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# On the Feasibility of the Closed Cycle Local Economy Based on Pyrolysis

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## Abstract

Modern technologies allow much higher rate of prosperity than normally seen around the globe. The development can be achieved based on the local resources. Pyrolysis should play the central role on the initial stage of the processing of the biomass. The practical experience made by the development engineers allow to make solid conclusion about the current problems faced during the introduction of the technology. The introduction of pyrolysis technologies, especially in developing countries, faces non-engineering problems. The assessment of the economic viability of the introduced technological process can be performed based on the coverage of the global deficit, primarily in terms of resources substituted as inputs. To motivate the local population, it is proposed to introduce a large number of small production facilities with a unified system of coordination of producers and partial transfer of ownership rights. The regional economy should undergo the balanced growth and be protected by cheap quasi real regional currency and expensive accumulative currency. The regional saving rate can be regulated, allowing for the accelerated rate of regional investments. New green technologies based on pyrolysis should allow for the new regional economic policy named “Green economic defensive initiative”.

**Keywords:** pyrolysis, solar energy, biogas, bioplastic, mineral fertilizers, green technologies, regional economy, utilization of local resources, processing of biomass, sustainable product, economic viability, coverage of the global deficit, market economy, protection by currency, balanced growth, industrial farming, regional saving rate, green economic defensive initiative, civil society

## 1. Introduction

One of the modern ways to test a new technology is to implement it in the developing world. Pyrolysis can be viewed as a lowtech technology suitable for these purposes. It was possible over the last 10 years to try to make many attempts to use the technology. It became very fast quite clear that the prime problem is not with the technology, but rather with the economic factors. A universal economic solution is needed. There should be no conceptual difference between the developing and the developed world especially now in the age of globalization. People tend to act economically similarly in any society with a certain variety that has to be incorporated in the general solution. There is no any fundamental advantage in a developed

country over the developing country in the age of globalization. In a stagnating region in a developed country the situation is even worse as in a developing country where people normally are not deprived of the hope of improvement. This text is based not as much on the academic studies as on 10 years of practical experience of the author of this discourse working as a development engineer in the field of the sustainable technologies. There is a strong believe that or there will be very much attention shown towards the complex economic solutions or there is no way the pyrolysis-based technologies will find the broad popular support.

## **2. Green economic defensive initiative**

If an investment in a technology is not profitable, any investments in this technology will be just a dream regardless of how much this technology is beneficial for the humanity. Of course, the state can get involved and finance the implementation of the technology, but for a limited period of time. The development of the technology is way more stable process when the technology grows naturally during its industrial implementation. Time works for the technology and the technology grows with time.

Newfoundland could have been a rich and economically self-sustainable territory, but nowadays if not the recent discovery of the shelf oil the province would have been just poor. This is the direct contradiction to the modern state of development of technologies and the availability of natural resources on the island. There are winds, waves and solar power for energy. There are ores on the island and the neighboring coast. There is carbon in the form of the very rich on vegetation sea shelf.

As always there is the discussion between professionals of different trades about the measures that could have been taken by the state to improve the situation, and where would have been the border between the state involvement and the well-organized popular movement. How far the state must go in its endeavors to support and control is a very controversial topic. Internet grew out of the USA military technologies, but the leading USA corporations advocate for the free market development. Sweden is trying to exercise the tight political control over its development and is a success, but North Korea with its totalitarian control over everything is rather an economic failure.

The main problem with the governmental funding is that it is limited and quite often poorly selective. It relies on already existing sources of the national income and non-profit investments what excludes the possibility of self-propulsion. A solution without the idea of self-propulsion is the recipe for a failure in the long run.

In plain words, the task is to build a self-sufficient economy if not the closed cycle economy within the conditions of the global free trade economy with the orientation on the global markets. The contradictory in theory task is not a contradictory task in reality. Historically there are examples that rather support the claim [1]. The concentration of production in one spot in the global economy will automatically lead to the spill over of the production to other regions and to the migration of the labour force to this region thus rendering the idea of the closed economy unsustainable.

Possible solutions with the macroeconomic instruments for the local economy in context of the global sustainable development would be protection by currency, protection by import taxes and redistribution based on various economic features. All these solutions are secondary after the civil society is already in place. Without the civil society any investments in any production beyond the tradesperson level are impossible. These are macroeconomics topics.

The discussion on this level of analysis comes every time the economic problem is out of scale of the microeconomic discussions.

The objective of this paper is to discuss the possibility of any solutions on the local level. An engineer is the key figure for the local solution. A cash generating product should be invented, costs of the production should be minimized. Additional problems should be considered, such as sustainability of production in the long run, suitable industrial organization, and many others.

