UPCYCLING MODEL: REEVALUATING WASTE IN RUSSIA

By Daliya Safiullina

Preface

It would be an understatement to say that the issue of construction and demolition waste is underaddressed in Russian legislative system. This chapter simply doesn't exist on the legislative level making any attempts of implementing it almost impossible. The consequences of such a short term thinking and neglecting the problems that our society will be facing in a few decades may be absolutely detrimental due to the enormous scale of the problem.

The problem is urgent not only for the Moscow Region but for Russia as a whole. Therefore this research is looking at the massive hardware "heritage" of panel housing that we have inherited from the Soviet era, current tendencies in construction, extrapolating the consequences of such into the future and a model proposal where wastes can be prevented from ever entering the waste stream by being turned into a "resource".The research depicts extracts from an amendment to the construction legislation that aims to set new priorities in waste management- mitigating the consequences of already produced waste derived by mass housing across Russia as well as reducing the amount of waste generated in new construction and recovering energy whenever possible. The research is focused on Russia with a particular focus on the Moscow Region as one of the largest producer of construction and demolition waste due to extensive housing production on a mass scale and aims to meet the interim purpose of creating a sustainable quality of life for all.

Amount of panels in Russia, if put together, would result in a fence long enough to wrap around Russian border 1.3 times.*

CHAPTER 1. CASE FOR CHANGE

1.1 Wasting the potential of waste management in Russia

Known under several aliases-dumps, polygons, landfills in Russia is a complex phenomenon and by far the most common way to deal with waste generated by all industrial sectors. Despite that de jure disposing waste on landfills is not the only option for waste disposal, de facto disposing waste in a dump polygon (landfill) in Russia remains the only alternative.

Numbers as drivers of change

90% of debris in Moscow is currently being exported only to landfills.The problem of running out of physical polygon space in the Moscow Region to store the waste has long been underestimated and underlooked by the officials. Finally, the problem was acknowledged on the State level when Valeriy Shkurov, the Minister of Housing and utility services in Moscow Region. In February of 2012 the state approved a long-term waste disposal program "Waste management and disposal of waste from production and consumption in the Moscow Region for 2012-2020". The proposed actions include building waste processing complexes, waste sorting complexes and waste resorting stations.

Out of 3.5 billion tons of waste generated annually in Russia (as of 2009), only 1.7 billion is disposed. The fate of the other 1.8 billion tons remains unknown.
The significant addition to the waste that is already accumulated by the residential sector is being accumulated by the construction, demolition and excavation sectors. Of 3.5 billion tonnes of waste generated in Russia it is assumed that at least one third comes from construction and demolition activties.
Currently for 15,000 legal, registered landfills, Russia accounts for app. 10,000 unauthorized landfills or illegal dump sites. "Salarievo" landfill in Moscow Region is believed to be the largest landfill in Europe. Despite the fact that it was officially closed in 2007, it is still accepting the waste being generated by Moscow City.

Over 60 % of waste disposal polygons in Moscow Region have run out of physical space.

Fig. 1 Image depicts the hero of "Whire Sun of the Desert" movie, USSR, 1970, in a desert at Russian border that could have been built of concrete panels. The calculations are done for exterior panels alone in all Russian regions that accounts for only 26% of all constrion elements of a building.

CHAPTER 2. THE RESOURCES

2.1 Russia's supply and geopolitics of Natural resources

Russia is one of the world's richest countries in raw materials, many of which are of geopolitical importance and significant inputs for an industrial economy. Oil and gas used to be the primary hard-currency income for the Soviet Union, and they remain as such for the Russian Federation. Russia's traditional fossil- based energy complex completely dependent on coal, oil and gas supplies provides fuel for traditional power plants and thermal energy power plants.

The volume of sales of governmental companies accounts for 52% of the overall volume sales of oil and gas. These numbers indicate that Russian government appears to be successfully profiting from this market where theas country's economy is highly sensitive to global demand and high volatility of oil and gas prices. The structure of the Russian power sector has been centralized where as the last decade demonstrates the trend of decentralizing energy generation that has gained momentum. According to the BP statistical review, Russia has 10.8 billion tons of oil; however, if it maintains its current rate of extraction, this oil will run out in 19 years and eight months.

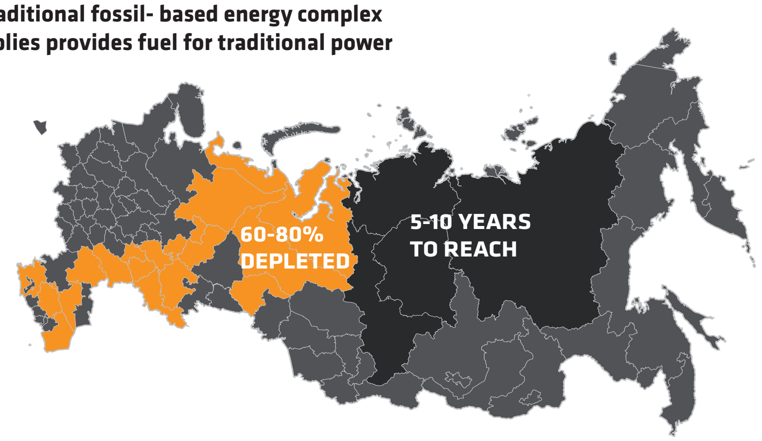


Fig. 3 Diagram of resource depletion. 75-80% of Russia's known oil and gas deposits are depleted . The map indicates the tendency of oil and gas depletion in the Western part of Russia, thus exploration of the resource is moving towards East, to Siberia.

"Export of oil and gas is still the primary and easiest way to produce money for Russia. Government is aspiring to take strategic positions in the sector."

