

# World at the Crossroads – manual

## The Game

The game „World at the Crossroads” simulates the rise of the industrial civilization, from 1900 to 2200. It can be perceived as a model of The Limits to Growth, commissioned by the Club of Rome in 1972, converted into a strategy game that helps understand systems dynamics and complex interactions between Earth and human civilization.

You can undertake decisions influencing your economy, society, agriculture, energy infrastructure and pollution controls. The aim is simple: make people happy. The better you meet their needs and avoid crises, the higher score you will have.

The game realistically simulates key trends taking place during the growth of the industrial civilization. Demographic, economic data, energy use and extraction, food production and pollution are based on historical data. Models implemented in the game are also based on real data and dependencies. For example, game’s climate module is based on [C-Roads model](#) – algorithms and data are advanced enough that initialization of data for scenarios (GHG concentrations, carbon cycle, heat transfer in oceans, temperature growth, sea rise, ...) is performed just by tracking historic/forecasted GHG and sulphur aerosols emissions from 1750.

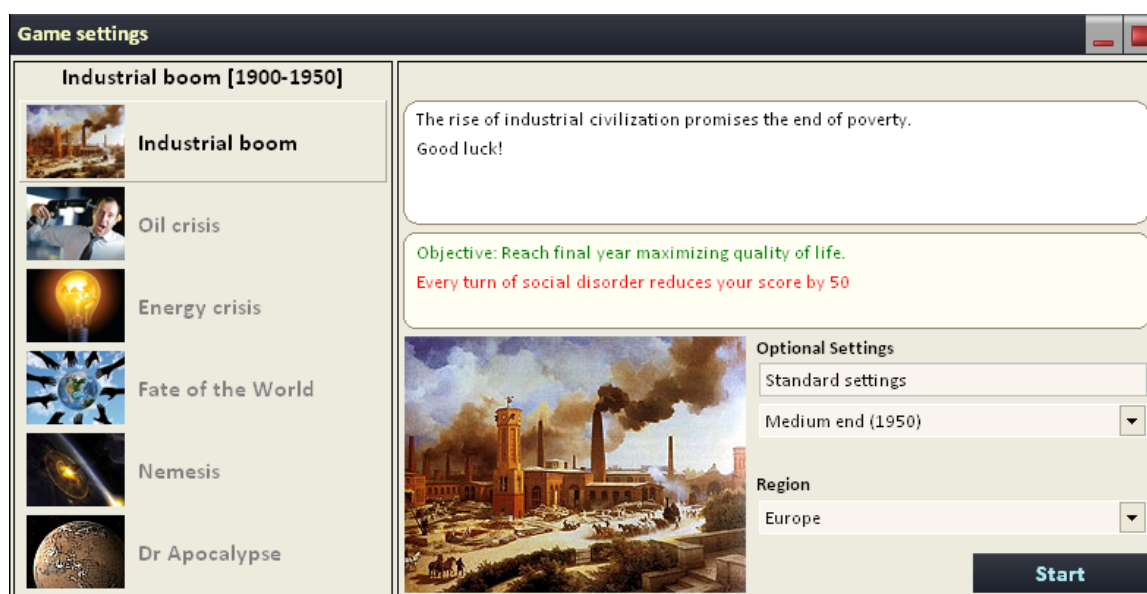
The game very realistically re-creates our choices and the history of our civilization in the XXth century, showing, that the strategy of exponential growth was a very logical choice and an efficient way to provide well-being to the people. Running the simulation further in time shows nevertheless, that sticking to this strategy for too long may lead to serious trouble, and if we want to preserve the achieved well-being and have a good and safe future, far reaching changes will be necessary. What’s more, the faster they take place, the easier the transition will be.

## Installation and first execution

Extract the archive WAC.zip to a writeable directory (note that system directories like “Program Files” are write-protected). Execute WorldAtCrossroads.exe.

## Interface

Run the game and select „Single Player”→„New game” →”Command a region”. Select scenario „Industrial boom” and click the „Start” button.



You will play Europe for fifty years, from 1900 to 1950. The World is a relatively simple place, economy is small, resources are plentiful and pollution is marginal. There are excellent conditions for getting familiar with the game and its interface.

