CEM 153: **INDUSTRIAL HEMP VALUE CHAIN (IHVC) AS AGRO-INDUSTRIAL INNOVATION***: New perspectives and approaches needed for the establishment in Italy.*

1- CLIMATIC CHANGES AND TRADITIONAL INDUSTR MODEL: THEIR CURRENT CRISIS AND THE NEED FOR *WIN-WIN* SOLUTIONS

Throughout its evolution and diversification, our industrial economy has hardly moved beyond a **linear model of resource consumption** that follows a 'take-make-dispose' pattern. (ECOLOGING,2013) (fig.1). This "path" led us to many unprecedented climate changes over decades to millennia (IPCC, 2013). Many companies have begun to notice that the traditional linear system increases their exposure to risks, most notably higher resource prices and supply disruptions(ECOLOGING,2013).

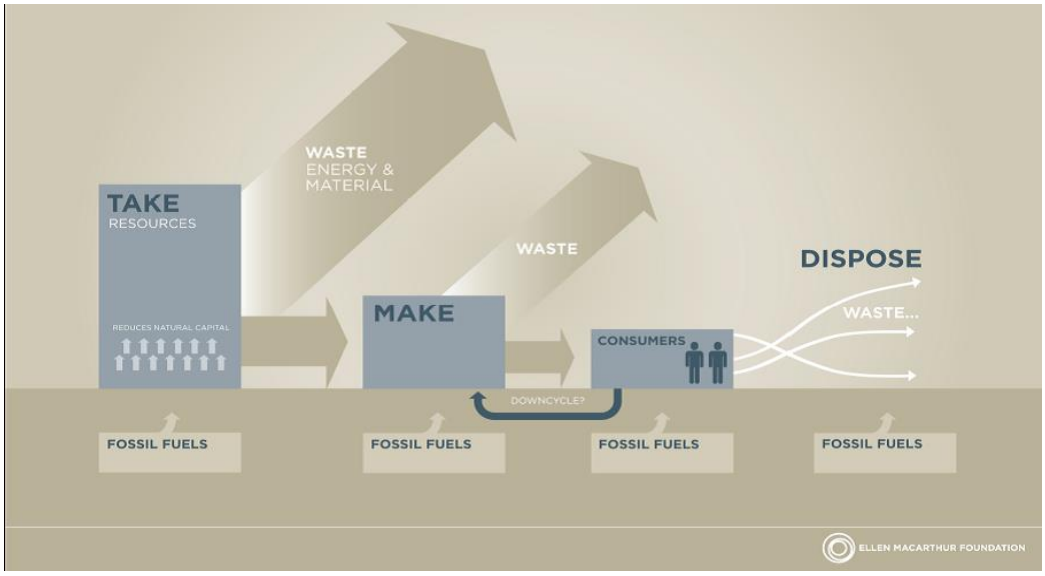

Figure 1 *- Linear economy, involves traditionally waste and fossil fuels. Source Ellen Mc Arthur foundation*

Among others, recently EU published "2030 EU framework for the climate and energy[1]" a strong political commitment to environmental protection and the mitigation of climate change.
Not surprisingly, in conjunction with the presentation of the 2030 framework for the climate and energy the communication "*towards a European industrial revival*"[2] was presented[3].
Since 2008's recession, governments, the business community and civil society have been embroiled in a fierce debate over how to restart the global economy (Rifkin, 2013).
The EU is weakly emerging from its longest ever recession with EU28 GDP growing by 0.2% in the third quarter of 2013(EC-2, 2014) while Italy's economic growth and labour market conditions deteriorated, with growth at -2.3% and unemployment rising to nearly 11% in 2012 (Theodora,2014).

[1] After 2020 objectives, new commitments have been added.

[2] The European Commission is urging Member States to recognise the central importance of industry for creating jobs and growth, and of mainstreaming industry-related competitiveness concerns across all policy areas. This is the key message of the communication 'For a European Industrial Renaissance', adopted on 22 January 2014

[3] by A. Tajani European Commission Vice President and Commissioner for industry and entrepreneurship

Concern about climate change and the exit from the crisis could go hand in hand; EU's intent is to provide certainty to economic operators making solid and predictable policies to protect the climate and stimulating investments. (Carraro,2013)

A long-term industrial policy targeting at the development of 'clean' products and technologies could well form the base for a major industrial policy initiative (EC b,2014).

Historical scholarship on business-environment interactions has largely sidestepped the study of corporate innovations with both economic and environmental benefits (Desrochers P., 2009), nowadays industrial hemp's value chain (hereafter IHVC) has potential to create innovative win-win solutions.

2- AGRO INDUSTRIAL INNOVATION ASSOCIATED WITH INDUSTRIAL HEMP: ITALIAN HISTORIC VALUES AND NEW INNOVATION NEEDS

After being **grown and used extensively for centuries** in the Italian peninsula, both from the Romans and Venetian empires (Celetti D.,2007), during 19-20th century(figure 2), Italian hemp has been acknowledged among the best in terms of quality all around the world(Guidi D., 2003) and played a central role in the every day's life for many, as **a valuable resource** with **historical significance** and **cultural-economic importance**(Hempbox ,2013).

Figure 2 *- Kneading-procedure that could break the hemp stalks through the use of a specific tool: THE "gramola", a wooden lever, long and cumbersome that, because of its heaviness, it was rather difficult to manoeuvre. Source: Biblioteca Storica Nazionale dell'Agricoltura*

In 1977 industrial Hemp became illegal, and nowadays the crop isn't taken hold in a big way in Italy, but is starting to spread interest after industrial hemp was legalised, 15 years ago**.**

M**odern agriculture techniques** and knowledge with the **necessary industrial adaptations** are the new paradigms, while **new participative communications technologies** can bring its potentials to a wider set of new stakeholders.

3- INDUSTRIAL HEMP VALUE CHAIN: NOWADAYS MAJOR ISSUES, DESIGN CHALLENGES

Firstly, Industrial hemp production must be **profitable** from an economic standpoint, regardless of the political environment, to be a viable alternative crop (Vantreese V.L.,1998) since it must be **competitive** not only with other fibre and oil **substitutes**[4], but with other production **alternatives**[5] as well.

New IHVC should question the conventional organization where we can observe several levels of activities that arise often from the distance between the producers and consumers (Fig. 3). **Transportation** has negative implication on hemp economic and environmental feasibility (ADAS 2005).In Italy rising fuel prices, among Europe's most expensive[6], worsen the situation.