The recent history knows a number of spectacular failures of companies and governments making investments in new technologies. There are a few examples to mention. There were some talks circulating in the professional environment concerning the German investments in the solar energy projects in the northern Africa. There were some articles in the media concerning Italian attempts to produce components of TV sets in Russia. Both projects failed because of the lack of interest of the local population. Definitely, the companies were bringing wealth to the local communities, but the population of the local communities felt that they were turning into the colonial deprived population. Direct resistance or very negligent fulfillment of duties are normally the outcome. In both cases the tremendous financial losses were the result.

What is absolutely necessary to do from the earliest point of the foundation of a new enterprise is to establish the proper relations with the local labour force and all active parties involved with the project. Here comes the engineer to the forefront as the leader of the working and the conveyer of the technical fulfillment of the project.

A possible solution for the involved participation of the local labour force could be industrial farming. This term is coined by the author of this discourse. The idea is straightforward and simple, though the technical and the organizational side of the project is a challenge. It was noticed that classical cottage economy was a possible economic solution in terms of the involvement of the local population in an economic activity. Small proprietors and at the same time producers develop positive attitude towards the means and the process of production as far as there is a demand for their product and the flow of cash allowing for the accumulation of wealth [2].

Economic studies based on the German reality clearly show that small productional units are no less efficient than big corporations. Studies based on the American reality show that small economic units have lower income per worker than big corporations. Putting all together it is possible to conclude that local productional units in junction with the centralized system of coordination, procurement, and sales is possible and necessary in order to compete successfully on the international markets. The centralized organization must take over such questions as labour education, sustainability of production and certification of production processes and produced goods, overcoming the barrier of the initial capital when required.

Let us take a hypothetical country with low industrial development for the ease of analysis. Let us say, we want to organize the solar panels production of energy in the form of the industrial farming, let say somewhere on the African soils with the idea of sales to the European Union. Clearly this idea with the modern development of energy transmission technologies makes little sense. The resistance in electric cables consumes most of the energy over the long distances. And actually, it is the plague of Canada, where the waterpower plants in the North of the country with all their potential find no consumers as all the consumers are far away in the South. Nevertheless, for the purposes of the economic analysis, this could be a proper example.

There is no question that local peoples of Africa are well organized in terms of their local cultures for the purposes of solving of the local problems arising out



of the state of the local development. But the existing patterns are not suitable for any investments in any complex production. Any investments are not secure, no appropriate technical stuff, and there is no mechanism to secure the return on the investments made. All these missing parts are still to invent in order to secure any growth of the local wealth and stabilization of the local society as the whole.

There is a need for a sustainable product, a product that can be sold repetitiously for profit in the long run without the disruption of the local investment patterns. In case of an African scenario everything has to be done pretty much from the scratch. Sale markets have to be found and a product for these markets invented, local labour markets invented and the payments for the labour invented and better in the manner of the appropriate solution in the long run. The technological process suitable for the local reality should be put together and suppliers found. In other words, no sustainable development without the sustainable economic and industrial organizations. No sustainable economic and industrial organizations without the sustainable product.

In the developed countries the situation is not so much different. Though the exchange markets are in place it does not mean that the local economy effectively protected. It can be overwhelmed by businesses from much stronger or cheaper economic regions and suffer from flight of labour and businesses. It can suffer from the local social immobility being unable to initiate a new production up to the standards of the global economic and technical development. Even if all the necessary economic institutions are in place a new sustainable product has to be found and the sustainable production has to be organized.

Any commercial production is dependable on the cash inflow or the revenue created through the sale of a commercial product. The product that can be sold in the long run is central to the process. Existence in the long run means that markets accept the product, its revenue covers all the expenses, and its production does not disrupt the social and natural environment.

There are always concerns about the saturation of the existing markets. There is always a fear that to introduce a new product to the existing markets or to increase the already existing volumes of goods for sale is almost impossible. There is the perception that the modern markets are contracting and not expanding. The counterargument would be the assessment of the global markets by the coverage of the global markets with the existing supplies. From this prospective the global markets exhibit an enormous potential for growth. The growing population is outstripping the globally available resources. The majority of the global population is in poverty. Definitely, everything that can close the gap is feasible in theory. In praxis this means that or a new product finds its markets without contributing to the global problem of shortage like jewelry or the global shortage coverage analysis can validate the future existence of the product. The proposed sequence of analysis from the sustainable product, to the organization of production is: labour involvement and remuneration, labour education and social impacts. Technical aspects—the organization of the production itself, the system of provision, storage and delivery. Business solution—financing, marketing, and sales.