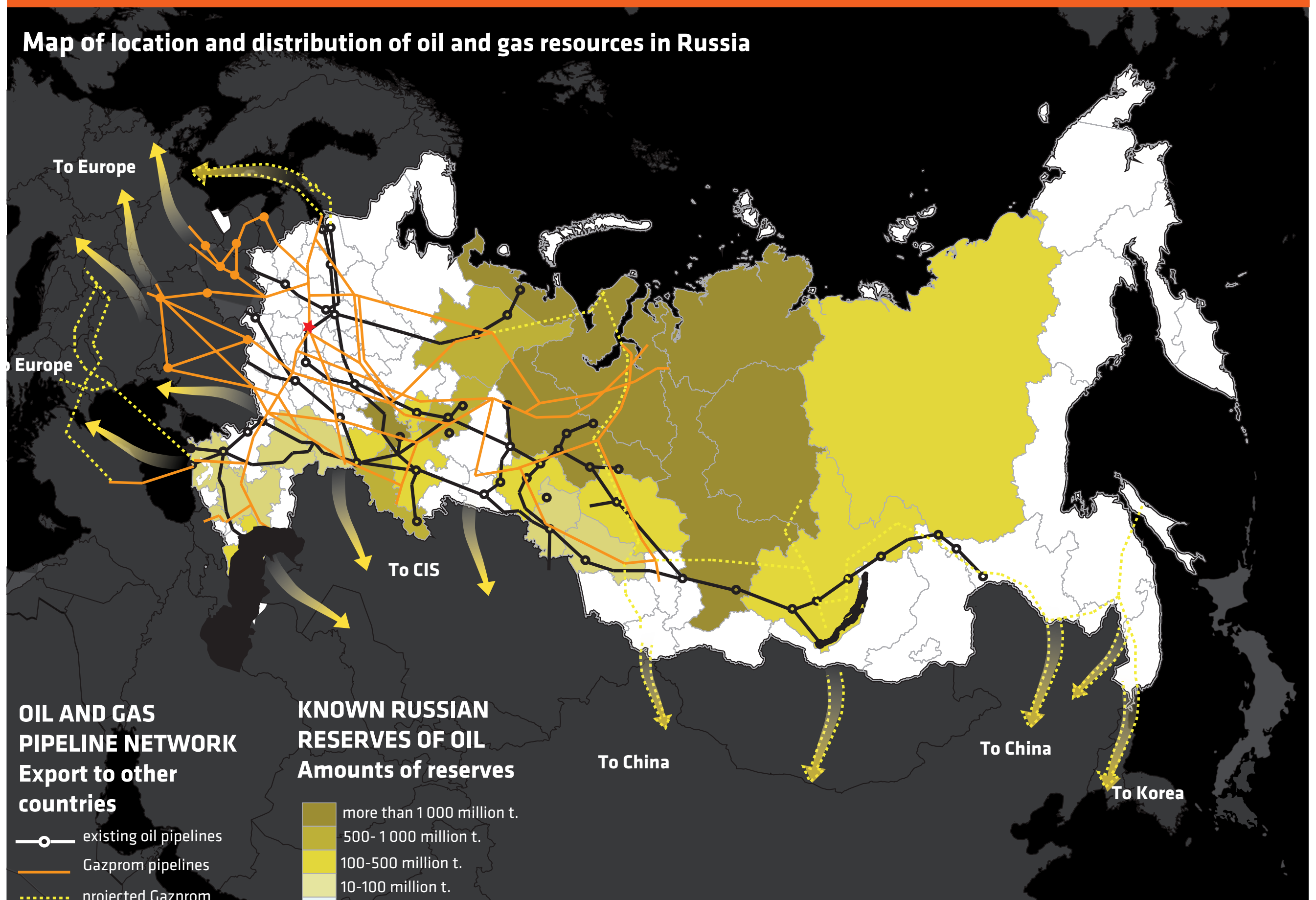


Fig. 2 Map of unified Russian governmental grid and the network of state- run oil and gas pipelines demonstrates how Russia is distributing its natural resources. Russia accounts for around 20% of the world's production of oil and natural gas and possesses large reserves of both fuels and large-scale exporter to Europe, CIS countries, etc. Source: research by Oleg Semakin

2.2 Russia's supply of Resources that sit idle

What if we see the urge for rapid development of the socio-economic combined with evident over-exploitation of traditional natural resources (resource depletion) as a potential driver for restructuring the future? What if the mistakes of the Soviet past and inertial development ever since can be the key point to constructively turn the crisis situation around and lead to a solution that may be a "foot in the door" for energy solutions away from the dependency on the oil grid?

The city of the future has to deal with mobility and integration. In this respect the embodiment of Soviet ideology produced on a massive scale across the country – ubiquitous and outdated microrayons- may not always a problem. Instead, they can become a solution, representing an Artificial Natural resource that didn't exist before. This new Artificial Natural resource for Russia may have an economic potential that may contribute to solving acute problems in the current fossil fuel fixated economy.

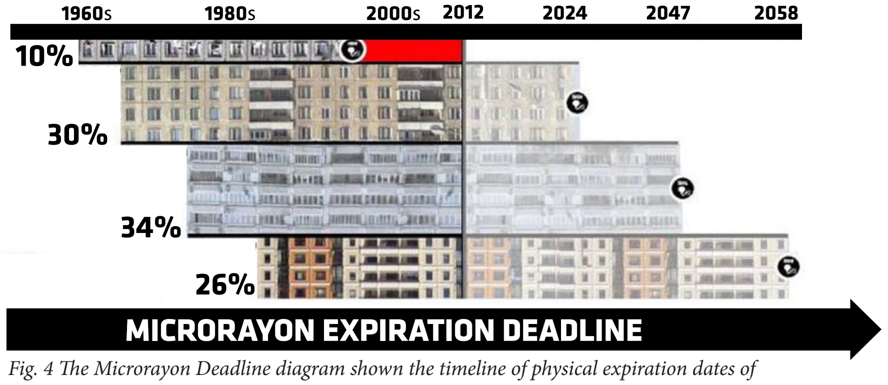


Fig. 4 The Microrayon Deadline diagram shown the timeline of physical expiration dates of prefabricated houses. Source: Dmitry Zadorin, Drawn by Ruslan Sabirov.

Demolition waste accumulated from microrayons expiring over next 12-25 years can become the first generation of Artificial Natural resource.

Fig. 5 The map clearly idicates that prefabricated mass housing of four "generations" of industrialization is predominant in practically all other types of housing in almost all the regions of Russian Federation.

2.3 The Direct conveyor: Current situation in construction industry

Russia has undergone significant political and economic changes since the collapse of the Soviet Union. Therefore, it would seem that the best remedy against it would be constant. However, favorable market conditions, fuelled by explosive growth in housing prices paradoxically did not create the preconditions for the beginning of modernization in the construction industry in Russia. Instead, the construction industry in Russia became one of the most anachronistic spheres.

What is the most striking is what is being produced by this large conveyor. Once being an integral entity, the USSR State Committee for Construction (Gosstroi) achieved first position in the world of expanded clay and cement production and Soviet housing construction complex reached the limit of its capacity- 87 million square meters of housing per year in 1985. Today the construction industry is almost completely detached from its scientific basis - a source of ideas on implementation of new technologies that was almost paralyzed since 1990s. As a result, (integrated house-building factory called DSKs, now privately run, remain the major producer of housing in the country. Dozens of companies that continue to produce prefabricated so-called "new" series of housing differ from their Soviet by tiles or coloring and are built with the same outdated technology that was used during the Soviet period.
More than 90% of all residential buildings in Moscow are being built of reinforced concrete. According to experts, the Soviet technology reserve of reinforced concrete has been exhausted. One of the reasons why the principals of reinforced concrete is outdated is that it does not allow for flexibility and customization that are paramount in 2012. Consequently, the Russian construction industry is not able to perceive the new technology. This technology still implies building load-bearing walls that require significant "embodied energy" expenditures as opposed to one of frame construction utilized widely for decades in the West. The industry seems to be in need of a complete overhaul itself.

Mentality of industrial era that created microrayon no longer exists but construction companies are actively exploiting the soviet industrial base utilizing the same materials and technologies as 50 years ago.

Map of major DSK leaders that are the largest producers prefabricated mass housing in Russia