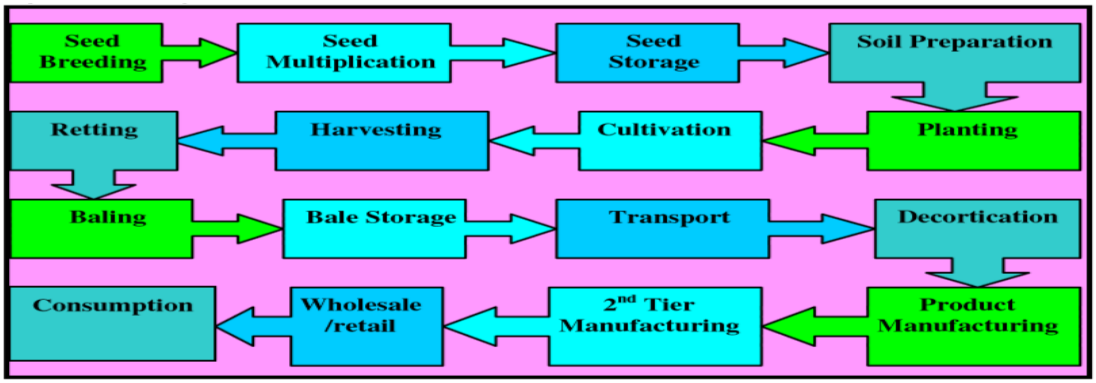

***Figure 3**: Hemp market value chain. Source: DAFF SA 2011.*

Designing aiming to reduce at minimum the distance is important but to produce a better design **all the barriers that hamper the establishment of IHVC** must be addressed(table 1), creating enough balance between efficiency and resilience(figure 4)

Technical	**Commercial**	**Knowledge**
Lack of knowledge in hemp growing	Difficulty to source hemp seed	Lack of R&D in better hemp strains
Poor hemp quality	Poor hemp crop yield	Farmers' lack of knowledge
Lack expertise in hemp production	Necessary winter storage	Architects' lack of knowledge
Lack of expertise in hemp use	High trasportation costs	Builders' lack of knowledge
Lack of producers	Farmers profitability	Construction industry lack of knowledge
Lack of processing plants	Difficulty to start up the hemp industry	Cosumers lack of knowledge
Lack of initial capital	More profitable market for hemp	Government lack of knowledge
Lack of processing plant R&D and related industry	Lack of economy of scale	Others
Others	Hemp products are expensive	
	Consumer resistance to innovation	
Regulatory	**Psychological**	**Invisible**
Farmers difficulty to get clearance for hemp cultivation	Hemp association with marijuana	Synthetic fibre and products vested' interest

[4] such as wool, cotton, flax, and soybean and palm oils
[5] for example, corn, hay and tobacco
[6] http://fuel-prices-europe.info/index.php?sort=8 Show that Italy is always in the top positions of fuel prices, excluding LPG in which is around 7th position.

Difficulty to obtain certifications(new strains, machinary, labels..)	Misconception that "traditional product are better built"	Other natural fibre, alternative product interest
Difficulty to get structural insurance	Others	Cement industry' vested industry (for hemp and lime)
Others		Others

Table 1 *- Initials barriers for hemp building industry mainstreaming. Source by the author, 2014*

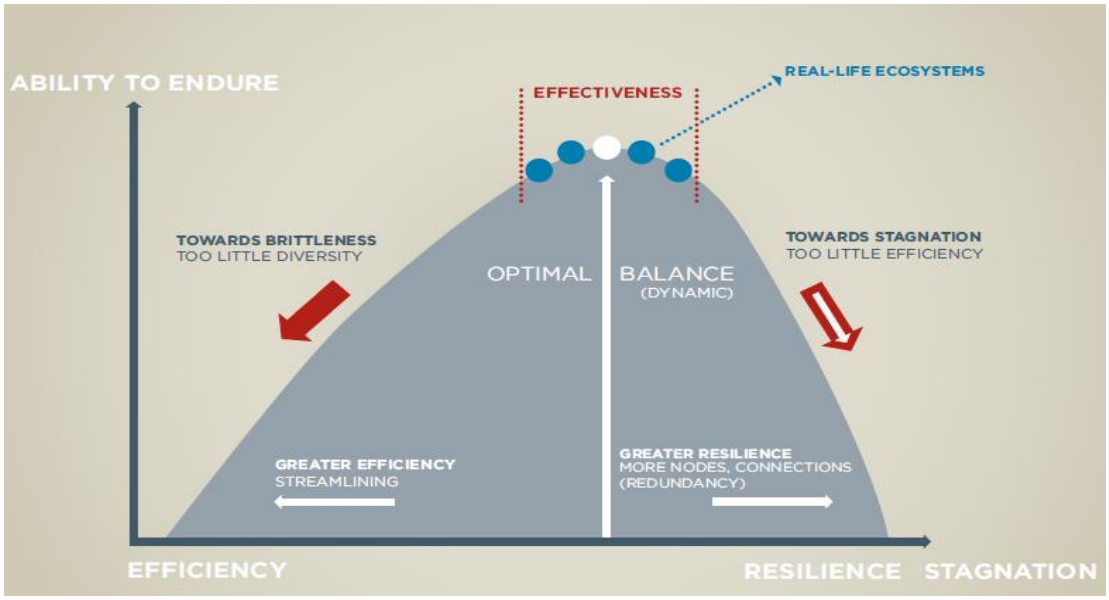

Figure 4 *- Finding effectiveness, the dynamic between resilience and efficiency . Source Ellen Mc Arthur Foundation*

If IHVC is established with a **simplified scheme** it's then **easier to identify** raw material producers, transformers and distributors; therefore **certifications** can be taken more in considerations.

In complex chains, involving a great number of actors, consumers are not always are able to identify the producers of raw materials (Kruken L., 2008)(figure 5).

Figure 5 *-Short value chain helps* ***proximity*** *and* ***traceability****, otherwise it may be lost. Ssource: Kruken,2008 edited by the author*

Certification means **visibility**, which **improve awareness**, that the product is a project resulting from relationship between people who produce and consume(Kruken,2008).

Recently Google© has produced a website[7] which shows and describe several Italian products offered from agro-industrial and other sectors, as confirmation of the relevance and nowadays' sensitivity towards this themes[8]. A pivotal sector of the "Made in Italy" is definitely the **rural** that includes the food and agro-tech as strategic segments.(Battaglia,2014)

Even if a small part within agro-food segment, certified quality hemp can benefit from this established qualitative context. The boundaries of **ethical consumption** and **corporate social responsibility** can merge into **a win-win solution** for the national context.

"Responsible consumption investigates all product features and ***represents a natural evolution*** *of the practice of critical consumption, based not so much in relation to predetermined criteria but in the habit of thinking of questions before choosing a product*"(INEA, 2008).

Future recognition and awarness of the environmental and economic potentials of industrial hemp can be improved by consumers behaviours, corporate efforts and governments legal framework, all of them looking for win-win solutions.