Stepping aside from the proposed sequence of analysis the first question to discuss is the protection of the profit pro unit of the product sold of the production in question. The latest trend in the economic development is the protection of the local producers by means of the local currency. This method has very much potential and fully recognized by certain members of the European Union. The main exchange currency of the European Union is euro. Some countries like Check Republic keep their own currencies for the local circulation. The floating rate of exchange of currencies allows bringing in balance the imports and exports of a nation. The buildup of a stack of currency of one country by another country will immediately trigger

at least in theory the adjustment of the exchange rates thus rendering the deficit or surplus in the balance of trade impossible. As the result the national industries as a whole are protected from the foreign competition and the imports match the exports.

At this point many professional people may wonder what kind of protection and from what it would be. It is quite clear that the material wealth is determined mainly through the availability of material resources and productivity of labour. But, first of all, we are living less and less in the world with the dominant material culture in terms of the material production. Alone the video games with the whole army of the support personnel working in the virtual reality prove the point. And besides this, it is about the protection of the sustainable balanced development. The developed industrial centers may produce cheaper and better. This leads to the depletion of the local financial power, regional stagnation and the flight of labour and businesses. The introduction of the local currencies leads to the immediately less efficient production but gives the opportunity for the local economic powers to grow. Maybe it is not so evident when one looks at the USA, but when someone looks at Africa next door to Europe one sees an absolutely different picture. In the States there are very strong agglomerations of the national industries and the rest are most of the time thinly populated areas. In Europe, it is reach western European states and just over the border—poverty.

The national economic strategy based on the idea of the global technological leadership is pretty much impossible for the majority of the nations. What is absolutely possible is to be not worth than the rest of the world and sometimes even better. There are ways to protect the local industries, pay for the trade deficit, learn from the rest of the world and even go forward and contribute to the world's development as the provider of the new ideas. Let us call the strategy the economic defensive initiative. If these strategy is based on the local renewable resources it has the right to be called the "Green economic defensive initiative".

In other words, with the local currency as the mechanism of redistribution that makes local prices cheaper than the foreign goods at the expense of the local economic efficiency, there is a chance that there will be no flight of the local industries and labour out of the region. The protection of the local industries by means of other economic institutions is not necessary. The facilitation by such means as well-developed infrastructure is not a bad idea. An alternative to the protection by currency would be direct transfers paid by the federal government to regions to sustain their local economic development.

It is still quite unclear how to introduce the scheme imitating the national local currency in a community or even a territory. So far with only a few experiments on the go it is too early to say to what extent the scheme may work. In an African remote local community, it is possible to introduce something like a local currency with the clearing center somewhere in a Western bank. Actually, RBC bank of Canada was ready to help out to run the scheme for any community, for an African, Latin American or East European. The support was to be provided for the financial operations of an enterprise and extended for the individual accounts of the labour involved.

### **3. Balanced regional economy**

Another a very powerful tool of the economic analysis that has to be mentioned here is the analysis of the national economy by the structure of the national employment. The proportionate number of people employed by different sectors of an economy is based on the productivity of labour in these sectors and the gross

output by each of the sectors. Next step after the employment structure analysis would be the input–output matrices and planned economy, but this is not the initial purpose of the analysis. The employment structure analysis is a very powerful tool for finding bottle necks by productivity in the economy and justification of the investments for the improvement of productivity by sectors of the economy. This tool also is very handy when the economy is not based on the free market money for goods transactions, but goods for goods exchange. For example, if a local community owns a quarry and this a community in a developing country, then a financial payment will not increase the well-being of the community as much as for example building a school, a hospital or alike.

The employment structure analysis allows to estimate the number of people needed by sectors before the investments in the subsidiary industries are done. Proper investments can be vital for the successful development of the enterprise. Possible fields of investments: education of labour and procurement of the means of production, professional organizations and certification, protection of the industries and provision of supplies of the input materials. It is about trades people in the service of the local community and the enterprise. One of the possible ways to support the local tradesmen is the provision of facilities where the small industries can be successfully located, supported and function. It is very important that financial adjudication services are provided in addition. The European history knows plenty of successful examples of the organization of this type.

From the start it is necessary to decide if unions should take place in the organizational and social life of the future enterprise, should unions be a part of the local regional economy or not. Unions can be a very important factor of labour organization for the purposes of the self-identification and solution of the local problems, problems associated with the labour itself as well as technical problems on the production site [3]. Unions can be the cementing factor for the local community. Unions can keep the moral of the working force high. On the other hand, unions can be a tyrant that will drive the production costs high and force the acceptance by the enterprise of the inefficient solutions in all of the aspects of the industrial organization.

