 50%)
3. Filters storm-water quality
4. Lowers surface temperature
5. Energy savings can reach 15-30% (cooling/heating)
6. Contributes to biodiversity by creating habitats for wildlife and improve atmosphere for humans

ADVANTAGES AND CHALLENGES

Advantages:

- New potential for regional development powered by the drilling activites
- Opportunities to create jobs
- Creation of a technological „incubator“ for novel developments
- Creation of a new local identification (less migration of young people)
- Chance to develop a counterstrategy to the usual boom-bust-cycle
- Opportunity to create jobs also for the future

Challenges:

- Initial selection of the most appropriate industry partners also interested in the communication between EIP partners and the community
- Attract also in future interested partners to master the trasition phase
- External factors affecting the EIP (e.g. change of raw material supply, market opportunuties for EIP partners.etc.
- Lack of necessary communication (see pg 20)

IMPORTANT ROLE OF A COORDINATION AGENT

Lots of information and knowledge are needed to implement a successful EIP.

Companies may lack the skills for networking if they are not accustomed to it (Starlander 2003). They might also be lacking in knowledge about the concept of inter-company cooperation and potential strategies. Moreover, there might be an unclear understanding of the causal relationships between cooperation and sustainability. Communication within a firm can be a barrier if the hierarchical structure of the company includes separated responsibilities or if sustainability and cooperation information systems are deficient. Continuous training should be enhanced to increase knowledge within organizations. Information flows and their efficiency can be improved by institutionalizing cooperation (Fichtner et al. 2005).

Sharing information can also pose a barrier if there is a risk of giving away trade secrets and a need not to disclose confidential information.

A coordinator can gather information and help identify potential synergies and collaboration areas. (Starlander 2003).

It is important that the coordinator follows up meetings and discussions to keep up the companies' interests. A coordination agent can also have a role in informing and motivating the companies about potential benefits to be achieved. A coordination agent should be fully committed to the network and gain credibility from the other actors (Starlander 2003, Heeres et al. 2004).

A coordination agent can be one of the companies or, more often, an academic institution, consultancy company together with public bodies, or trade, entrepreneurs or employers associations. Private companies may be the most motivated and their management might be the most efficient. On the other hand, a firm might focus too much on areas where it has a direct interest. A firm also requires significant resources for coordination.

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