4- DISINTERMEDIATION OF IHVC BY INTEGRATED SUPPLY CHAIN

The introduction of integrated supply chain projects requires the development of models capable of **interpreting the dynamics** of vertical and horizontal **coordination between the agents** and the definition of the aspects that most affect the **ability of operators to give added value** to products and to acquire assets in exchange for a competitive advantage (Contò et al,2009)
IHVC's **disintermediation** offer several benefits, in fact improving also the possibility of a widespread use in rural areas(Battaglia,2014 b).

Planning and **promoting communication** are some of the more evident roles played by a design aiming to promote local development. The **key aspects** to be considered in the **promotion of local products are transparency and traceability, history and meaning** (Kruken L.,2008).
Optimum solutions to close the **gap of knowledge** (table 1) among professionals and markets actors are surely major issues for IHVC, but the **most important phases** to link are the **cultivation** and the **first tier manufacturing**[9], regardless the different hemp's purpose[10].

5- MAJOR COLTIVATION ISSUES

The technique of cultivation must be rethought in terms of business and environmental conditions but also the needs of the entire production process (Fibranova, 2013).

Industrial hemp is **financially and politically fostered** by EU, at the moment 46 varieties of low psychoactive contents[11] are available (Hansforten, 2013), but several research is still going on[12].

[7] http://www.google.com/culturalinstitute/project/made-in-italy?hl=it

[8] According to the Agriculture Ministry the "**Made in Italy**"(also **a well-known marketing advance in future established EU IHVC**) was a holding company the brand would be in third place for revenue after VISA© and Coca-Cola©, worth about 250 billion, 17% of the GDP.

[9] Hemp "bast," the outer surface of the hemp stalk, has the longest fibres. Hemp "hurds /shivs" are the inner woody portion of the stalk, with shorter fibres. Special machinery is required to separate the more valuable outer hemp fibres from the inner fibres.

[10] like **fibres**, **shivs, seeds** or **biomass** which involve different machineries

A trigger for IHVC could be its benefits **as rotation crop**, because it suppresses weeds and decreases outbreaks of insect and disease problems (Rhydwen,2006). Hemp may also rebuild and condition soils by replacing organic matter and providing aeration through its extensive root system and guarantee also phytoremediation.

Around Italy, an exhaustive overview of the possible areas to use doesn't exist yet but the analysis in figure 7,8(Baldini et al.2013) can be a good example.

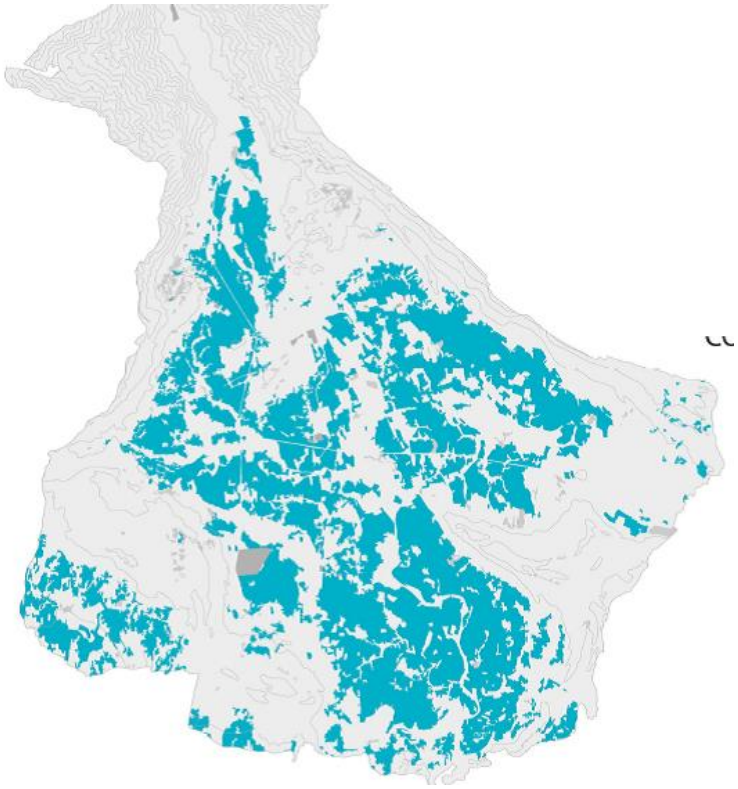

Figure 7 - *13,500 ha. Of cereal crops to exploit in order to introduce industrial hemp as a rotation crop,* Italian example in the Canavese area, Piedmont region. *Source Baldini et al 2014*

[11] TetraHydroCannabinolids are the unit of measure to determine if industrial hemp is viable or it's considered drug, the bechmark is below 0.2% of THC
[12] C.R.A of Rovigo as example is one of the major Hemp R&D in Italy, and have several researches going on to create performing varieties.

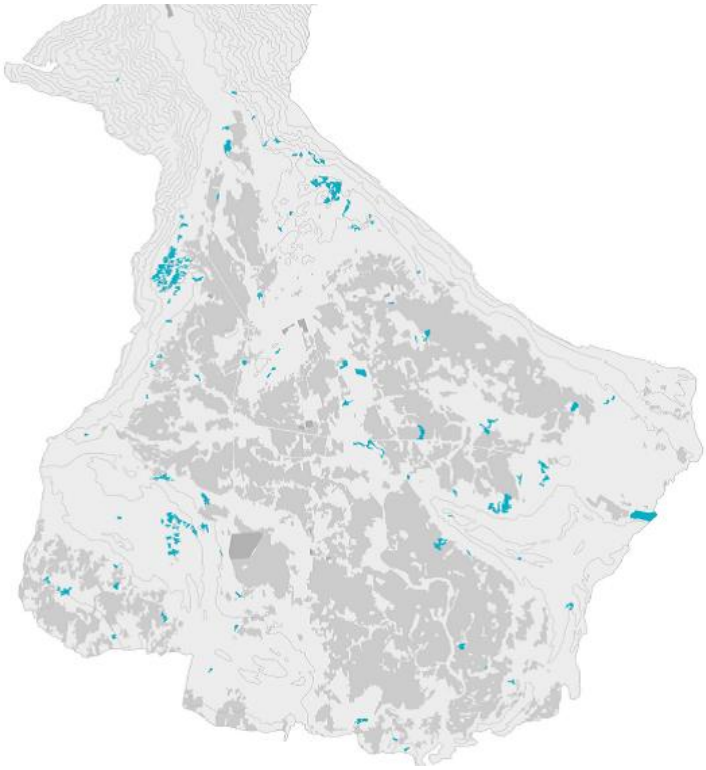

Figure 8 *- 495 ha. of not cultivated or abandoned areas to recover hemp cultivation in the same Canavese Area, Piedmont. Source Baldini et al 2014*

Industrial Hemp can both help in restoring biodiversity(figure 9-10) and became an low environmental profile crop if intensive monoculture regimes are used as a farming method (Rhydwen,2013) .