Should there be unions or not is an open question. The modern trend in the global economy and especially in the USA is to avoid unions in the economic life. Such organizations as Walmart succeeded at keeping unions at bay. The managers in the company are trained to counteract any intentions of the creation of the unionized labour. On the other hand, such countries as Germany are very successful at cooperation with the well self-organized labour.

Regardless if this is a unionized or not unionized enterprise, the same problems will arise, and someone has to solve them. If there is no union, bound to the enterprise officials must be appointed. If there is a union, there should be a form of control over its activities that is often even prescribed by the law.

Labour has to be paid and the payments have to be secured. There should be a place where savings can be made. In case of the retirement the retirement payments must be secured and carried out. All these operations often are impossible in the developing countries. In the developed countries the private financial organizations can take over the functions of the state allowing for more financial freedom and allowing for more just redistribution systems. For the developing countries it is the security that is the prime issue. It could be as simple as robbery or complicated as corruption or ill devised financial or taxation policies. Financial institutions located abroad with the accounts for each of the involved in the labour force could be a solution. Of course, the situation is not as simple as this, and many more questions will arise as, for example, what exchange rates and for what currencies should be applied and when exactly and where transfers should be made, or how to ensure that exactly the right recipients are getting the payments at the pay-off.



It is necessary to remember that one of the prime goals here is the sustainable economic development of the region. An artificial introduction of a local currency can really help a region to accelerate its sustainable growth. It is possible to reduce unnecessary imports substituting them with local products and use currency to buy the stuff that promotes growth. The economic model that helps in this situation is designed to view big agglomerations of population as self-supplying systems with extra import to substitute for the lack of the local resources or production.

A good example would be the idea of steam engine transportation based on the solar energy. For a developing country to buy foreign goods is prohibitively expensive, as these purchases deplete the national stack of currency at the adverse rate of exchange. Thus, imported fuel is too expensive in comparison to a locally produced fuel. The currency spent on the foreign fuel could have been spent on goods promoting sustainable growth. A possible local substitute could be steam produced with the solar power and supplemented with biofuel to keep up the temperature in the kettle on the go.

Naturally, additional questions arise, it is still unclear to what degree it is possible to control the quality of the product produced in a developing country. In the example of the solar and pyrolysis oil run locomotive, who can guarantee the cleanness of the product and who will pay and with what means for a travel with this locomotive. One may wonder, if it is enough just to organize a profitable business to generate the wealth for the local development or a much tighter control will be needed.

An economic policy can be evaluated based on the stack of cash in the possession of different groups in a society. It does not matter how the volume of money is defined. The discourse on the conversion between M1, M2, and M3 money is not a goal of this paper and will be avoided here. Based on the stacks of currency is possible to assess what consumption pattern will exhibit a nation in the short run or what economic policies will bring the nation out of the depression balance. For a local economy this means the predictability of the social impact with the emergency of a new profitable industry.

The same way the rates of the national or regional inflation can be predicted based on the available stacks of currency. It is possible to imagine that with the high rate of inflation money stacks are being depleted faster than normally and the national speed of currency circulation slows down as everyone is cautious to spend the rest waiting on the events. Thus, inflation dies out much faster, as it is normally predicted.

Back to the development of the local production. The international borrowing definitely can be the source of the necessary capital, but it also will be the source of the local organization. The model under which the local community finds itself facing the foreign financial institutions helps to answer two questions, under the necessary rate of payment on the borrowed capital what salary levels can be achieved by the members of the local labour force. Definitely, according to this pattern of reasoning the wages achieved will be much higher than a competitive wage. Even if the source of capital comes from the local sources, as the local pension fund for example, it still can be regarded as the foreign borrowing for the ease of analysis.

Through the higher wages local investment funds can be accumulated. Saving in the pension funds, local or national, should also be viewed as the local investment funds. Questions concerning local funds and local investments are open questions for discussions, regulations, and choice of the business organization. It is still to decide who has the right and under what conditions to use the funds for the investment purposes.

A similar situation arises if a union takes control over an enterprise or at least plays a very significant part. The questions to be answered how to decide on the



establishment or abolishment of jobs and the rate of payments. It is necessary to lay down what role can play the union in the choice of external partners and the conditions of the contracts. Such contracts can be very beneficial for third parties and can lead to the conflict of interests. It has to be established if the employees have the right to receive a premium paid by the external partners and what would be a bribery. Probably the union must have the right to review these contracts and have the power of veto.

The feasibility of wages can be estimated based on the international rate of financial borrowing. The idea is that the foreign financial institutions find themselves in the free competition and the international interest rate is established [4]. Thus, the flight of the local capital does not make much sense and the local producer is facing the international rate of interest as the result of the international financial situation.

