INTERNATIONAL PARTY

Theoretical proof of concept: Large city construction project

(2018)

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Purpose and background

The purpose of this document is to illustrate how it is possible to finance and construct a green city for ten million inhabitants. Such a project is one of the key proposals of the International Party to alleviate poverty on a massive scale, while simultaneously addressing some key environmental issues.

The proof of concept will be done by means of a financial simulation which calculates input requirements and expected output on a yearly basis. The input requirements are labour, materials, machines, vehicles and buildings. The simulation estimates how much of these inputs are needed to reach a predetermined target, namely a city of ten million people within sixteen years. The simulation calculates the finance that would be needed to start such a city, and the expected cash-flow on a yearly basis.

Project concept

Vertical integration to save costs

The basic idea is to create a corporate entity, say the City Cooperative, in which the development project will be managed and executed. The Cooperative will start and operate a number of vertically integrated enterprises. These should add value at each step of the production process, from mining raw materials up to finished apartment buildings and neighbourhoods. Differently said, the Cooperative will consist of various enterprises that produce everything needed to construct and operate a city for ten million people. Practically, it implies that the Cooperative will start a mine (enterprise-1) to produce iron ore, which will be used by a blast furnace (enterprise-2) for the production of steel. The steel will be used in the construction of buildings and infrastructure by the Cooperative's construction arm (enterprise-3).

Payment coupons

Coupons to limit consumption and save more

One cornerstone of economic growth is investment in capital, which is attained by saving. Very fast growth needs a very high savings rate. To attain such a high savings rate during the construction phase of the new city, workers of the Cooperative can be paid in coupons. They can be rewarded one credit point for each hour worked, of which the largest portion will be converted to 'square metres'. Square meters will be a deferred payment, or saving, which gives the workers a right to the newly built property, equal to the size they have saved up. Such a system will ensure that only a small portion of the output of the Cooperative is consumed during the construction phase, and a larger portion is invested in capital. After the construction phase, more 'hours' will be available for immediate consumption and less for saving in terms of 'square meters'.

Some coupons expire

Such a coupon system is in essence a dual currency system. The 'hours' are used to purchase consumer goods and services, is valid for only one month, and cannot be saved. The 'square metres' are a saving and represents a claim on the property of the Cooperative. It is similar to a share, only with a fixed real value. Workers will be able to sell their 'square metres' in exchange for foreign currency. One other advantage of paying workers in terms of the number of hours they worked, is a currency which is resistant to inflation.

Self-serving cooperatives

Workers organised in similar economic cells

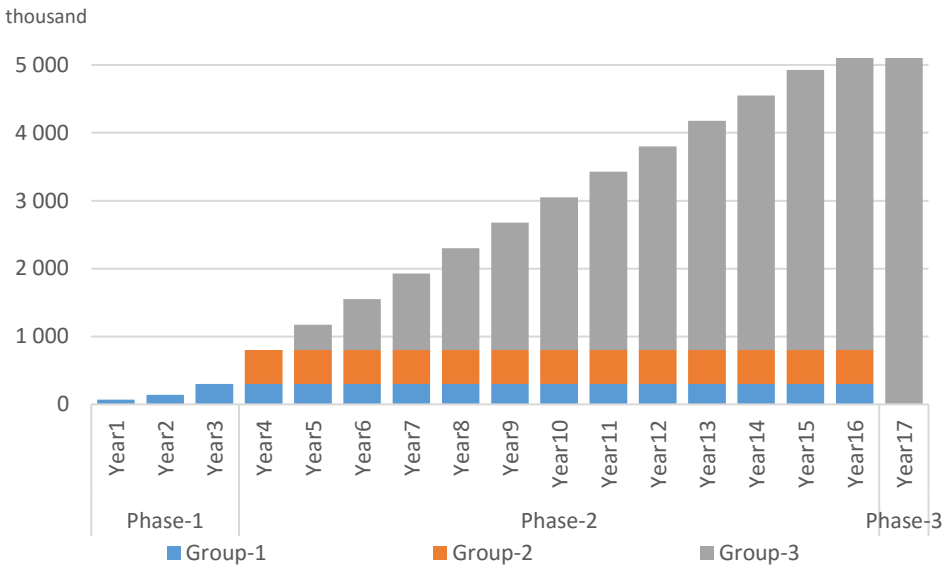
All the employees of the Cooperative can be subdivided into smaller groups (cells) of say 100 workers each. These cells will have a similar structure, aimed to supply in most of the goods and services needed by the workers of that cell. The structure will assign workers to certain jobs, such as cooks, cleaners, teachers, builders, farmers etc. The 'hours' portion of the coupons with which workers are paid will be valid in their own cells. In the first phase of the construction project, most workers in each cell will be assigned to construction work. In the final phase (when construction is completed), more workers will be assigned to services and luxury.