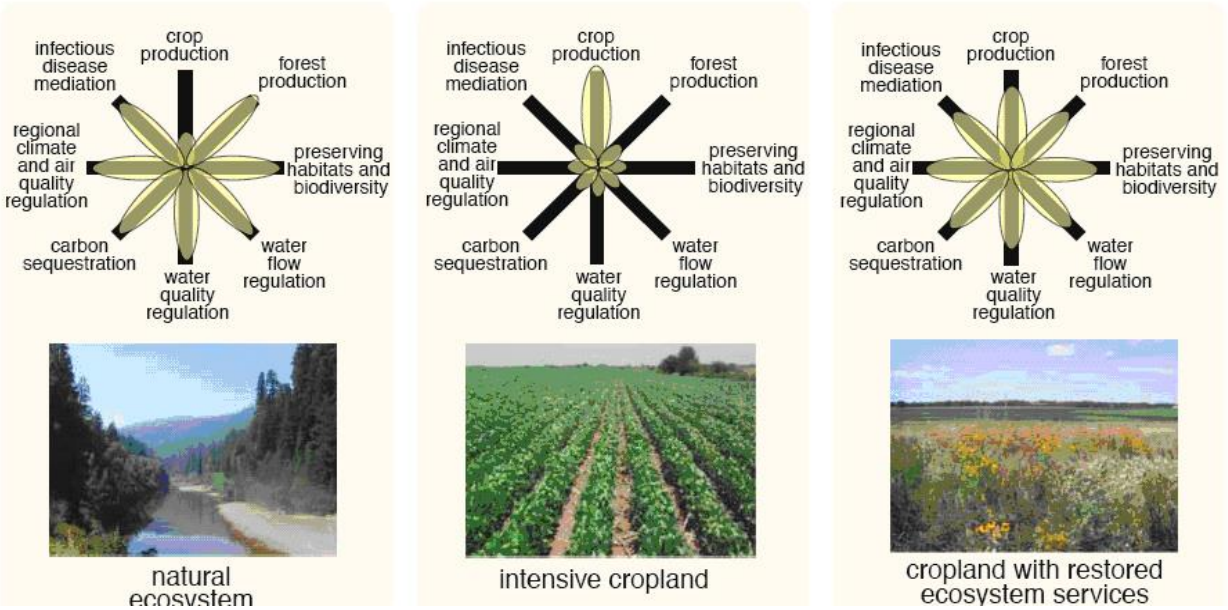

Figure 9 – Biodiversity friendliness as component for restoring ecosystems and related input/output, even if the figures are debatable, Hemp helps restoring a more balanced ecosystem, source: Ellen McArthur foundation

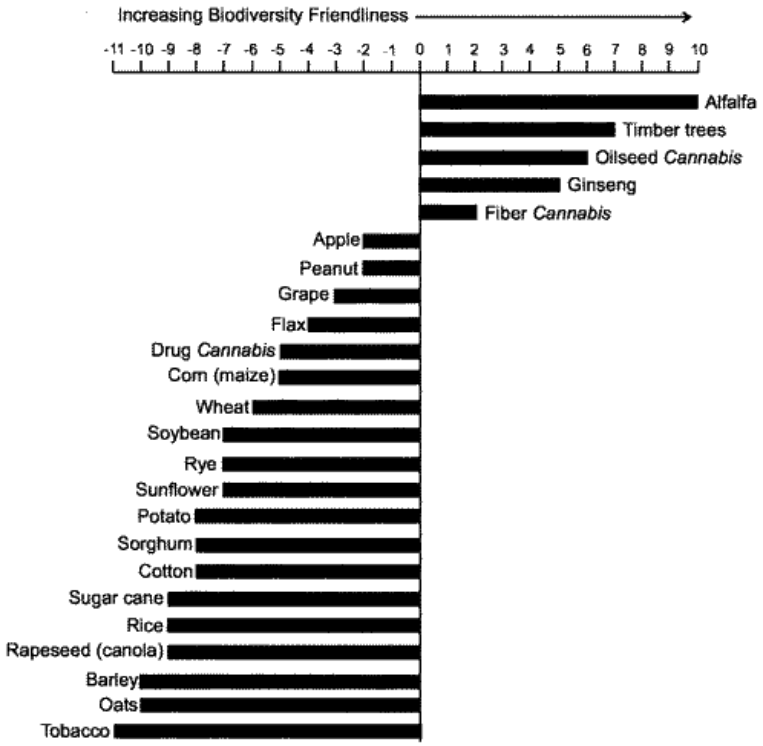

Figure 10 – *Hemp cultivation (especially for seeds) improves local biodiversity. Directly as a food sourcevto birds and small mammals and indirectly because of hemp cultivation needs no biocides. Source Small 2002 quoted in Rhydwen, 2006*

6- MAJOR PROCESSATION ISSUES

The lack of processing plants then makes demand and profit projections extremely speculative and debatable. Given that Italy lacks of IHVC updated production's cost data and industrial hemp market overviews, the only known fibre-plant is located in the north-west part, in Carmagnola[13]otherwise farmers, according to Italian law, .has to sign a contract with other hemp manufacturer to be legally sound.

Giraudo(2011) argued that, similarly to flax in Northern Europe, it's desirable that the farmer sells the product separating fibre and wood part already, **obtaining greater value added** with the transformation. Hypothesis for location in the Canavese area is shown in figure 11 while figure 12 shows possible synergic activities which can be created.
15 years ago the traditional processing of hemp was at a technological level of 50 years earlier and correspondingly unproductive (Nebel K.,1995). Currently, hemp fibers processing has limited processing capacity in Europe, regardless the demand; **high investment costs**, **unsecure supply** and **quality variability** create an uncertain situation (Gosovious,2013).