#### **4. The necessity of the commercialization of the process**

The borrowed capital has to be paid for and paid in the long run. Labour and suppliers have to be paid in the long run. The suitable product has to be found and this product has to be sold for profit in the long run to pay for the contributing factors. Thus, the invention of the sustainable product is the prime aspect of the local economic development.

A sustainable product can be invented based on the regional economic patterns and the outer economic situation. The survival of the local economy will be based on the ability to defend its general industries and to promote the growth of its specialized export industries. The best scenario is when the sectors of the local economy exhibit sustainable proportionate growth and trade deficit is paid by the surplus of the local production.

Investment funds should not necessarily be of the international nature. Profit from the operations can be redirected towards savings thus creating the investment funds. Savings are generated by both sides of the economy by the businesses and the labour. The created investment funds can be very important for the regional economy as the source for the establishment of the local enterprises. Unions can play a very significant part in this process that should at least in theory promote the business-oriented thinking of the union members. The offspring enterprises can benefit the former labour force and generate even more wealth for the local economy.

Here comes very handy the structure of employment analysis. Investments should manifest themselves in the changing structure of employment of the regional economy especially if the enterprise is dependent on the local resources and the local social climate. The only possibility when investments do not reveal themselves in the changing structure of the local employment is when the investments are done in the capital and the productivity in the sectors is growing equally fast.

The national rate of savings is one of the macroeconomic parameters that describes the performance of the national economy [5]. This parameter can be applied towards the regional economy. This parameter allows to estimate the portion of the national or regional income that goes towards investments. For the analysis of the regional economy this parameter may become especially important if the material or intellectual capital is in big demand and of the imported nature. By readjusting this parameter with the macroeconomic measures, it is possible to meet the financial needs to pay for the necessary imports.

The possible solutions for the readjustment rate of regional savings can be the royalties paid at the exchange of the local currency, local taxation that goes strictly

into the investment funds, and all kind of other possible type of royalties. The regional pension funds with their accumulation of funds can play a significant part in this process.

It seemed that the production of electricity deep in Africa is not a sustainable in the long run idea. The empirical results rather were confirming this assertion. This is the experience of the engineers without borders in their efforts to improve the living conditions of peoples of Africa. The local productions for example of solar panels died out first of all due to the poorly understood economic factors. First of all, Engineers Without Borders failed to commercialize the process thus rendering the payments to the providers, labour, and professional staff not sustainable.

Engineers without borders were not a commercial organization and was not trying to organize a profitable entity in the long run in the first place. One of the reasons it failed to create the sustainable development in the countries of its operations is that it was lacking the will and intelligence to bring the sustainable changes to the local economies.

It is very possible that even when there is the will to commercialize the process the local markets still have to be invented. The situation is straight forward: local resources are not available as no one is selling anything. There are no means of buying something as there are no means of payment in circulation. The same is with the local and international labour, people have to be remunerated for their efforts. Work must provide people with means to sustain their living increasing its standards. With no local markets available the two classical solutions are available: the forced labour camp or the military camp. The first solution means people are forced to work with the bare minimum of supplies, just to sustain their living. In the second case the supplies are shipped from the well-established centers of production and redistribution. The first solution is unacceptable, the second is prohibitively expensive.

The historical solution in the absence of the well-established markets for goods of general consumption in volumes comparable with the national consumption is the process of taxation in real products and assignment. There are plenty of historical examples when whole villages of the peasant population were assigned to certain productions. A classic example would be the early Middle Ages. It does not mean that the peasants have to be the labour force in the production, they can be just the suppliers in goods to provide for the labour, first of all food. For a developing country this solution still can make much sense as the back payments to the population can be made in real goods as medical equipment, building materials or anything alike. To implement this solution in a developed country is rather problematic first of all due to the elaboration of the consumer basket.

Another solution can be borrowed from the Soviet Union. At a certain point the government allowed the sale of the foreign goods to the population for people with the special currency. The system was called Bereska, probably another instance of the national humiliation. To what degree this historical solution can be implemented in the development economics is not quite clear, but the idea is quite promising. It is possible to pay to labour and small suppliers with the nominal records money that can be traded for real high-quality products in the specialized stores. The secondary markets better be tightly controlled or organized or there will be high rate of corruption and criminality. For more details on the criminality spurred by the Western economic aid please read about the recent Somalian history.