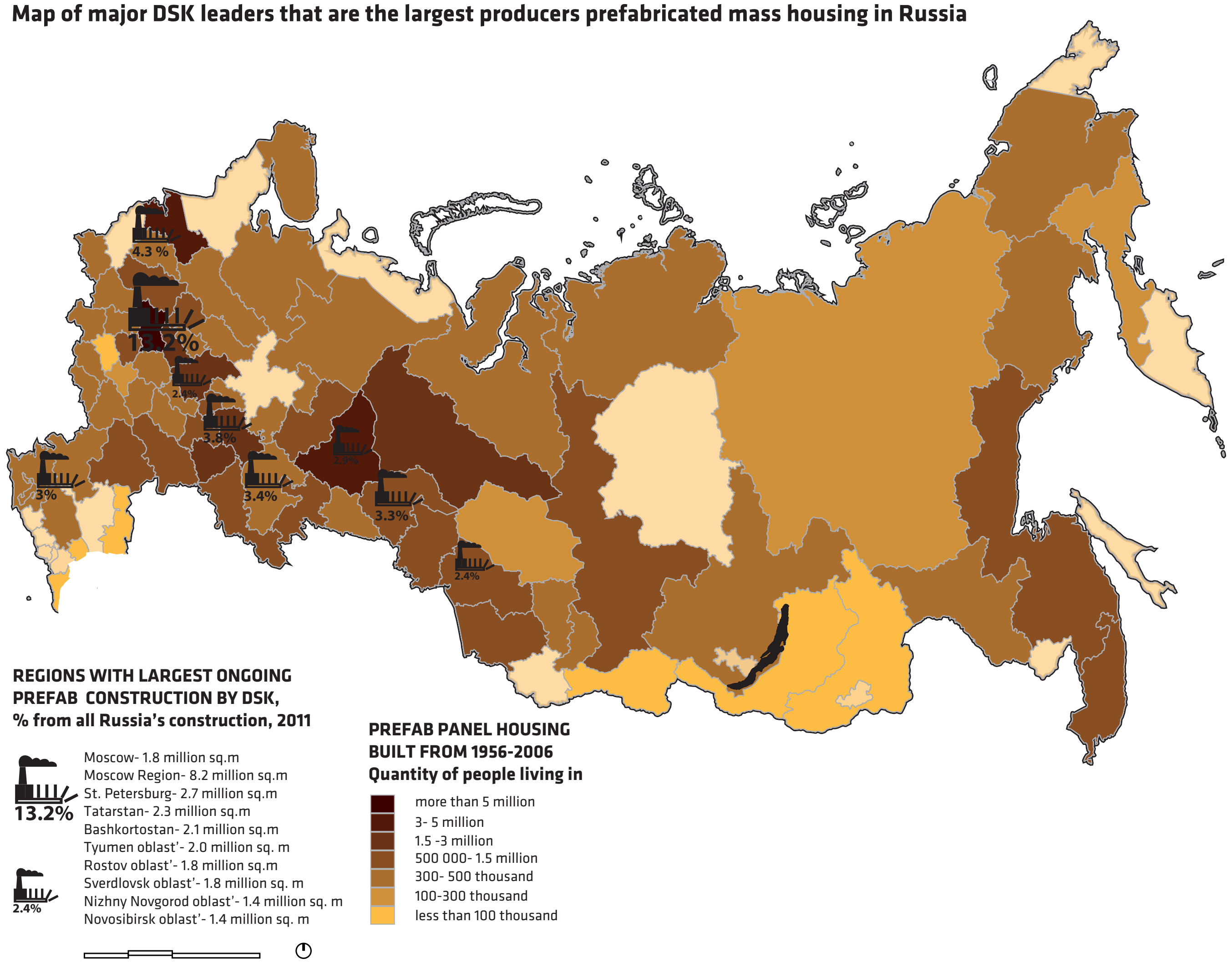


Fig. 6 Map of DSKs continuing to produce prefabricated mass housing demonstrates how many percent on the current construction market is manufactured by DSK. The share of prefabricated panel houses in the primary market currently is about 43%.

Why change?

According to experts, all processes related to construction production, whether it be state or corporations, need to be updated every five or six years. However the short-term oriented interest of the construction industries combined with the lack of proper state regulations result in a highly inert environment where old outdated equipment is being revived. The quality control system does not work, penalties for environmental damage are scanty. Deterioration of the equipment is one of the major barriers to the introduction of new technologies as there is a need for a radical re-stocking of-equipment for cement plants. The deterioration rate of equipment in cement industry currently accounts for 90%, this being a disadvantage in addition to the fact that concrete and cement production in general are among the most energy-intensive materials used in the construction industry and a major contributor to CO2 in the atmosphere. By the end of 1970s it became evident that costs of housing energy supply for life in prefabricated houses produced by DSKs exceed the international standards by three to four times.

Current state of construction market

The prices on cement are high where as manufacturing capacity for it is low, and yet there is a great demand for cement in different regions of Russia. In fact, the amount of sq. meters being built annually per person in China is 5 times greater than in Russia. The rate is (0.35 sq. m/ person (60 million sq. m) in Russia versus 1.5 square meter per person (2 billion sq. m) in China). All attempts to render the goals of national programs such as "Affordable housing" rendered almost null.
The cost of cement, if compared to neighbouring China, is six to seven times more expensive in Russia ($150- 200 compared to $40 per ton in China). However importing cement to Russia from China renders inefficient due to transportation costswand tax problems that destroy all the benefits.
Introduction of innovative technologies in the current market is associated with significant investments and high risks. Yet the construction management and delivery process is very fragmented and there is no holistic way of controlling it. The problem is that whenever new technological solutions that can generate savings up to 20-25 percent become available, it affects only one side of the building process - for example, foundations (15% of the cost of the building), building envelope (shell) (55%), roofing (10 %), etc. On the Moscow construction market where the ratio between average prime cost of construction for one square meter to the final cost can be to five, saving 5-10% of final cost doesn't seem for construction companies worth of investing into risky transitions if they are not economically feasible.
The model that would change all the concepts of construction simultaneously is lacking. One of the attempts to create one was federal program "Gilye" that targets a production rate of 130–140 million square meters / year. This is about 1 sq.m/ person, the same rate as is being built in Austria, which is by no comparison better supplied with housing than Russia. Average cost of construction in Russia - a thousand dollars per square meter. The selling price is higher than two or three or four times. At an average cost of housing construction in Moscow at $1500 it sold for $5000. In such a relationship whether it is important for builders to build housing is not for $1500 but for $1300 or even $1,200?

Shady market of construction and demolition waste in Russia

Historically the waste management in the country was state-dominated, however today it is driven by app. 40 % private companies.
The current situation on the Moscow Region waste market depicts how the lion's share of waste management market belongs to one person. The situation with construction and demolition waste is slightly more sophisticated. The widespread nepotism together with rampant corruption within the sector results in companies trying to implement illegal schemes in order to gain governmental assistance.
Construction and demolition waste recycling attempts are counted on fingers. Current situation with waste disposal resembles one of purchasing a ticket to a theater.
The cost of "ticket" for a s-called "professional" landfill, where garbage is buried in the ground with the use of special isolation technology has increased ten-fold since 2005 (e.g.600 rubles per Kamaz waste (10 tons) as opposed to 6000 rubles in 2011). landfills in Russia often cost exactly the amount of money it takes to collect and transport the waste to the landfill. Prices for garbage collection depend on the distance that is traveled by a "Kamaz" to the client. Prices usually start at 4000 rubles per 8 cubic meters of debris. In a highly competitive market it is economically not feasible to raise prices in the garbage after the polygon-monopolists. The demand proper construction waste disposal has dropped dramatically.
In reality it seems like no one is actually legally responsible for disposing the construction and demolition waste. The management company is not obligated to pay "before" nor "after" the verification. Construction and demolition waste belongs to the 4th grade in the waste ranking which means that the proprietary has to be charged an additional fee for Causing Harm to the Environment (NVOS) in the situation where disposing this sort of waste causes a harmful impact and it is proven. However, the legislative system overlooks a lot of flaws that allow to avoid any responsibility for it.

Who is actually paying for all this waste?

Since there is no clear working model of dealing with construction waste a lot of illegal dumping is happening. Despite the situation is being shady, the bottom line is already clear: DSKs do not bother about disposing the tonnes of construction debris that remain after the short lifespan of results of their intensive production . Which results in a citizen that has to pay significantly for something that is deteriorating the environments and preventing sustainable quality of various levels (state taxes, utility costs, health problems, etc.)

DSKs spend on average two times more cement per square meter and two to three times more metal than in developed countries.

Citizen results in paying at least four times for this waste: overpriced initial cost, high utility costs, state taxes and medical care as consequences of unhealthy environment.

CHAPTER 3. TOTAL UPCYCLING

3.1 The Reversed Conveyor Model for DSK

It is obvious that the socialist spatial model should be revised to correspond to current conditions. In reaction, this research pursues ways to deal with the microrayons that have already been produced and are doomed to become demolition waste in 25-40 year period of time upon reaching expiration date. This research is looking at developing potential strategies to deal with the large amounts of waste. The "Upcycling Model" proposal introduces ways to stop the "conveyer", revert it, recycle it and offer the alternatives, it will show a "win-win" model: DSK construction factory, environment, municipality, citizen.