[13] Turin is located in Piedmont, north west of Italy while the only processing plant is based in the "canavese" area, which, similarly to Hempshire in UK has obtained the name from the famous hemp cultivation (canapa is translated as hemp)

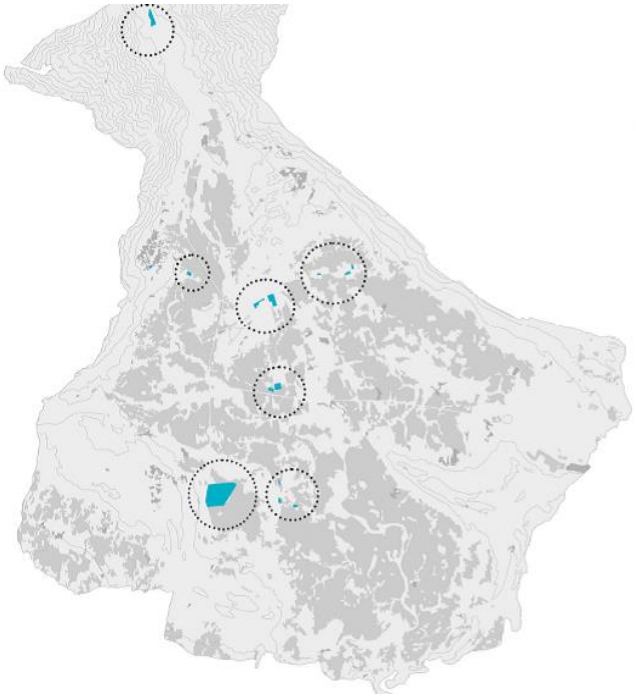

Figure 11 - *268.000 m^2 of dismissed industrial are usable for industrial hemp manufacturing plant, Canavese area, Piedmont. Source Baldini et al. (2014)*

The potential and implications of **clusters** to create favourable innovation ecosystems for mutually reinforcing groups of SMEs needs to be better exploited, as a means of promoting IHVC growth(EC b,2014) (Figure 12)

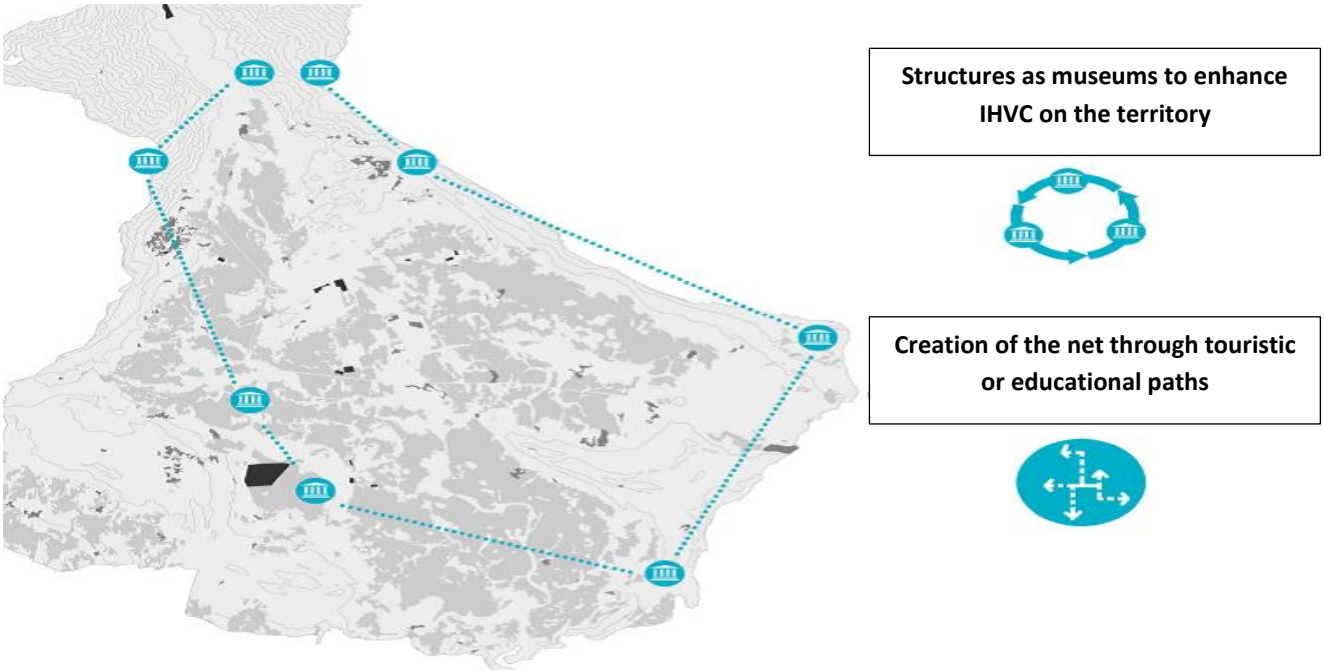

Figure 12 - *Possible ideas to enhance hemp crop history and appeal of the territory, In order to create synergic networks around IHVC and facilitate cluster creation. Source Baldini et al.(2014)*

7- NEW TECHOLOGIES AND SOME CHALLENGES TO THE LINEAR ECONOMY

Today, Internet technologies and renewable energies are beginning to merge, creating a new industrial infrastructures for a "Third Industrial Revolution"(Rifkin,2013).

Use of the Internet, as example, has **skyrocketed** in the last 15 years(figure 13), revolutionising global interconnectedness and opening up a true notion of "**global commons**" for nearly all of the world(Keeping track,2012)
This has positive implications for the development of so-called **"citizens' science" networks** for local and instantaneous monitoring of various phenomena.
On the other hand, following the linear pattern, a **growing obsolescence** of devices increases the amounts of electronic waste, containing hazardous chemical compounds used in the fabrication process, causing significant environmental and health impacts and poses enormous challenges for recycling (UNEP 2005b quoted in UNEP,2011).

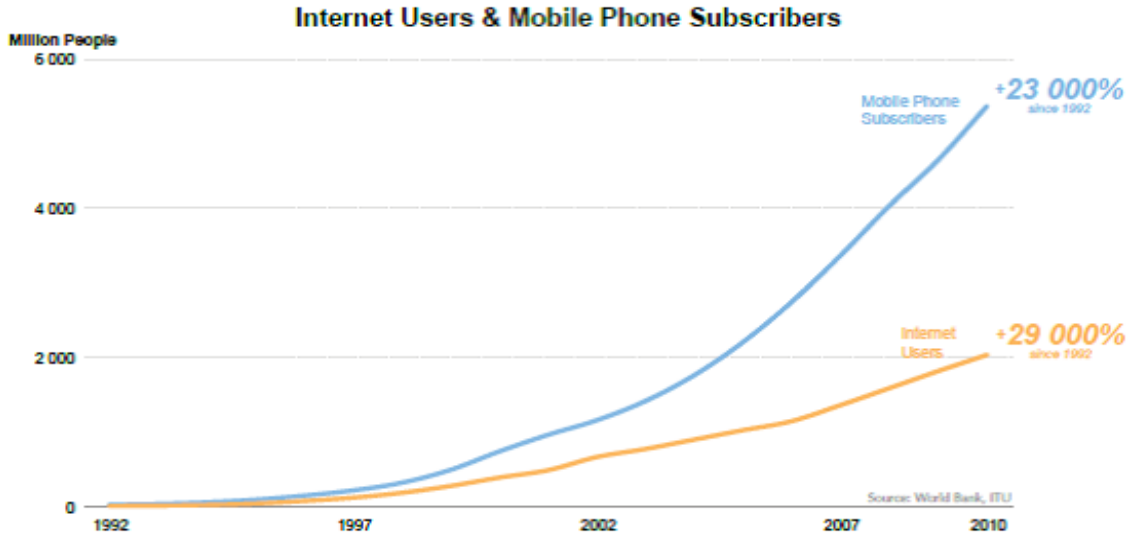

Figure 13 *- The "global village" has developed rapidly on the basis of new technology. Source UNEP*