The three phases

The construction of this new city can be subdivided into three main phases:

1. The establishment of mines, acquiring of plantations and land and construction of factories that produce building materials.
2. The full scale construction of mixed-use residential apartments for 750 000 people (187 500 households) per year. The construction of factories for consumer goods.
3. No more construction. Long-run equilibrium. Restructuring of the city economy towards more consumer services and shorter work weeks.

Figure 1: Workers employed per phase



Constructing first factories

Phase-1 will run from the first to the third year. In the first year 70 000 workers can be appointed. They are responsible for the construction of factories and indicated as Group-1 in Figure 1 above. In the second year an additional 70 000 workers will be appointed, and in the third 160 000 more. This will bring the total number of workers in Group-1 to 300 000, and they will construct factories until the end of year-16.

Constructing mixed-use apartments

Phase-2 will run from the fourth to the sixteenth year. In the fourth year a new wave of workers, namely Group-2, can appointed. They are responsible for running the new mines, factories, farms, plantations and mostly for the construction of the mixed use residential buildings. This group will consists of ½ million workers, of which 225 000 will be construction workers. They will also operate until the end of year-16.

A third wave of workers will be appointed from the fifth year, namely Group-3. They will mostly be responsible for producing consumer goods and services. Every year 375 000 more of them will be appointed to all the self-serving cells in the city. Each cell will receive an equal number of Group-3 workers who will be responsible for cooking, cleaning, maintenance, health, education, entertainment and more. As the workers of Group-2 complete 187 500 apartments every year, the workers of Group-3 will be able to move into the city.

Long run state

Phase-3 will be the final phase, starting in year-17 when the city reaches a population of 10 million people (5 million workers). From this point onwards no more additional factories and residential buildings will be constructed. All the workers of groups 1 and 2 will be reallocated to Group-3.

Green city principles

This section presents a short description of the key design factors of a green city that is environmentally friendly and economically efficient. More technical details are available in a separate document.

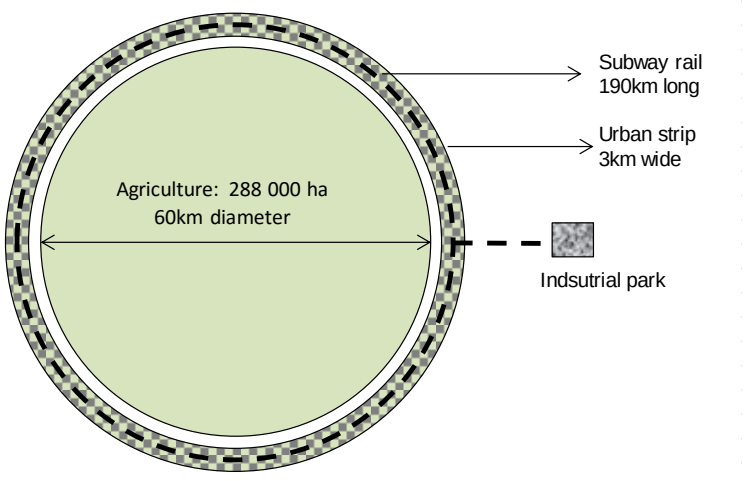
City plan

Cities without cars

Many of the vices of today's modern cities stem from the automobile. These are vices such as noise and air pollution, urban sprawl and many traffic accidents. In general, middle class households spend around 20% of their income on private transport, thus working one day every week simply to own a car. Designing a city in such a way to allow for underground rail, bicycle roads and walkways (and sidestepping the need to own cars) could thus bring about cleaner air, a tranquil atmosphere and a 4-day work week.