The idea of production of electricity in Africa for sales in the European union directly evidently is not a sustainable one. Big production numbers will turn into a trickle by the time they will reach the markets in Europe or elsewhere. Nevertheless, this is the question of sustainability to invent a product suitable for consumption over big distances produced locally. And electricity can still be the one as far as it goes into the product as direct or indirect input. A good example would be coffee

that an item of export to Europe. Through coffee electricity can be sold in the European union indirectly.

Another possibility to sell electricity indirectly is to save energy in the chemical bonds. The chemical production requires input of energy. Solar panels and wind or tidal turbines deliver big quantities of energy, but of coordination with demand. The production process on the contrary can be schedule in accordance. Thus, solar energy can be saved in chemical bonds and sold over big distances. A good example could be the idea to sell clean heating oil to the big agglomerations of population.

If the organization of the local market economy is not possible at least in the short run, the organization of a profitable enterprise and the positive influence on the regional development are still possible. What matters is the agglomeration of physical consumers as the end point of financial transactions. Financial capability of the local population is not so necessary as there could be other means of exchange and redistribution. The main income at least on the initial stages of the new local development will come from abroad. It is still the availability of the local labour and availability of certain local resources that play the crucial role.

Selling to the local population quite often can be a problem as the local markets still have to be organized. Even if there is quite dense local population it still can have zero buying power. Here comes handy the money stack analysis to model the creation of the local markets based on the successful local production. Alternative to the creation of the local markets would be the direct redistribution of the consumer products. The problem is that it pretty much entails the creation of the local planned economy with coverage of the whole consumer basket.

The local markets in the typical African context cannot be defined as sufficient in terms of promotion of local industrial development. It is not so much about the financial unattractiveness of these markets. The financial situation finds its manifestation in the material exchange that the local markets can suggest in return for the produced industrial goods. Historically this is exactly how it went on, the parallel development of the agricultural und the industrial sectors of the economy. The main problem is time that was necessary to put together the accidental factors. It took literally centuries, if not longer.

On the other hand, the autonomous development of the local markets is still possible. Again, the example of Newfoundland, it a province in a well-developed western country. Local markets are small, but financially sound. By means of the real exchange economic scenario it is possible to conclude that nothing prohibits the high level of economic/industrial local development. In theory the availability of the local resources should be sufficient for any level of wealth limited only by the level of development of modern technologies.

While the Newfoundland economy is very low on performance the same of Sweeden is quite sound. Both countries are in the northern climate and cannot compete with the rest of the world in the traditional sectors of the economy, like agriculture. Sweeden is flourishing because it can manage its internal sectors of economy and trade with the rest of the world with specialized goods.

A good theoretical question if any local product in surplus can be used as a specialized product for the international trade. The best approach would be to consider is the saturation of the global markets with this product and the possibility of the stagnation of prices for the product by the immediate neighbors in case of the high volumes being supplied [6].

Sweden retained its internal markets even under the new socialist system. This allows for the local development. Investments in the local economy pay off. In case of the developing countries the absence of the well-developed local markets is a big problem. A newly established enterprise should orient itself towards the external markets and something should be improvised for the local situation.



From the historical perspective Sweden was undergoing its pro-socialist transformation at the times when the global competition was not as acute as it is now. By the time of its great changes Sweden was already one of the world most developed countries. Sweden could preserve its economic institutions and develop further. In case of the developing countries the situation can go as bad as no markets for goods for money at all are in existence. What comes very handy is the structure of employment analysis and general planned economy. Good question if it is still possible over a short period of time to nurture the more efficient free market and monetary circulation by introduction of financial payments for labour and suppliers at the newly established enterprises. For example, buying food from the local population, and the local population can get high quality import goods in the specialized stores.

This is where the Engineers without Borders failed by not being able to create long lasting impact on the societies in question. Everything was falling apart after they were leaving. No mechanisms of perpetual maintenance and improvement were introduced.

The USA government followed the same line of reasoning trying to bring industries to the less advanced countries. The well-known to the public cases so far were not very successful. One of them to mention is some operations in the T-shirts production. One enterprise was placed in Vietnam. The main problem with this placement was that the only operation left to the enterprise in Vietnam was earning literally pennies leaving the workers with the wages way below any international standards.

A sustainable product must have the ability to be sold and produced in the long run. In the production process the producer and the working force must feel themselves motivated. The product must be environmentally friendly, face the continuous supply of raw materials, and the enterprise be able to find and educate professional working force. What else must be packed in the definition of the sustainable product is open for further discussions.

The Engineers Without Borders the same way as many other economic powers like international corporations did not manage to create the sustainable product first that would contribute to the continuation of the local production. Like solar panel projects that led nowhere. No one even cared to establish the mechanisms of the economic exchange keeping the production cycle running.