This new tools allowed software and hardware innovations to aim at **circular** (figure 14a,b) and **distributive** economy, offering an alternative to the traditional industrial status quo, eventually with **bottom-up** and **open source** approaches .
By weaving open source permaculture and technological cycles together(OSE,2014) *Open source ecology*[14], even if still much remains to be tested, offers huge potentials , with **significant implications**(Jakubowsky,2011), especially if the ***"global village construction set"***[15] become effective and reliable(Figure 16).

Greater **distribution of means of production**, **environmentally sound supply chain** and **enhancements of DYI maker culture** are some of the most relevant (Jakubowsky,2011).

[14] http://opensourceecology.org/wiki/Open_Source_Ecology
[15] The **Global Village Construction Set** (GVCS) is a modular, DIY, low-cost, high-performance platform that enables fabrication of the 50 different Industrial Machines that it takes to build a small, sustainable civilization with modern comforts. http://vimeo.com/30171620; http://opensourceecology.org/wiki/GVCS

Even if machines must be certified to EU norms to be used in firms[16] (Battaglia b,2014) GVCS's spader or tractor can become useful in soil preparation while the universal seeder, micro combine and hay rake should be adequately prototyped to hemp characteristics and requirements.

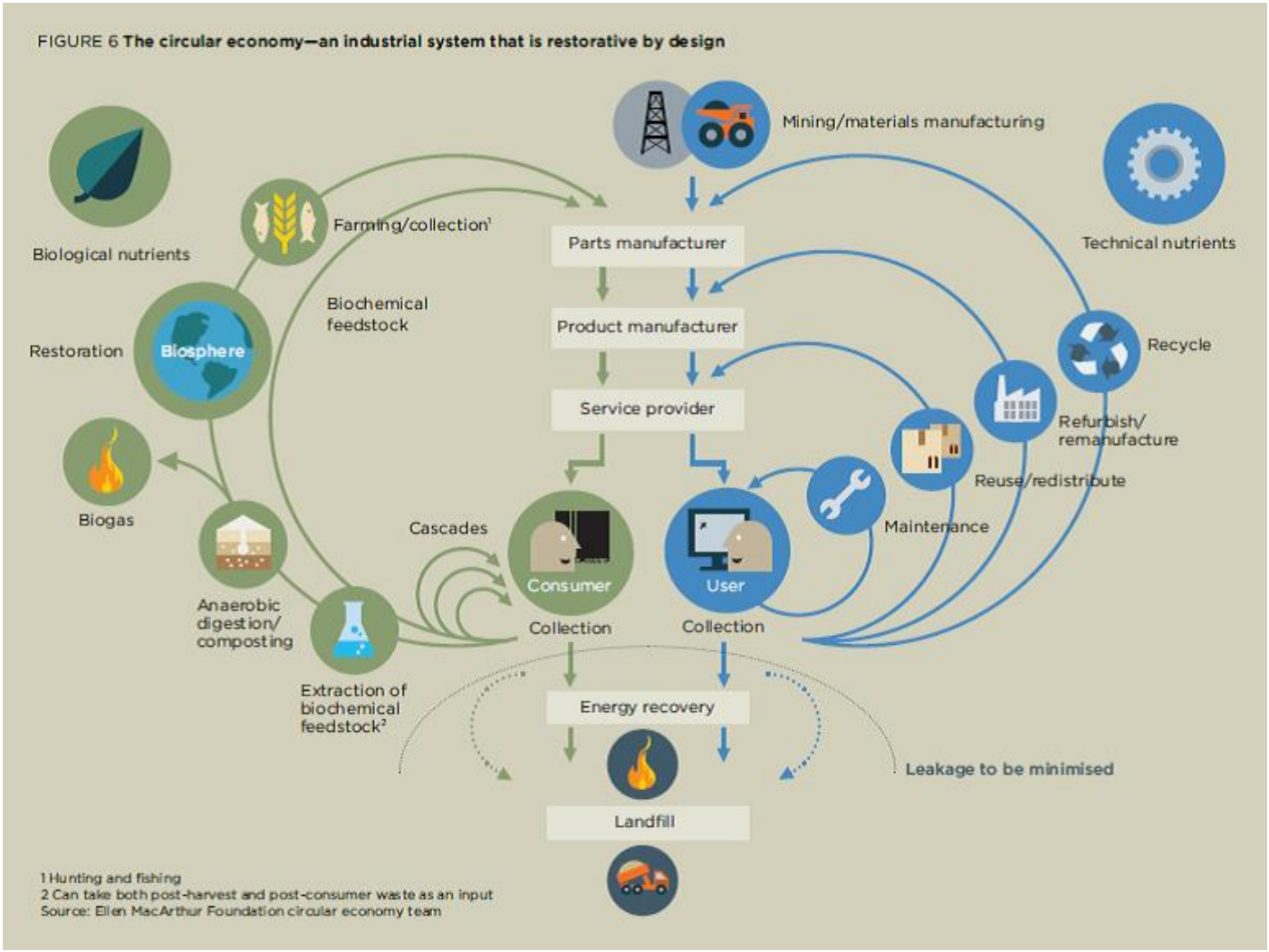

Figure 14a *– The circular economy, an industrial system that is restorative by design. Source Ellen Mc Arthur foundation*

[16] According to EU health and safety regulations only if individuals create it, DIY machineries are usable.