After short introduction the command screen will appear.



Your task is to achieve as high score as possible (shown in **Score Panel**), achieved by high level of people's contentment (shown in **Contentment Panel**), influenced by life quality, food and energy availability, pollution, economic growth, crises and other factors such as society's opinion on aggressive energy-efficiency measures. If the contentment indicator  $\triangleleft$  falls to the orange zone, it means that the society is upset to the level of rioting.

On the picture above the total contentment is 0.7 – it means that if you finish the turn right now you would get for this turn 0.7 pt (with additional corrections for economy size, economic growth and wealth relative to other players, as well as debt level and soil quality).

In the **Budget Panel** you can see the budget at your disposal and available funds (after various spending).

Under Budget, Contentment and Score Panel you can see tabs, allowing access to the action panels. There are panels for: Economy/Society, Energy, Food and Pollution/Environment. Info/Statistics panel serves reporting purposes.

Panel tabs display key indicators.

In case of **Economy/Society** there are GDP, population, GDP per capita and Debt/GDP level. Especially important factor is a yearly GDP growth, showing how fast your economy grows (or contracts). GDP growth depends on a number of factors:

- **society's outlook** – the more the people are focused on consumption and money making, the higher the growth will be;
- **population growth** – growing population demands new stuff, construction of new houses, roads, schools, factories and other infrastructure, thus stimulating the growth of economy;
- **demographic structure** – the higher percentage of the working people, the stronger the economy. High number of children or elderly people will depress the growth;
- **wealth level**. In a very rich society the growth becomes more difficult. When everyone has a house with a swimming pool, two cars, three TV's and a grill, further growth of consumption slows down;

- **taxation/stimulation.** The lower the taxes (and higher the stimulus), the faster GDP growth;
- **trade balance.** Trade surplus helps accumulate wealth and stimulates GDP growth. Trade deficit acts otherwise;
- **financial and industrial politics.** Conventional tax system is better for GDP growth than taxation of resources use and pollution. Similarly, constant work of factories allows to maintain higher production rate, than in case, when factories run only when energy surplus is available;
- **government type.** Freedom is good for economic growth, autocratic rule is not;
- **food and energy availability.** Lack of either of them is destructive for the society and the economy;
- **health financial system.** Financial crisis strangles the economy.

In case of **Energy** key indicators are energy production and demand – divided into liquid fuels (available from 1910) and other energy carriers. Energy shortages are highlighted in red. On the bottom of the tab the trade balance info is displayed.

In case of **Food** key indicators are food production and demand, farming intensity (100% is a neutral value, higher exploitation rate leads to gradual soil erosion, lower exploitation rate lets the soil regenerate). In case of energy shortages, leading to decrease of food production, info will be displayed. On the bottom of the tab the food trade balance info is displayed.



In case of **Pollution/Environment** key indicators are financial cost of pollution for the economy and discontentment level.

OK, once we know the interface, let's play.

## Let's play


**It's year 1900.** Your budget is 1210 bn. Some of it is used for welfare spending (-127), some is used by pollution (-79). Your available funds are 1004 bn. You can spend the money as you wish.

The most important issue is to provide food and energy. Because food production depends on energy, let's start with the later. Click the Energy tab. We have 328 units (mtoe) of energy, while the demand is 359. How can we meet the demand? Let's improve the energy efficiency first – click 'Improve efficiency'. This will cost 153 bn. Now the energy demand is reduced to 349 mtoe. We could apply 'Improve efficiency' again, but applying it again in the same turn will be more costly. Energy efficiency will improve anyway "by itself" – the process is faster in societies with greener outlook, richer (higher ratio of GDP created in services) and with higher technology level.

Now we will satisfy the needs with the use of coal, which is the cheapest option. The cost of 1 unit is 4.8. But before we start construction of mines/power plants, let's research better and cheaper technologies. Click the research option (laboratory flask)  [4,8] 254  3 and click 'Research' (for coal – second row). Now the building cost has fallen to 3.9/unit.