The Model

The Upcycling Model is based on analysis of problems of current construction and C&D waste management in Russia found throughout the research. Existing examples of construction and demolition waste models from around the world have been collected and examined. The current construction industry practice has certain flaws and is not suitable for long term planning. In setting pro-active boundaries for future development, the most important issue is to streamline, and to establish a common language between public authorities, construction industries and developers. Legislative ambiguities should be tackled bringing the nature of the deconstruction industry on a national level.
The project proposal describes a model where wastes can be prevented from ever entering the waste stream by being turned into Artificial Natural resource and may serve as a baseline for further investigation on national or regional patterns of deconstruction-related activity.

Product:

Guidance Document that provides policy makers, waste managers, and businesses with the background to Life Cycle Thinking and illustrates the way to embed construction waste management and disposal into the process of construction production into housing production process initiating political change in terms of quality use of waste management on legislative level.

Target audience:

-Policy makers, local authorities and government: support policy directions and choices at federal, national, regional and local level
- Buisnesses, Architects, Contractors and site managers: identify efficiencies that can lead to cost savings; designing projects, materials procurement, in setting site waste management targets, and in communicating their environmental performance

Objectives:

-encourage and enable businesses and consumers to be more efficient in their use of materials
-reduce the amount of waste generated,
-recover energy whenever possible mitigating the consequences of already produced waste derived by mass housing across Russia
- set new priorities in construction and waste management

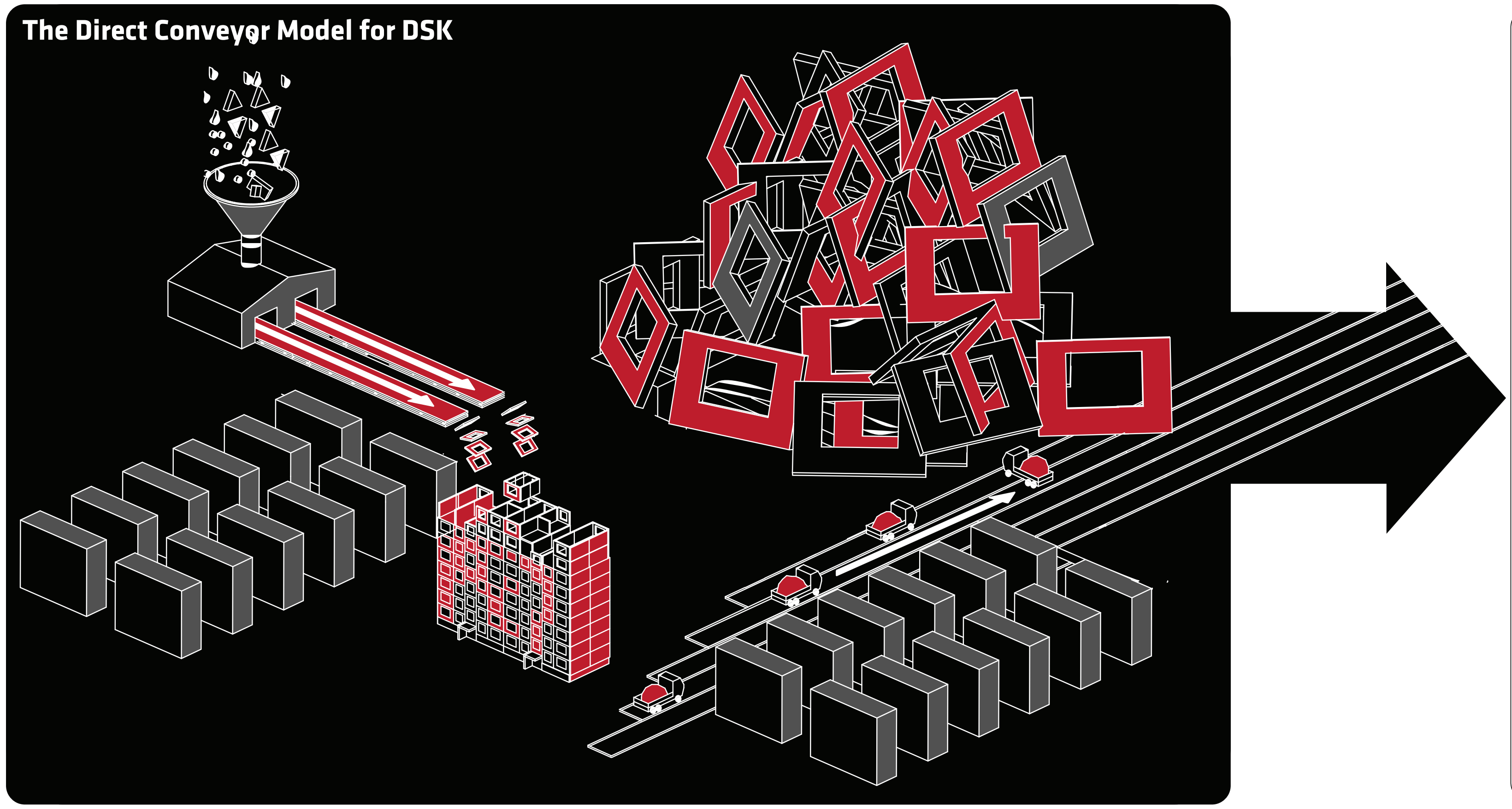


Fig. 7 The Conventional DSK model demonstrates how most of the construction debris results in a landfill after the lifespan of a building.

3.2 Redefining terms according to Track 1- Track 2 concept

In restructuring the "resource" developed during Soviet times to serve the needs of next generation type of housing that is emerging, it is important to redefine the notion of sustainable construction- related activities according to the Track 1- track 2 business model.

Construction Waste Management- Redefining the Definitions for construction market

Track 1 Thinking	Track 2 Thinking
Recycle [downcycling] materials are refashioned into a product of diminished quality **Reuse** use of a product more than once in its same form for the same purpose	**Upcycle** taking a used or discarded product and refashioning it to create an entire new product of higher quality or value **Upgrade**
Direct Conveyor for DSK	**Reversed Conveyor for Re-DSK**
Demolish The removal of existing structures and utilities as required to clear the construction site. The removal of the facilities proposed for destruction in the justification for the new construction. Demolition can include mechanical and manual methods.	**Deconstruct** Manual selective dismantling or removal of materials from buildings for the purpose of building material recovery, salvage or reuse. Deconstruction can include non-structural and structural recovery of building materials.
Non- Structural Deconstruction Mature market	**Structural deconstruction** Emerging market

[Upcycling] is taking a used or discarded product and refashioning it to create an entire new product of higher value