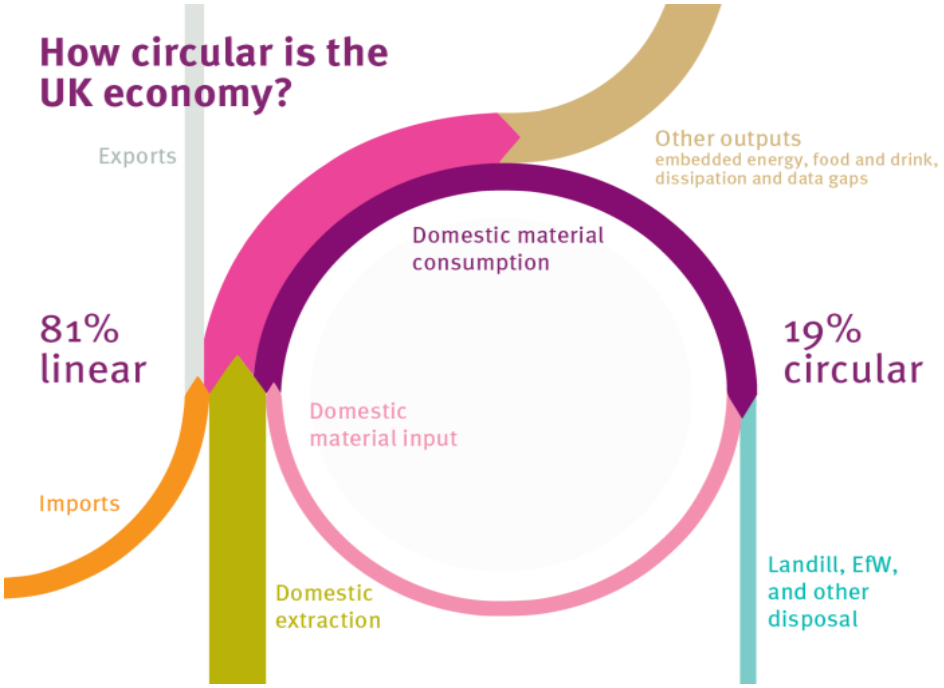

Figure 14b *– Available example from an industrialized EU member, UK's circular economy. Source* *http://greenlivingblogorguk.files.wordpress.com/2012/05/ukce.png*

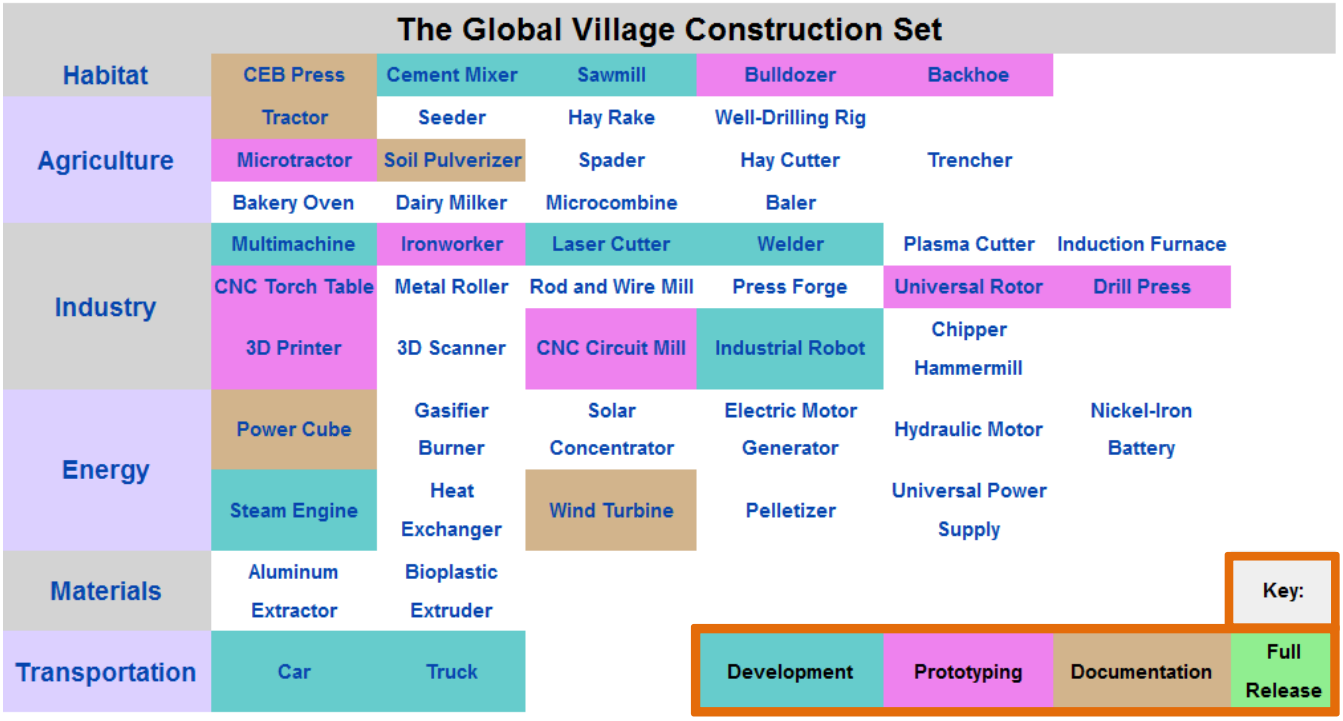

Figure16 *– Global village contruction set, 2011 situation. Source opensource ecology.org/wiki/GVCS*

Fostering an open and community driven model could enhance **social innovations** through prosperous entrepreneurship, also in rural areas. A **platform** which provide know-how, strategic suppliers and p2p[17] trading can succeed in create a short and effective IHVC.

[17] A **peer-to-peer (P2P) network** is a type of decentralized and distributed **network architecture** in which individual nodes in the network (*"peers"*) act as both suppliers and consumers of resources, in contrast to the centralized client–server model where client nodes request access to resources provided by central servers.

In a work on **transition processes of agro-industrial systems** from Lamine (2012)the focus on territorial scale considers the changes needed in **governance modes**, highlighting the **need for new , alternative networks**.

The Challenges for **linear through-put economy** towards **circular economy** can be resumed in some **key ideas with academic influences**(Mc Kinsey,2013).

Waste is considered useful and has to be minimized while **nutrients in cycles** are distinguished between "biological' and 'Technical". Another issue is the **resilience** and **scale** which involves shifts to renewables, energy efficiency and devolved grids, plus the shift to selling products as services with **new business models.**

Rifkin(2013) underline the importance of **(re)education** of eentrepreneurs and managers in order to take advantage of **cutting edge business models**, including distributed and **collaborative research** and **development strategies**, **open source** and **networked commerce**, performance contracting, shared savings agreements, and sustainable low carbon logistics with lean supply chain management.

The layout of **intelligent networks** will also require a **fit for purpose regulatory framework**(Rifkin, 2013) as well as the development of appropriate interoperability standards among **EU**, **Member States**, **regions**, **provinces**, **industry** and **communities** which have all a role to play in fostering the digitalisation of business processes and in developing the industrial dimension of the digital agenda, applied to the IHVC.

8- CASE STUDY: THE MISSION OF THE PLATFORM *HEMP BOX*[18]

Starting from the basic ethical principles of **social** and **entrepreneurial innovation** and **collaborative economics**[19]**and consumption**[20](figure 17), **HempBox** (figure 18)is a business support organization, which "reinventing" IHVC supply chain in Italy(figure 19), aims to **create the perfect substrate** to leverage hemp's potentials such as nanotech[21]and in all its processed forms.(Hempbox, 2013).