Below is a simple picture of a green-belt city with an underground rail system (subway) as main transport method. Ideally, all residential apartments should be within walking distance from a subway station. Cars should not be allowed inside the city.

Figure 2: Layout of a green-belt city



Intensive food production close by

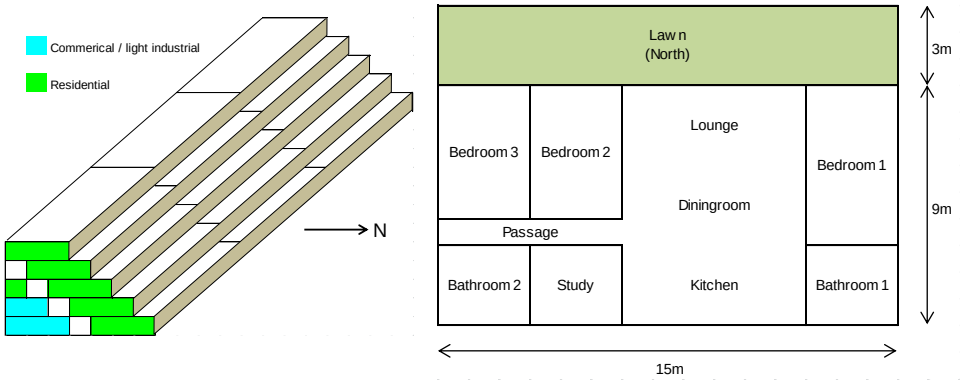
By practicing high intensive agriculture, the city can supply 70% of its own food from within the 288 000 hectare inner circle. (Israel manage to feed 25 people a healthy diet from each hectare of arable land.) By adding an outer ring of cultivated land which is 14km wide, the city would be able to feed itself completely (in a circle of diameter 77km).

Mixed-use buildings

Work and live in the same building

Multiple objectives can be attained by adopting terraced-like mixed-use buildings as basis for people to both live and work in. Floor space should be available for residential purposes, retail, schools, light industries and entertainment. With their places of work in the same building they live, the need for people to commute daily will be much less. The advantage of a terraced building is that each apartment could enjoy its own lawn and garden on its front side. Below is an illustrative example of terraced building.

Figure 3: Example of a mixed-use building



Financial model

This section describes the three different phases of the project and presents a budget and cash-flow for each year, including the finance needed from an external lender. The end goal is to construct a new city for ten million inhabitants, of which five million will be workers.

Economic input-output structure

Construction workers form the base

The number of workers needed to construct a city forms the base of this yearly financial simulation. These workers will need input factors such as materials, machines, vehicles and buildings. The amount of input factors they need can be derived from the structure of an existing economy (for example the South African economy). The National Accounts of Statistics South Africa provide this information, presented in the table below.

Table 1: Input and output per formal sector worker in R million (2020 prices)

Sector	Output	Materials	Buildings	Vehicles	Machines	Capital
Farmers[1]	0.80	0.08	0.86	0.01	0.01	0.89
Miners	1.64	0.20	0.77	0.05	0.63	1.44
Factories	2.28	1.27	0.54	0.00	0.45	1.00
Construction[2]	1.51	0.37	0.03	0.04	0.12	0.19
Cleaners	0.48	0.09	0.08	0.01	0.05	0.14
Waiters	0.48	0.09	0.08	0.01	0.05	0.14
Cooks	0.48	0.09	0.08	0.01	0.05	0.14
Clerks	0.68	0.04	0.17	0.01	0.10	0.28
Maintenance	0.68	0.04	0.17	0.01	0.10	0.28
Utilities	4.87	1.06	16.05	0.14	0.84	17.04
Teachers	0.56	0.04	0.98	0.03	0.11	1.13
Sales	0.68	0.04	0.17	0.01	0.10	0.28
Transport & storage	1.94	0.31	2.10	1.10	0.60	3.80
Nurses	0.82	0.12	0.46	0.02	0.05	0.52
Security	0.56	0.04	0.98	0.03	0.11	1.13
Care takers	0.82	0.12	0.46	0.02	0.05	0.52
Entertainment	0.44	0.04	0.60	0.02	0.07	0.68
Managers	1.03	0.14	0.58	0.02	0.07	0.66
IT	0.80	0.07	1.56	0.02	0.08	1.66
Doctors	1.98	0.22	1.11	0.04	0.13	1.27
Professional	1.03	0.14	0.58	0.02	0.07	0.66