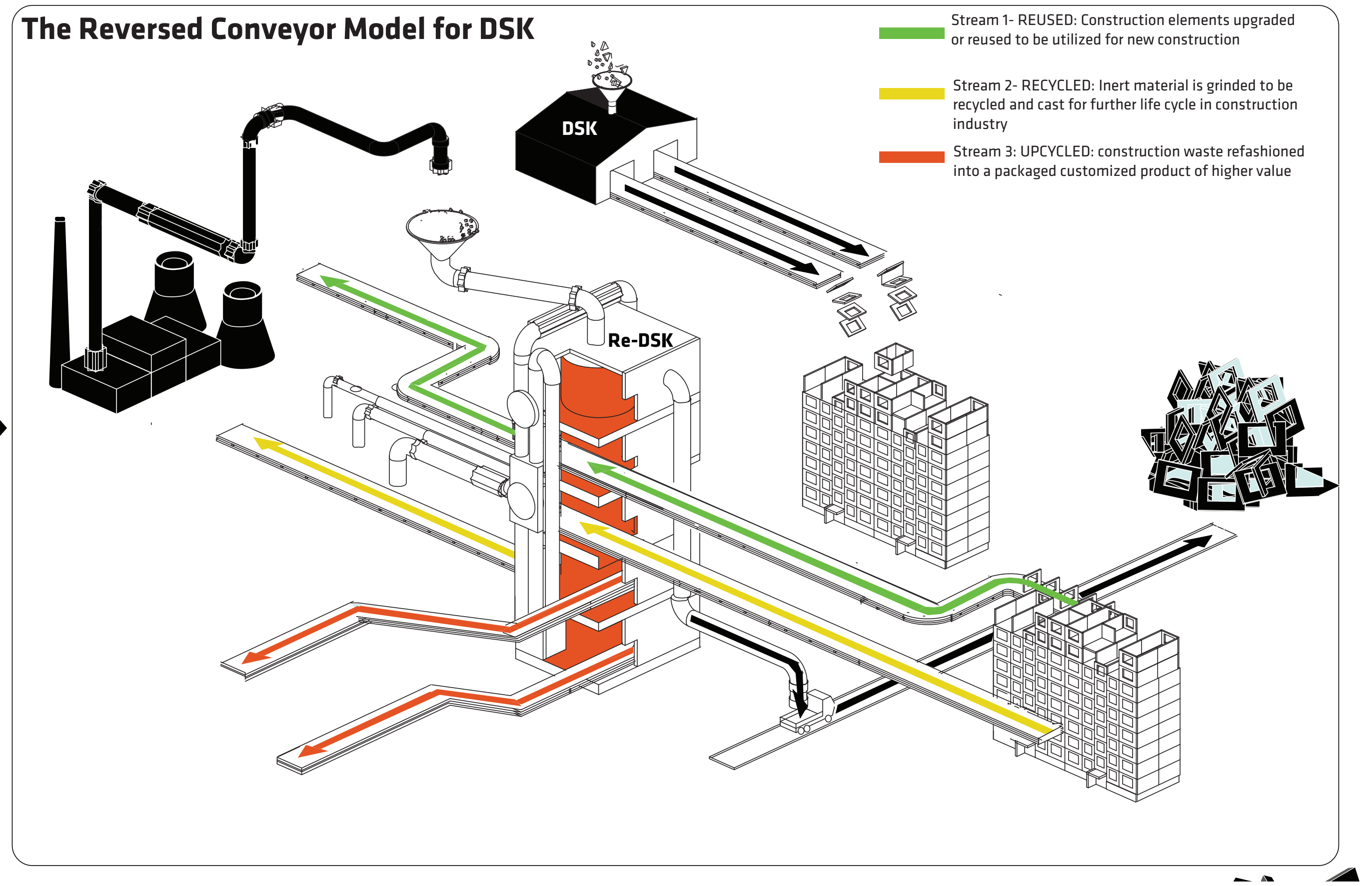


Fig. 8 The diagram of the Reversed Conveyor for DSK shows how the "flow" of concrete resource in construction that extends beyonf the lifespan of a building and derects the fstreams of construction materials that hamy already been produced.

3.3 The Reversed Conveyor Model

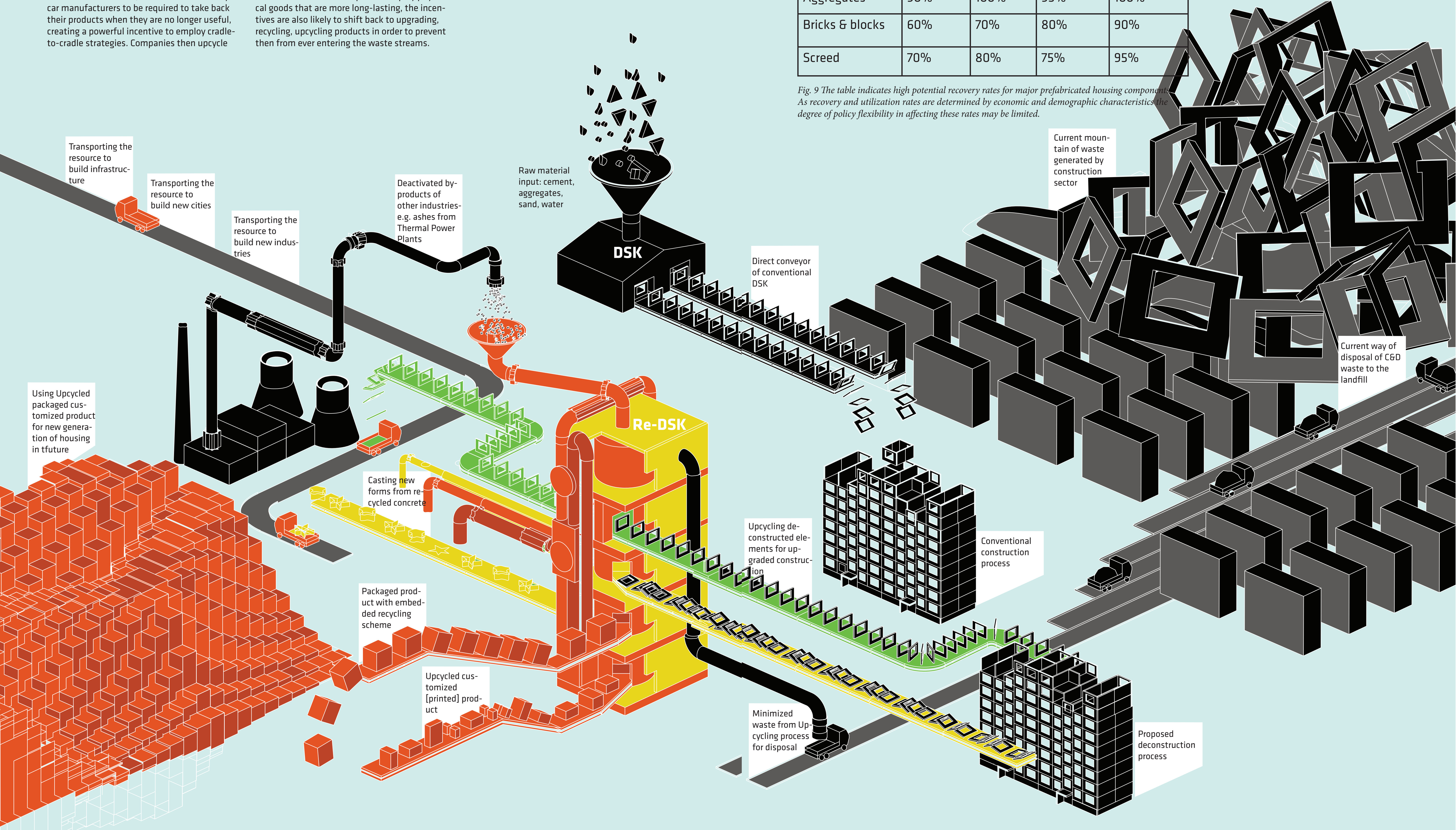
The Upcycling model would produce an entirely new type of packaged customized product with embedded recycling technology and policy on how to recycle it, manual that eventually in 50 years or so (DSK 1.0) type of plant wouldn't be necessary.

The model is based on take-back schemes for DSKs to avoid disposable products. If analogy is to be drawn between the construction and automobile industries, then DSK are similarly to car manufacturers to be required to take back their products when they are no longer useful, creating a powerful incentive to employ cradle-to-cradle strategies. Companies then upcycle the parts and materials into new products in compliance with particular requirements for manufacturers to recycle or upcycle products. As Track 2 businesses acquire or employ physical goods that are more long-lasting, the incentives are also likely to shift back to upgrading, recycling, upcycling products in order to prevent then from ever entering the waste streams.