Do not say never ever will happen to transport energy from Africa to Europe. How about producing biofuels, energy can be saved in the carbon chemical ties and brought to the consumer. How about an even more devilish plan? The locally produced in Africa energy will come to Europe as coffee. No one suggests burning coffee beans in furnaces like fuel but drinking it. The idea is the substitution of products, stop bringing low quality fossil fuels from abroad, produce local electric power, produce local heating oil for power plants and for engines, locomotives, heat up with solar, maintain the temperature with the heating oil.

And again, about the USA industrial history. In the second half of the XXs century pretty much all the innovations in the agricultural sector were invented and tested by the research institutes run by the USA government. What makes it to believe that the lack of the local technological development is not justified on the grounds of the lack of the economic exchange markets and the protection of property. In the States the level of the economic development is much higher than in the developing countries, especially in the countries to the south of the European Union. Normally countries do not have the luxury to enjoy the privilege of continuous funding for the research and development purposes. To sustain the sustainable growth the sustainable investments in the research and development is necessary. The best way to achieve it is to build a sustainable industry that can pay for this development and test of the new technical solutions in praxis.



Through the creation of the sustainable product the local markets are getting the chance of incorporation into the global economy. At the same time the local markets must have the protection mechanisms that will ensure the existence of the local industries. The state of affairs of the local peasants being forced to the natural economy is not an example of the well protected local economy, but rather of its defeat.

Without making investments in a technology all the dreams about the implementation of the technology will remain just a dream. For any investments to take place the technology has to be financially attractive. The implementation financed by the state is not a great solution as it exists only as far as there is funding. The task of an engineer is to improve the technology reducing costs up to the point where it is cheap enough to compete with alternatives. If it does not work, it does not mean that this is the end of the application of the technology. There are plenty of neighboring factors that should be considered. Quite often the whole technology should be revised. Production with the technology requires inputs, has side effects, and produces products. The implementation of the technology should be reviewed on all the stages of the production process.

Speaking about inputs it is necessary to keep in mind that there are all kinds of them. There are inputs during the construction and maintenance of the production process, and inputs that are used to create the product itself. When it comes to practice, the difference in approach is evident. The initial inputs are the ones that often are taken out of consideration during the readjustment process.

On the financial side of the analysis inputs are the costs that will be put against the cash flow generated by the sales of the products created with the inputs. It is possible to minimize the expenditures on the inputs, on the waste handling and to increase the revenue per unit of sales. With the growing costs of inputs and the price of disposal of waste the avoidance of waste is picking up in importance. It happens that the byproduct of production can be the most revenue generating seller.

Smart industrial organization can play the vital role in the development of the relations with the labour involved and the local population. The proposed idea is the idea of the industrial farming. In the case of the local energy production this idea would be called the energy harvesting farming. The idea is to try to avoid using mega plants and rely more on small production units operated half independently by the local population at the site. This organization creates the positive attitude towards the production in question as it makes people feel more like the proprietors than the exploited colonial labour. The not interested population as isolated islands can be simply circumvented without much damage to the production as a whole.

Historically the cottage economy did not survive the competition against the fast-growing agglomerating companies. It does not mean though that with the modern industrial organization the idea has no future. Many big corporations build their operations on franchising. The organizing authority will deal with such problems as securing the suppliers, solving internal disputes, controlling prices and quality of the product, dealing with the side effects and securing the ways of distribution of the product. Other important issues would be optimization of the production and the education of labour.

## **5. Invention of a sustainable product**

Speaking about the optimization of production in the rural areas, wide implementation of pyrolysis can be the breaking through technology. Following the same logic of optimization, the pyrolysis production cannot be just the source of the local cheap fuel. A much more sophisticated sustainable products have to be invented.

If it is energy in form of the biofuel it has to come together with the invention of the local means of transportation like the solar-biofuel powered locomotives. If it is biogas, it should be produced with the hinder thought of using biogas to produce bioplastic to use as the input for solar lens for the local heating installations. The latter can be used as the source of energy for the local production as drying of coffee beans or alike, for cooking, or for heating of the local housing. Imports should be reduced, and exports created. The import of plastics and fuels should be diminished, and the foreign currency used for something more useful. In this case a sustainable product like coffee will pay towards the balance of trade.

Not only coffee, there is a vast field for product inventions. While a new product for sales over the long distances can be invented the production waste can be reduced. The mineral residue from the pyrolysis won from the biomass can be used as mineral fertilizers [7]. Historically people were burning forests to use ashes as mineral fertilizers. Nowadays the mineral residue can be packed and sold, even in small packages as pot flower fertilizers.