[1] Refers to highly intensive hydroponic farming *[2] Higher productivity using CLT*

Source: Statistics South Africa, Quantec, International Party

Input-output example

To interpret the table above, take for example hydroponic farm workers. On average, each farm worker are able to produce R800 000 worth of food per year. To be able to do this, the farm worker will need materials such as fertilisers, fuels, seeds etc. worth R80 000. He will also need a once-off investment in capital such as land, hydroponic tunnels and irrigation systems worth R860 000. Hydroponic farming is very labour intensive, therefore requires little investment in vehicles and machines, which can be shared among many farm workers. After sharing, the cost of vehicles and machines is R2000 per farm worker. Overall, a capital investment of R890 000 is needed to put one hydroponic farm worker in action.

Similarly, factory workers needs a once-off capital investment of R1 million (R540 000 buildings and R450 000 machines) and materials of R1.27 million per year to produce goods worth R2.28 million per year. These ratios in Table 1 can now be used to estimate the labour, capital and materials needed for a massive construction project.

Key assumptions

Other key assumptions are that an interest rate of 7% is charged on loans to the project. Income taxes will become applicable only once the project generates a profit, thus up to that point income taxes can be ignored from the calculation. Lastly, besides the payment coupons, workers will also be paid R2000 per month in currency, while managers and other professionals will be paid an additional R15000 per month.

Targets

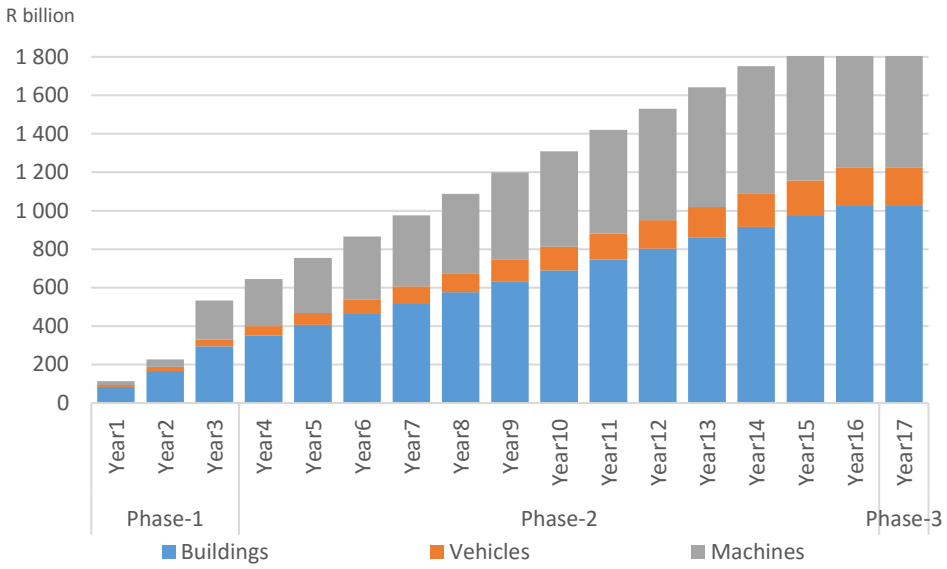
Housing for 750 000 per year

Based on the assumptions above and the simulation below, it is possible to finish construction of the city-for-ten-million within sixteen years (including three years of preparation). Thus, apartments and commercial space for 750 000 people need to be constructed per year for thirteen consecutive years.