3.4 Recovery Rate Dataset and Assumptions

Material	MRF Recovery Rate Mixed Waste Skip		MRF Recovery Rate Segregated Skip	
	Baseline	Good	Baseline	Good
Concrete	70%	**80%**	75%	**95%**
Metals	70%	85%	80%	95%
Aggregates	90%	100%	95%	100%
Bricks & blocks	60%	70%	80%	90%
Screed	70%	80%	75%	95%

Fig. 9 The table indicates high potential recovery rates for major prefabricated housing components. As recovery and utilization rates are determined by economic and demographic characteristics the degree of policy flexibility in affecting these rates may be limited.



CHAPTER 4. HOW IT ALL WORKS

4.1 Defining Sustainability for different stakeholders

The general definition of sustainability is meeting the present needs without compromising the ability of future generations to meet their needs. The Upcycling Model involves all the principal parties of a project-owner, architect, engineer, contractor, and subcontractors etc and re-defines the notion of sustainability for the major stakeholders. This is when the Customer Focus Ideology kicks in- involving each of the vested parties early on in the design process.

for the Government:

• Shift the incentives to repairing, recycling materials, reduce the costs of transporting of construction and demolition waste to businesses that will reuse recovered building material.
• Expand tax deductions for the private sector recovery of used building materials (non-profit charitable organizations for donating used building materials; private UBMRO business to encourage their development)
• Create bidding requirements that award bonus points for contractors who use non-structural and structural deconstruction techniques to recover materials.
• Give incentives to emerging companies that provide the necessary services of sorting, removal, and recycling.

for DSK:

• Come in earlier in the cycle
• Account for the upstream and downstream benefits and trade-offs. Identify environmental improvement opportunities at all stages across its life cycle, from raw material extraction and conversion, through product manufacture, product distribution, use and fate at the end-of-life stage.
• Embed recycling technology and policy on what is supposed to be done with it after the "lifespan" of the product while manufacturing Provide customer with product of higher value than the previous "panels"- e.g. is customized holistic approach-incorporating the waste from other industries
• Create recycled aggregate production plant and the use of recycled aggregate concrete mixing plant or pre-products processing plant to make full use of waste concrete.

for Architect and Contractor:

• Architect is to include the CWM plan in the construction documents within the conventional building activity cycle [design/bid/build] at an early stage comply with the new code of practice for the Building Industry (required to minimize waste, developing ways to reuse existing materials, which may be included in the new design or elsewhere)
P provide on-site instruction of appropriate separation, handling, and recycling to be used by all parties at the appropriate stages of the project.

for citizen:

• Acquire or employ physical goods that are more long-lasting
• Enjoy the h ealthy pleasant environment

4.2 Possible applications of recycled material

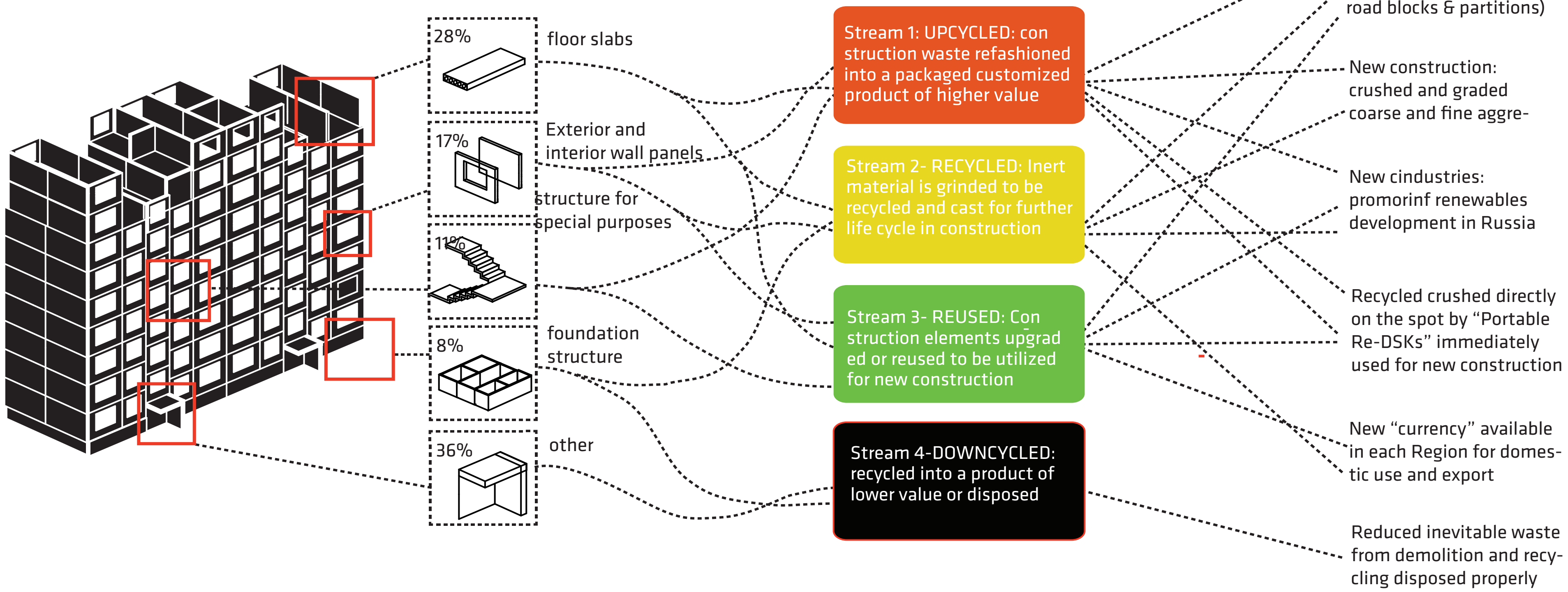


Fig. 10 Components of the buildings: The diagram shows the percentage of particular building component, e.g. floor slabs are 28% of the building, visualize the components and the potential applications of the recycled or upcycled material.

4.3 A peek into technology

Mass produced prefabricated buildings on the scale of a country allow for buying in bulk and using or recycling the majority of the materials at the manufacturing site. Constituent parts of a product typically deteriorate at different rates, standardized parts are more easily reused, replaced, and recycled. Standards for the series of industrial housing generations established during the Soviet era to allow for lowering the cost of making offers across several platforms today.

Since technology itself is not the primary goal of this research, it is important to stress that there are a lot of efficient technologies long available that lay idle but could be implemented by DSKs. The following pages show a peek of how technologies from the Artificial Natural resource can produce better and more efficient materials. However, it is important to point out that these are methods that do have a potential of being used in the near future but are not proposed as a remedy for a long-term perspective since Upcycling model proposes to utilize the Artificial Natural resources that are already in existence in order to clear the way for the emerging innovative technologies that would come by 2020s.

"There are technologies available in Russia that allow for construction of housing with more efficient thermal characteristics, better natural ventilation 30% cheaper that current market rates."