Figure 17 *– from the agricultural stage to industrial processing according to hempbox base ethical principles Source Battaglia-b(2014)*

[18] **(http://hempbox.org/)**

[19] In this model, individuals transact directly with other individuals on a two-sided marketplace platform, these are not strictly P2P systems in the technical sense as there is generally a central market platform that enables the transactions. Examples include Airbnb and Krrb.

[20] *"What's Mine Is Yours: The Rise of Collaborative Consumption(CC)"* book is the reference text for CC. In the book and related articles the authors organize the vast array of examples of CC into the systems: product service systems, redistribuition markets and collaborative lifestyles - http://www.scribd.com/fullscreen/54676100?access_key=key-2ja53ikem8lolofq1v2m

[21] E.g. Bioplastic compounds for 3-d printers

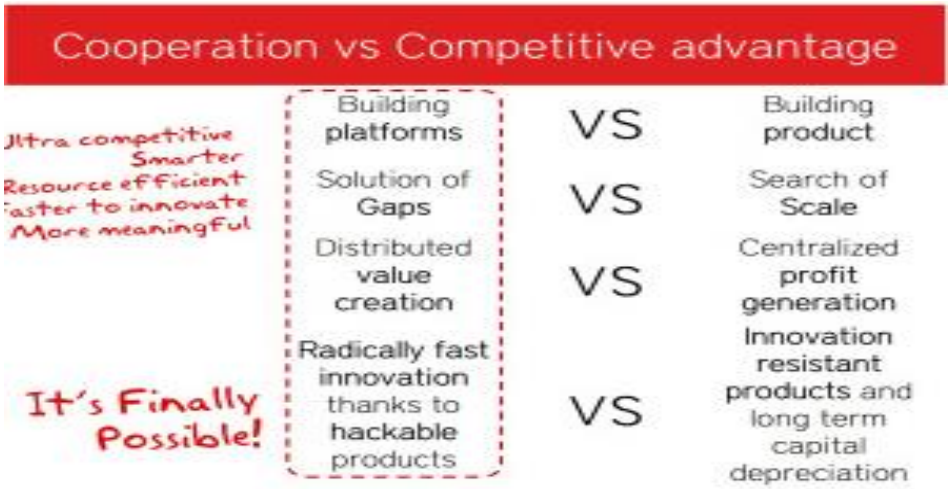

Figure 18 *– Cooperation model vs. Competitive advantage(linear-based, traditionally) model according to hempBox. Source Hempbox.org*

Figure 19 *– Some Outputs and initial goals of the Hempbox project. Source Hempbox.org*

9- OPENESS IS A RELSILIENCE STRATEGY, COMPANIES ARE COMMUINITIES.

The project is now partner with several subjects(figure 20) from institution, agencies, networks of experts on sustainable design and social entrepreneurship thanks to its business transformation and environmental protection potentials(Battaglia,2014; Hempbox,2013).

The revenue model can be based on **subscription and transaction fees** trough the platform, Value Chain strategic **investment for new manufacturing centre,** sold **seeds**(maybe a fit-for-purpose variety) and **R&D Development** on hemp cellulose or precision agriculture(Battaglia,2014).
Another source could be offered by the adaptation of the **community supported agriculture** methodology to raise capital and share more crop's benefits and manufactured products.
It would fit also into government or private building industry programs/schemes of refurbishments, **based hemp solutions** coming from IHVCs(Figure 21) .
Thousands of jobs across the territory could be created if the real potential of industrial hemp is going to be taken seriously in consideration from government and private sector alike.

Figure 20 *– partners of Hempbox. Source(Battaglia,2014)*

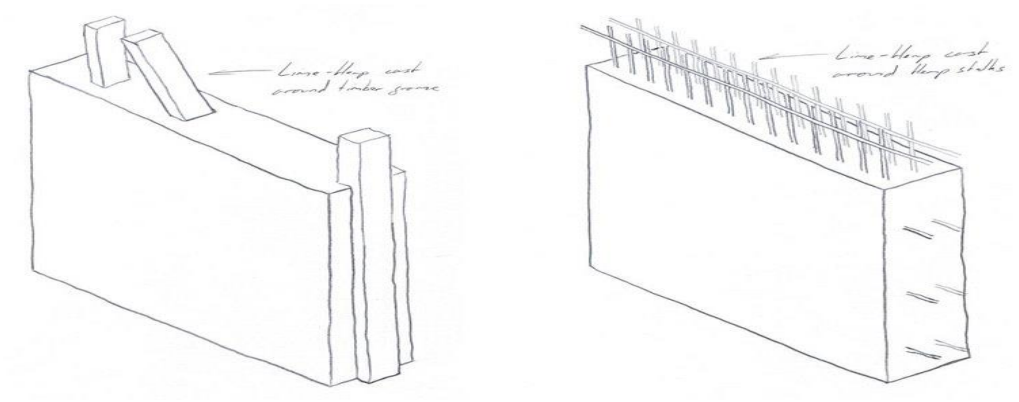

Figure 21 – Worldwide research and development has sparked an increase in new, innovative uses for hemp. Alongside hemp hurds-binder compounds and fibre insulation ***current research is trying to understand if also stalks can be used in construction*** *source* http://www.hemparchitecture.com/#/theory/

10- CONCLUSIONS

The Rationale of establishing and enhancing a hemp agro-industrial value chains is given by the current environmental and economic situation where removing carbon dioxide from the atmosphere and improving biodiversity can create a win-win solution.
In Italy, after being extensively used, appreciated for the quality and been a valuable resource with historical significance and cultural-economic importance***,*** *industrial* hemp ***it's nowadays not mainstream*** **because of several barriers but** M**odern agriculture,** and **necessary industrial adaptations could make a successful new-birth of the industrial crop. New participative communications technologies** can then bring its potentials to a wider set of new stakeholders and markets.

The introduction of integrated supply chain projects involve new approaches to IHVC major issues, in particular cultivation and manufacturing issues.
Hempbox's value proposition brings back a narrative, a fulcrum around which the social life of many rural areas and people has experienced, using nowadays' knowledge to exploit IHVC potentials.
Limitations include lack of proper business planning, for economic feasibility of IHVC, and Legal framework analysis; both essential to IHVC establishment.
Implications can be useful for academia, practice, policy and industry. Each field can improve the analysis made since IHVC is a multidisciplinary topic and requires vast research.

Further research can be made in regard of the exportability and scalability of IHVC model applicable for rural areas or a exhaustive business plan which determine the necessary area(crop rotation and dedicated land) to install a manufacturing plant.

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(*Battaglia is one of the three founder of the project hempbox)*

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