Profile of fixed capital stock

Over the course of the project, the main types and amounts of production capital needed are depicted in Figure 4 below. The initial capital will be financed through loans from external financiers. As the project develops and internal capacity grows, a larger portion of capital will be created within the cooperative (especially buildings). Also, as surplus production are exported, foreign currency will be earned that can be utilised for the import of capital goods such as machines.

Figure 4: Profile of fixed capital stock over the course of city construction



Phase-1: farms, mines and factories (three years)

Creating initial production capacity

In phase-1 the new hydroponic farms, mines and factories will be established needed for phase-2. Thus the production capacity will be created for the manufacturing of the necessary building materials for the construction of a new city-of-ten-million inhabitants. The aim will be to complete this phase within three years. The first step is to acquire land for the city and farms (according to the green city criteria). Recruitment and training of employees will mostly be among school leavers and start-off with a boot camp. At the boot camp new recruits will be trained in essential skills such as discipline and cooperation. They will also be taught construction skills such as carpentry, masonry, welding, plumbing, and electricity. Some would be trained in hydroponic farming skills.

70 000 workers and R113 billion invested

The number of mines, factories and farms required in phase-2 can be calculated based on the input-output requirements of Table 1. With this target in mind (Table 3) we can calculate the number of employees and investment needed in the first year (Table 2). The total investment target for year-1 is R113 billion. Of the proposed 70 000 workers, 58 000 will be allocated to the construction of the new factories, utilities and farms. The balance will be spread among various occupations.

Table 2: Financial simulation of year-1 (thousands of workers and R billion)

WORKERS		BALANCE SHEET				EXPENDITURE										INCOME				Cash flow
Sector	Number	Buildings*	Vehicles	Machines	Capital	Buildings	Vehicles	Machines	Invest-ment	Materials	Depreciation	Wages	Interest	Taxes	Cost	Output	Internal consumption	Sales	Profit	
Farmers	1	12	0	0	12	-12	0	0	-12	-0.1	-0.7	0.0	-0.9	0.1	-2	1	-1	0	**-1**	**-13**
Forestry & mining	0	6	0	0	6	-6	0	0	-6	0.0	0.0	0.0	-0.4	0.0	0	0	0	0	**0**	**-7**
Factories	0	38	0	0	38	-38	0	0	-38	-0.1	0.0	0.0	-2.7	0.3	-2	0	0	0	**-2**	**-40**
Construction	58	3	3	10	16	-3	-3	-10	-16	-21.5	-2.9	-1.4	-3.0	-4.8	-34	88	-11	76	**43**	**27**
Cleaners	1	0	0	1	1	0	0	-1	-1	-0.1	-0.1	0.0	-0.1	0.0	0	1	-1	0	**0**	**-1**
Waiters	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**0**
Cooks	1	0	0	0	0	0	0	0	0	-0.1	0.0	0.0	0.0	0.0	0	1	-1	0	**0**	**-1**
Clerks	1	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**-1**
Maintenance	1	0	0	1	1	0	0	-1	-1	-0.1	-0.1	0.0	-0.1	0.0	0	1	-1	0	**0**	**-1**
Utilities	0	14	0	1	14	-14	0	-1	-14	-0.1	-0.5	0.0	-1.1	0.2	-1	1	-1	0	**-1**	**-16**
Teachers	1	0	0	1	1	0	0	-1	-1	0.0	0.0	0.0	-0.1	0.0	0	0	0	0	**0**	**-1**
Sales	1	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**-1**
Transport & storage	1	11	6	3	20	-11	-6	-3	-20	-0.4	-1.2	0.0	-1.5	0.3	-3	3	-3	0	**-3**	**-23**
Nurses	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**0**
Security	1	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**-1**
Care takers	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**0**
Entertainment	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**0**
Managers	1	0	0	0	0	0	0	0	0	-0.1	0.0	-0.1	0.0	0.0	0	1	-1	0	**0**	**-1**
IT	0	0	0	0	0	0	0	0	0	0.0	0.0	-0.1	0.0	0.0	0	0	0	0	**0**	**0**
Doctors	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	**0**	**0**
Professional	1	0	0	0	0	0	0	0	0	-0.1	0.0	-0.1	0.0	0.0	0	1	-1	0	**0**	**-1**
TOTAL	**70**	**83**	**11**	**19**	**113**	**-83**	**-11**	**-19**	**-113**	**-23**	**-6**	**-2**	**-10**	**-4**	**-44**	**99**	**-22**	**77**	**33**	**-81**