-Marcel Bikbau, the General Director of Moscow Institute for Materiology and Efficient Technologies, Member of Academy of Natural Sciences, International Academy of Ecology, Safety, St. Petersburg Academy of Engineering, New York Academy of Sciences

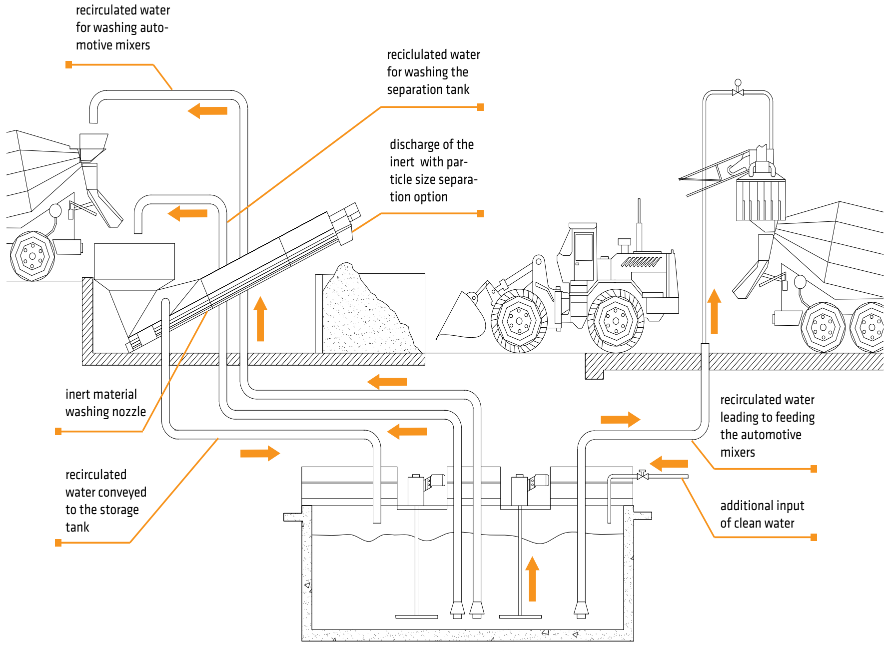


Fig. 11 Example of Euromecc technology that prevents concrete from entering the waste stream.

4.4 Missed out opportunities: technologies

Despite the fact that all the technologies mentioned above were invented in Russia and have been available for implementation for a few years now, large construction industries do not seen to demonstrate interest in them. One of the objectives of this guideline is to design the awareness that there are technologies that may be more energy efficient and economically feasible at the same time for DSKs.

STCC stands for Steel Tube Confined Concrete

The USSR has developed a breakthrough scientific and technical base for construction technology with application of Steel Tube Confined Concrete frameworks as a new supporting structure. The world's first method of calculation STCC structures was published by Professor Gvozdev in 1932. Today the legal framework for STCC structures adopted from USSR exists in of reinforcement.
Currently STCC structure technology is most widely spread in China, particularly Shanghai and Beijing. This may be a result of an academic exchange of Mr. Tsai in Moscow Institute for Engineering and Construction back in 1961. The technology was also adopted and is widely used in Kazakhstan where 3 million square meters of STCC structure housing with increased 9-point seismic resistance is currently being built in Almaty since STCC column is in fact not a subject increased strength of the concrete.

The special technology of Mechanochemical processing of cement, aligning it with the microencapsulation invented by Marcel Bikbau allows to produce cement with the same figures for the grade, increased durability while cutting down energy input almost twice (300-400 kilocalorie instead of 700-720 kcal per kilogram of cement).
The technology not only dramatically reduces

"STCC allows to reduce the prime costs by 25-30%. This technology would allow to save up to 50% of metal supplies without compromising on high seismic resistance and durability."

Germany, Austria, Japan, China, USA, but does not exist in Russia. The ideology of precast concrete declared taboo on all other technologies with a recent rare exception of monolythic construction.
Yet the implication of STCC structures permits the avoidance of using building material- consuming material-bearing walls, to facilitate multi-story high-rise building which would cut the amount of concrete and metal in half and reduce the prime costs by 25-30 percent. This technology would allow to save up to 50% of metal supplies without compromising on high seismic resistance, reliability and durability.
A Regulatory framework, technical characteristics data and hundreds of patents are available on Japanese, American, Chinese and Russian techniques of STCC structures, a technology that allows to produce STCC from used-up old pipes being one of them. Experts lead by Marcel Bikbau state that the strength of the STCC has to precipitous collapse.
According to Marcel Bikbau, cement today, when used in construction, reveals its potential for a maximum of 20-25%. This is the part of cement, which gives the brand strength in the concrete and causes of its construction and engineering properties. The potential of mechanically activated cements allow for production of heavy-duty 1300-1500 grade of concrete.

power consumption and improves quality of the product, but also allows for incorporating cheap (kremnozemistie dobavki) silica additives such as volcanic rocks, sand, slag and ash into the composition of cement. This is the way to the efficient processing of hundreds of millions of tons of industrial waste.

Mechanochemically processed cement, aligning it with the microencapsulation

A remarkable feature of this technology makes it possible to obtain excellent cements with high quality with 30-35% decrease of amount of cement clinker that is responsible for significant energy loss during the burn stage. As a result, from one ton of ordinary cement of 500 grade it

Holistic management: incorporating the waste from other industries:

Using waste from other industries approach is potentially a "win-win" solution.
The example of the existing technology developed by Yuri Peterson, a scientist from Novosibirskdemonstrates the way to use ashes accumulated as a byproduct of combined heat

The material demonstrates the same figures for the grade, increased durability while cutting down energy input almost twice.

an insignificant dependency on the state of the pipes, and actually the layer of rust is working as a damping layer and can replace polymer layers utilized by Japanese technology. The abundance of Russia's supply of worn out pipes is hardly questionable. Today the used tubes can be bought from two to three times cheaper than the new ones. However even the price for the new steel pipes are comparable to the ones

is possible to get 2.4 tons of binder grade 300-500, or 1 ton of cement grade 700-800.
The cement was certified in the United States and has received recognition.
In order to begin to produce cement with qualitatively new characteristics it is necessary to re- equip grinding plants (pomolniy tsekh) fully with relevant grinding. According to the experts, the thinner the cement grind is, the faster it will interact with water which is a pledge of

and power supply plant; TES) that is otherways harmful for the environment ash- disposal areas (zolootvali) to produce building materials for housing. Example of "Sibit" company in Novosibirsk in corporation with Novosibirskenergo) producing cellular concrete blocks that claim to exceed brick in terms of strength and thermal performance.

CHAPTER 5. CONSEQUENCES OF THE "WIN-WIN"

3.3 The addded value across all layers

Despite the fact that all the technologies mentioned above were invented in Russia and have been available for implementation for a few years now, large construction

Today the relative capital investment per tonne of cement - it is minimum $150-200.
However if using the technology of and is, in fact, the technology of finishing of cement clinker or cement, the necessary capital investment per ton of cement would be about $30-35.
With the introduction of siliceous additives according to the new technology the amount of cement produced in the country would increase by at least 10-15 million tons in the coming years.
It has been estimated in Chinese construction reports that that recycled concrete can actually be more economically feasible than conventional concrete. Recycled aggregate concrete prices are considerably lower than the traditional concrete prices. Even without the environmental benefits of recycled concrete, solely on the recycling of construction waste, half of the costs of disposal can be saved. The case of Shanghai demonstrates that while disposal of 100 000 m3 of waste concrete accounts for 14.85 million yuan, processing it into recycled concrete aggregate costs only about 8 million yuan (80 yuan / m3).

such a holistic model affects other spheres.

Environmental "win-win"

+reduces the amount of construction and demolition waste that is sent to landfills
+reuse of building materials reduces the demand for new building materials and therefore lowers the amount of energy and resources used in their production

Socioeconomic "win-win"

+increased employment opportunities
+job training for unskilled unemployed workers (dealing with "human waste" David was talking about)
+ historic preservation
+building materials affordability
+small business development in economically depressed areas
+potential for preapproved deconstruction due to standardized resources

Despite the fact that the value for the end user

monolithic construction.
Implementation of new technologies has to become a condition set by legislative system in the very beginning. Tenders must be created with the specific technological and economic conditions.
DSKs are to manufacture new material with embedded recycling system in it.
Economic requirements must be sharp: (e.g. instead of construction spending 0.85 cubic meter of concrete and 70 kilograms of metal per square meter of housing as it is currently being done in Moscow, and 0.40 cubic meter of concrete and 18.2 kilograms of metal, as in developed countries). That way whoever spends more would not be involved in the game.
In fact, apart from large state orders, the role of the state in construction industries is reduced to a minimum. There is no a particular institution in the Government that would be in charge of controlling technological policy. The existing Agency for the Construction and housing does not have the leverage nor for the construction industries, nor for the contractor where as the Ministry of Construction is the key agency

Embedding patented recycling features to mass produced panels could mean guaranteed profit over time while utilizing already existent Artificial Natural resources to clear the way for innovative technologies that is to come.