It is not yet quite clear if there is a place for a much more ambitious projects than mineral fertilizers from the pyrolysis process mineral residue. Bioplastics may be created and used for solar energy cooking and heating thus reducing the use of wood for heating purposes and deforestation in general. Mineral residue can be used if produced in very big quantities for the purposes of reversing the process of desertification.

Here comes very handy another idea—the idea of the processing of the seaweed. Normally the natural circulation of water washes off the landmass very much of the useful substances, like the mineral components of the soils. Water dissolves and the sea water contains all the possible elements and substances. The next question would be of how much of this stuff can be won back from the seaweed. Seaweed normally grows on the shelf from the stuff accumulated from the landmass. The most trivial idea is that the whole palette of products can be designed around one single industrial process more complex as turning biomass into biofuel and pyrolysis gas.

Depletion of the global resources probably will be the prime driving force behind the further development of the pyrolysis-based technologies. Bioplastic based substitutes can be won from the biomass [8]. Of special interest here would be the production from the seaweed. As the world is facing the problem of the global dispersion of the valuable materials researchers are looking for the technologies to reverse the process. The natural circulation of water slowly moves everything to the world ocean. An open question is how much of this stuff is accumulated in the seaweed and can be won back from the pyrolysis residue.

Energy saved in the chemical bonds can be transferred over big distances and used again. Thus, there is at least one good argument to use local cheap energy. In the south it can be in the form of a solar power plant, in the north—the tidal or wind energy, and everywhere the energy of the solar panels can be generated and used. At least, the accumulation of the energy in the chemical bonds lifts the problem of the time inconsistency between the production of the energy and the demand for the energy. And definitely the alternative energy should not be only used for the conversion of one type of energy into another. Any industrial process needs energy and this energy can be generated cheaply and locally.

Another sustainable biochemical process that may be successfully combined with pyrolysis is biogas. The positive side of the process is that it can be a very labour non-intensive passive process. Any problem with the thermal processing of any biomass is the high content of moisture. The biogas production involves the slow consumption of biomass by bacteria that results in the production of biogas and slush. The water molecules are being freed in the process and thus can be

drained. If the resulting residue can be a good feeding material for the pyrolysis process is still to be researched.

Recycling performed in the sustainable way based on the pyrolysis or gasification still can be considered for an industry to be placed in the region suffering under underdevelopment. The idea behind is the same, the carbon-based part of the waste can be separated from the rest of the waste material. Metals can be extracted based on their magnetic qualities. The rest is the rest. The whole process make sense though only if there is an abundance of very cheap energy to start with.

Processing of biowaste can be an absolutely different story from the financial perspective. Biowaste can be concentrated at the site of its generation and be treated locally. A good example here would be an animal farm. The animal waste is already quite energy saturated what makes the production of biofuels quite lucrative. Another aspect is that the mineral component in the animal waste is very high thus making the animal waste a potential stock for the production of mineral fertilizers.

Fresh water reservoirs can become a potent source for the production of biofuels and bioplastics. Water reservoirs allow for quite fast and very intensive growth of all kind of organisms capable of photosynthesis. Also, these reservoirs accumulate the run-offs of the fields. Water organisms use these substances during the life cycle. Processing of these organisms means the further utilization of fertilizers, not to mention the production of high-level energy substances based on carbon. The high density of the biomass and the ability to float and be carried down the stream can considerably low the costs of the further processing. The project can be combined with the extensive water treatment facilities and the fish and poultry farming.

Minimization of costs of production may still involve the invention of the special technical solutions and choice of local or alternative materials. Speaking about the European perspective such solutions as cheap metals from Siberia can be implemented. Speaking about the rural environment of Africa such local solutions as the local production of bricks can be considered. In every environment where the preliminary extensive process in the form of biogas takes place the mobile inflatable systems can be transported to the site of the production located at the site of the biomass.

The pyrolysis-based technology can become the technological foundation for the emerging high-tech power cell technologies. In case the world decides to convert its technologies and rely on the renewables the pyrolysis-based technologies can be used to produce fuel for power cells. These are the newly emerging technologies and to elaborate on the topic is not yet possible.

## **6. Conclusion**

The modern technologies allow to achieve much higher standards of living, as it is quite often seen even in the developed countries, and these high standards of living normally can be achieved through the utilization of the local resources. Pyrolysis based technologies can be successfully used to win substitutes for many non-renewable resources from biomass. Closed cycle local technological development based on pyrolysis is possible but remains rather a dream. The international progress makes the intensive trade with the surrounding world unavoidable, and the absence of the suitable local economic institutions make the implementation of the technologies by the regional producers impossible. New economic solutions and introduction of the new green technologies are necessary to sustain the balanced local development.

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