**Only factories and plant, excluding the mixed-use residential-commercial buildings*

Example of construction workers

The construction workers will need R21.5 billion of materials, which will be imported, to construct factory buildings worth R38 billion, utility structures worth R14 billion and so on. The total output of construction workers will be R88 billion, of which they will "sell" R76 billion to the internal economy, mostly the factory sector. After deducting input costs, a "profit" of R43 billion remains, which is in essence the value added by construction workers through their labour. After subtracting the investment cost from the profit, the cash flow surplus from construction activities is only R27 billion.

Cash-flow deficit of R81 billion

In a similar way, the cash-flow surplus of all the various sectors can be calculated. In phase-1 only construction will yield a positive cash flow. The total cash flow in year-1 is a deficit of R81 billion, which will have to be finance through credit.

Phase-2: residential and commercial buildings

Construct housing for 750 000 people per year

In phase-2 the residential and commercial buildings will be constructed. Enough needs to be built to accommodate 750 000 new inhabitants each year until a total city population of ten million is reached. To do this, some base assumptions needs to be established first. By assuming an apartment size of 135 m^2 per household of four, and an additional 62m^2 of commercial space, a total of 197m^2 is needed for every household (of four inhabitants). This area divides to 49.3m^2 per person. At a building cost rate of R9200/m^2 (2020 prices), the total construction cost per inhabitant is R453 000.

225 000 construction workers needed

To gain labour productivity, apartment buildings can be constructed of cross laminated timber (CLT), which also has a much lower carbon footprint. In this case, the annual output per construction worker is R1.51 million (see Table 1 above). One worker will be able to produce enough building space for slightly more than three inhabitants per year. Thus, 225 000 construction workers will need to be employed in order to construct housing and working space for 750 000 people per year. By employing them for just more than thirteen years, a city-for-ten-million can be constructed.

275 000 other workers needed

However, besides the required 225 000 construction workers, additional workers will be needed to mine raw materials and man factories for the production of building materials. The number of workers and amount of capital needed to establish these can be calculated based on the input-output requirements stipulated in Table 1 above.

Table 3: Workers and capital required to construct living space for 750 000 new inhabitants per year

WORKERS (thousand)		BALANCE SHEET (R bn)				EXPENDITURE					INCOME		
Sector	Number	Buildings*	Vehicles	Machines	Capital	Materials	Depreciation	Wages	Interest	Cost	Output	Sales	Profit
Farmers	26	22	0	0	23	-2.2	-1.3	-0.6	-3.6	-8	21	15	**6**
Forestry & mining	50	38	2	31	72	-9.9	-6.1	-1.2	-10.2	-33	82	82	**49**
Factories	125	68	0	56	125	-158.3	-18.8	-3.0	-28.5	-216	285	285	**68**
Construction	225	7	9	27	42	-83.5	-7.7	-5.4	-5.1	-91	340	0	**-91**
Cleaners	8		0	0	0	-0.7	0.0	-0.2	-0.3	-1	4	0	**-1**
Waiters	1		0	0	0	0.0	0.0	0.0	-0.1	0	0	0	**0**
Cooks	10		0	1	1	-0.9	-0.1	-0.2	-0.3	-1	5	0	**-1**
Clerks	5		0	1	1	-0.2	-0.1	-0.1	-0.2	-1	3	0	**-1**
Maintenance	10		0	1	1	-0.4	-0.1	-0.2	-0.3	-1	7	0	**-1**
Utilities	1	12	0	1	13	-0.8	-0.4	0.0	-3.8	-5	4	0	**-5**
Teachers	5		0	1	1	-0.2	0.0	-0.1	-0.3	-1	3	0	**-1**
Sales	5		0	1	1	-0.2	-0.1	-0.1	-0.2	-1	3	0	**-1**
Transport & storage	10	21	11	6	38	-3.1	-2.2	-0.2	-5.9	-10	19	0	**-10**
Nurses	3		0	0	0	-0.3	0.0	-0.1	-0.1	0	2	0	**0**
Security	4		0	0	1	-0.2	0.0	-0.1	-0.2	0	2	0	**0**
Care takers	1		0	0	0	-0.1	0.0	0.0	0.0	0	0	0	**0**
Entertainment	1		0	0	0	0.0	0.0	0.0	-0.1	0	0	0	**0**
Managers	5		0	0	0	-0.7	0.0	-0.9	-0.3	-2	5	0	**-2**
IT	3		0	0	0	-0.2	0.0	-0.5	-0.1	-1	2	0	**-1**
Doctors	1		0	0	0	-0.1	0.0	-0.1	-0.1	0	1	0	**0**
Professional	5		0	0	0	-0.7	0.0	-0.9	-0.3	-2	5	0	**-2**
TOTAL	**500**	**169**	**24**	**126**	**319**	**-263**	**-37**	**-14**	**-60**	**-374**	**794**	**381**	**7**