Economic exchanges between the main stakeholders of construction industry occur at the intersection
of the various value components. Counter intuitively, today it seems that expensive cement is profitable for businesses because the only stakeholder who would benefit from cheap construction would be the citizen. When evaluating the potential of construction waste upcycling we should single out the following three categories: direct revenue, indirect revenue and intangible value. The assumption is that if the direct revenue will initially increase due to "reverting" the conveyor and all the costs associated with change of equipment, the process will still naturally bring high profits to the construction industries through indirect revenue. Apart from this factor, the impact from is not direct, it will bring the cost down (cutting down the taxes) and create an environmental impact that benefits the citizens.

How should it be controlled, role of the Government

The model of Upcycling is proposed to be implementated into the National Projects for the mass construction of a modern comfortable housing such as "Gilye" Federal Program and has to be incorporated with a combination of legislative measures and modern technological solutions for effective use of new system of architecture and construction instead of outdated material and energy-intensive system of precast concrete, or even more expensive

in the U.S., Japan, Brazil, China, and in many other countries. Thus, a new institutional body incorporated into Re-DSK is to be established in order to control the quality of the material, ensure stable quality in mass production and compliance with technical standards.
The need to develop construction and waste management emerges not only because of the potential crisis of excessive waste and all the tragic environmental consequences but also due to the missed out opportunity to turn the waste into a benefit. Resource that may solve many other additional acute problems (such as promotion of renewables) and results as a paradigm shift for construction management where new governance structure will follow the path of development of new technologies that would lead to a solid result.

Map of supply and potential export to regions in demand for Artificial Natural resource

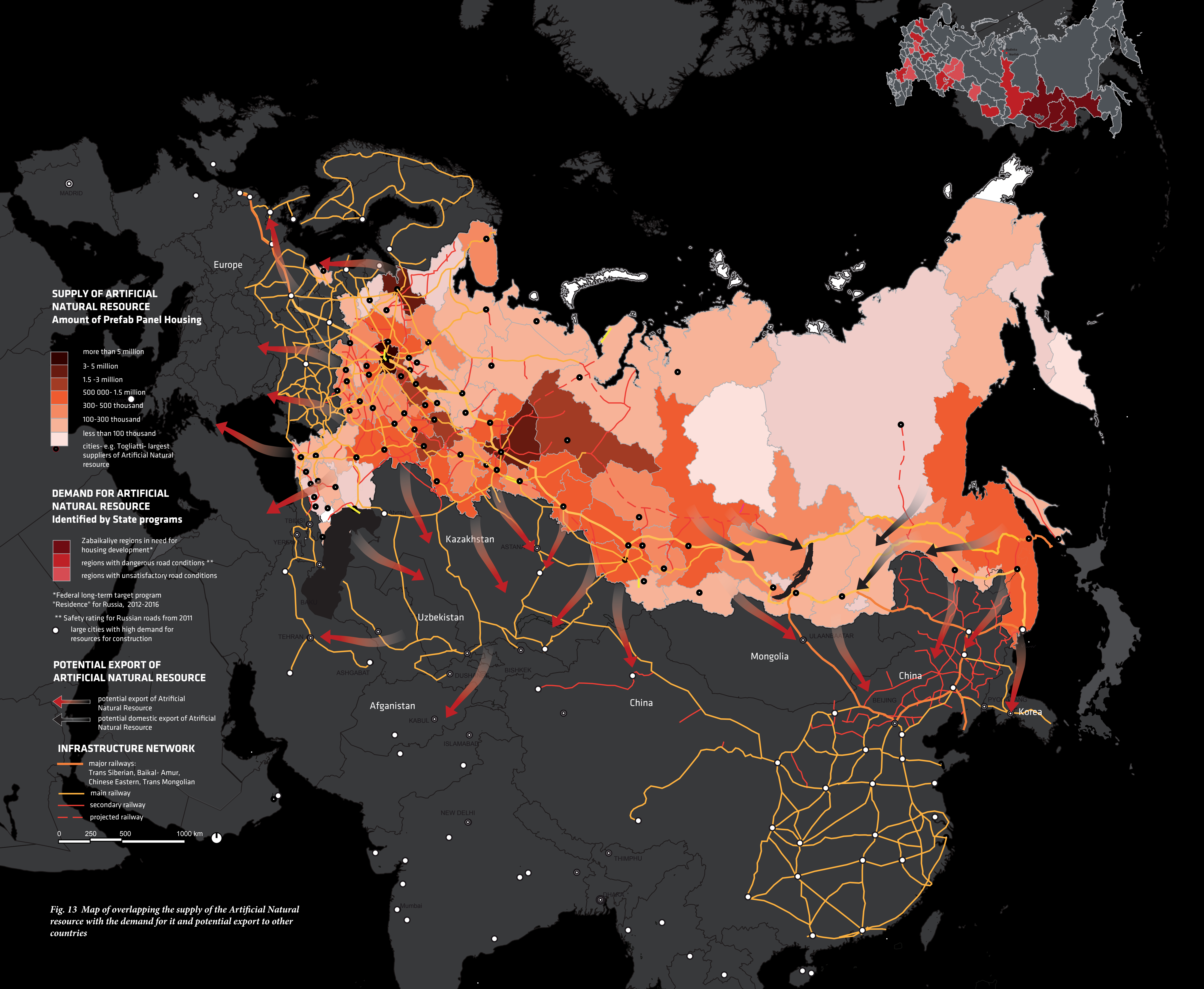


Fig. 13 Map of overlapping the supply of the Artificial Natural resource with the demand for it and potential export to other countries

Fig. 12 Map of regions in demand for Articicial Natural resource as defined by Federal programs

Conclusion

Potential for export

The map indicates that abundant reserves of Artificial Natural resource in almost every region of the country allow for export to the areas of highest demand as well as recycling on site while cutting down on transportation costs for such self- sustaining regions. There are all the necessary resources to form a Russian domestic concrete market. The enormous amounts of forecast deposits of demolition waste in Russia could cover domestic demands for asphalt and concrete in the foreseeable future in case the Upcycling model is implemented.

As Asian countries are rapidly developing it is assumed that demand for Artificial Natural resource and Upcycling product will be expanding. Additional layer of existing and projected infrastructure (predominantly railway) defines Russia as part of such global network of Artificial Natural resources and major exporter of concrete and steel due to exceptional geographical location. While China is the world's biggest producer of construction and demolition waste constantly producing 40 million tons of C&D waste annually (concrete annual production in China accounted for about 45 percent of the world's total (about 1.3 billion m3) it could be a potential strategic partner for exchanging the technology and the management of Upcycling, several Chinese companies have already expressed their desire to buy a technology of C&D waste recycling. It would be more energy- efficient to import Artificial natural resources such as recycled steel from Russia rather than shipping it from Australia as it is currently done.

Artificial Natural resource may solve many acute problems. We simply can not afford to be wasting the waste any longer.

The model of Upcycling is proposed to be implemented into the National Projects for the mass construction of a modern comfortable housing such as "Gilye" Federal Program and has to be incorporated with a combination of legislative measures and modern technological solutions for effective use of new system of architecture and construction instead of outdated material and energy-intensive system of precast concrete, or even more expensive monolithic construction.
Implementation of new technologies has to become a regulation set by legislative system in the very beginning. Tenders must be created with the specific technological and economic conditions.