Source: International Party **Only factories and plant, excluding the mixed-use residential-commercial buildings*

Sourcing of raw materials

The table above shows that 50 000 foresters and miners are needed to produce R82 billion of timber and ore to be used for city construction. These foresters and miners will need plant and buildings worth R38 billion to work from, also R2 billion of vehicles and R31 billion of machines. Combined they need a capital investment of R72 billion. Besides capital they will also need R9.9 billion of other input materials (such as fuel). They will sell these raw materials to the factory sector for R82 billion.

Sourcing of building materials

The factory sector will use these raw materials as input to produce construction materials such as timber, steel, glass, cement, pipes and cables. To produce enough, 125 000 workers will be needed in various factories, requiring an investment of R125 billion. Besides the R82 billion raw materials needed, the factories will also need R76 billion intermediate input materials, which can be produced within the cooperative. A total of R158 billion of input materials will be needed by the factory sector. The factory sector will produce goods and materials worth R285 billion. Of this most would be sold internally to the construction sector of the cooperative, and also to various other sectors.

Key challenge

To generate a cash flow surplus, the total sales of R381 billion is needed to cover also depreciation of R37bn, currency wages of R14bn and interest of R60bn. Of the total sales most would be to other internal sectors, but a **balance of R100 billion will need to be sold to external parties**. This will be a key challenge for the success of this project: finding markets to sell to.

Phase-3: Long run equilibrium

Shorter work week in long run

From year-17 the capital requirement to operate a city of ten million people will be attained. Further investment in new capital will thus not be needed anymore. As a result, a huge production surplus will be generated. In the long run, this surplus can be neutralised by reducing the number of hours worked by employees.

Table 4: Cash flow simulation (thousands of workers and R billion)

PHASE	YEAR	Workers	BALANCE SHEET					EXPENDITURE										INCOME				CASH FLOW
		Number	Buildings	Vehicles	Machines	Capital	Credit	Buildings	Vehicles	Machines	Invest-ment	Materials	Depreciation	Wages	Interest	Taxes	Cost	Output	Internal consump-tion	Sales	Profit	
	Year1	70	83	11	19	113	-81	-83	-11	-19	-113	-23	-6	-2	-10	-4	-44	99	-22	77	**33**	**-81**
Phase-1	Year2	140	166	22	38	226	-196	-83	-11	-19	-113	-46	-12	-4	-18	0	-79	197	-120	78	**-2**	**-115**
	Year3	300	294	36	203	534	-537	-128	-15	-164	-307	-99	-17	-8	-44	4	-164	422	-292	130	**-34**	**-341**
	Year4	800	351	49	245	644	-540	-57	-12	-42	-111	-402	-59	-24	-79	-12	-575	1200	-517	683	**108**	**-3**
	Year5	1 175	408	61	287	755	-534	-57	-12	-42	-111	-480	-71	-37	-87	-13	-687	1523	-719	804	**116**	**6**
	Year6	1 550	464	73	329	866	-519	-57	-12	-42	-111	-558	-83	-50	-94	-14	-798	1845	-921	924	**126**	**15**
	Year7	1 926	521	85	371	977	-494	-57	-12	-42	-111	-635	-96	-63	-100	-15	-909	2167	-1123	1 045	**136**	**25**
	Year8	2 301	577	98	412	1 087	-458	-57	-12	-42	-111	-713	-108	-76	-105	-16	-1019	2490	-1324	1 165	**147**	**36**
	Year9	2 676	634	110	454	1 198	-411	-57	-12	-42	-111	-791	-121	-89	-110	-17	-1128	2812	-1526	1 286	**158**	**47**
Phase-2	Year10	3 051	690	122	496	1 309	-352	-57	-12	-42	-111	-869	-133	-102	-114	-18	-1236	3135	-1728	1 406	**170**	**59**
	Year11	3 426	747	134	538	1 420	-279	-57	-12	-42	-111	-947	-146	-116	-117	-19	-1344	3457	-1930	1 527	**183**	**73**
	Year12	3 801	804	147	580	1 530	-192	-57	-12	-42	-111	-1024	-158	-129	-119	-20	-1450	3779	-2132	1 648	**197**	**87**
	Year13	4 177	860	159	622	1 641	-91	-57	-12	-42	-111	-1102	-171	-142	-120	-21	-1556	4102	-2334	1 768	**212**	**102**
	Year14	4 552	917	171	664	1 752	27	-57	-12	-42	-111	-1180	-183	-155	-120	-22	-1660	4424	-2535	1 889	**229**	**118**
	Year15	4 927	973	184	706	1 863	162	-57	-12	-42	-111	-1258	-196	-168	-119	-23	-1763	4746	-2737	2 009	**246**	**135**
	Year16	5 302	**1 030**	**196**	**748**	**1 973**	315	-57	-12	-42	-111	-1336	-208	-181	-117	-24	-1866	5069	-2939	2 130	**264**	**153**
Phase-3	Year17	5 302	1 030	196	748	1 973	464	0	0	0	0	-1099	-176	-185	-80	-14	-1555	4556	-2852	1 704	**149**	**149**

**Only factories and plant, excluding the mixed-use residential-commercial buildings*

Yearly cash flow

R540 billion credit needed

By escalating the process above for each year, the projected cash flow over the entire duration of the project can be calculated (Table 4). Credit required from external sources will be R81 billion in year-1, then peaking at R540 billion in year-4. By year-14 all debt should be paid off.

Surplus cash-flow from year-5

Most new credit will be required in year-3 when the machines of the newly-built factories and utility plants will be installed. An investment of R307 billion will be required in year-3. However, due to interest on accumulated debt from previous years, credit of R341 billion is required in year-3. After that a fixed yearly investment of R111 billion is needed to drive the constant expansion. From year-5 a surplus cash-flow will be generated, which can be used to repay debt. By year-14 all debt can be repaid and these surplus funds could be reinvested in similar projects.

Conclusion

The financial simulation presented in this document illustrates the potential to construct new cities for ten million people within sixteen years. The simulation is based on some key assumptions. The first assumption is the vertical integration of many primary production processes aiming to save intermediary costs. Secondly, to mainly use coupon payments of workers, rather than currency. For these two reasons, workers will be organised in economic cells with similar design. Thirdly, higher labour productivity in construction and farming is based on more efficient technologies such as CLT-construction and hydroponic irrigation. Lower transportation costs, due to shorter travel distances and mixed-use buildings, will also contribute.

The project of sixteen years is subdivided into three main phases. In the first phase mines and factories are built to produce the needed building materials for the second phase. In the second phase mixed-use residential-commercial buildings are constructed to accommodate 750 000 new inhabitants each year. In the final phase the city's economy is rebalanced away from being investment driven towards being consumption based. In this phase there is potential to reduce the working hours of employees to some extent.