Let's build required 21 coal mines/plants. Energy needs will be satisfied, but note, that the price of coal has risen to 4.1/unit. Why? Because first we mine the easiest seams, and after they are exploited, we have to move to the more difficult and expensive ones.

Now let's go to the Food tab. Here we have surplus – we produce 423 units of food, while we require 311. Farming intensity is 120% (meaning slow erosion).

Now enter the biomass management screen (click  120%). Biomass management screen differs from these for other energy sources. Instead of building a number of power plants, you can set the farming intensity – from 50% to 200%. The higher the exploitation intensity, the higher yields you will have, but at a price of lost nutrients and overall soil quality. Yields depend on a few factors:

- **agricultural base** – base fields area;
- **farming intensity**;
- **soil quality**;

- **weather** random coefficient – in case of natural disasters such as droughts or floods yields are significantly reduced);
- **technology bonus** – the higher the technology, the higher the coefficient is (note that energy shortages reduce gains);
- **pollution** – excessive pollution will reduce yields;
- **areas at your disposal** – base agricultural area may be reduced by protected areas.

Some fields may be assigned to energy crops. Even if you don't do this, some quantity of biomass (from forests and waste) will be set aside for energy needs anyway. In our case 70 mtoe is used for this purpose (see bottom right).

Because our scenario ends in 1950, we won't care for gradual erosion. Quit the biomass screen without changes and export the food surplus (112 units).



We get some money, GDP growth also goes up.

Now click the Pollution/Environment tab and spend 120 on air pollution controls. Note the slight improvement in agricultural yields. We will leave it this way.

Return to the first tab Economy/Society. Click 'Taxation/Stimulation' and apply a 'Medium stimulus package', spurring the GDP growth. Now the GDP/capita grows quickly and members of our society will get wealthier.

We could now pay back our debt (or borrow some more), but the current level of debt (20%) is OK – on one hand the interest rate is low, on the other, ramping up our debt would increase the interest and could become a burden – so let's leave the debt unchanged.

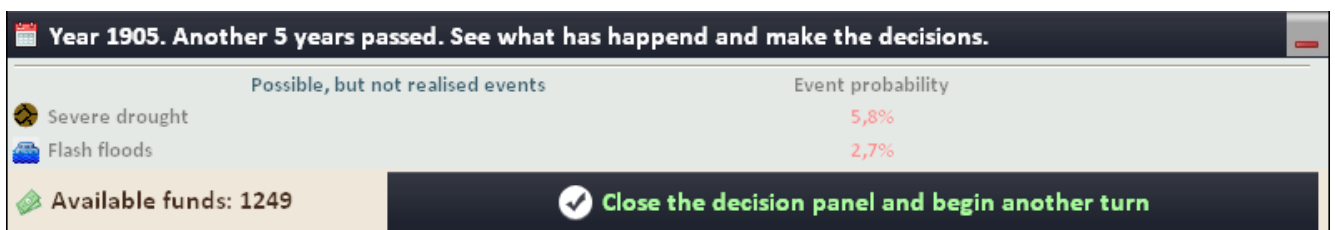
Let's spend the remaining funds on research. Click the Energy tab, then click the research option and invest in coal mining research.

Now we have allocated all our funds, the needs are satisfied and we can finish our turn, moving 5 years forward.



Now the turn summary will be displayed, summarizing changes in your economy between 1900 and 1905 – here you can compare your performance to the other regions.

Afterwards the events screen will be displayed.



It's possible (though not very probable), that you will face severe drought or flood. If so, improve the protections and proceed.





**Now you are in 1905.** Your GDP and budget are higher. Energy demand and population are higher as well.

Go to Energy tab, finish the research of better coal (mining) technologies, then satisfy the energy demand with coal. Note that fast economic growth means high spending on new energy infrastructure.

Go to Food tab and sell the food surplus. Spend the remaining funds on biotechnology/agricultural research (better technologies are close to development, maybe it would be wise to lend some money to finish it – but for now let's ignore this path).

End the turn.

After the turn summary the events screen will appear. This time some more events will (can) take place.

Year 1910. Another 5 years passed. See what has happened and make the decisions.		
 Demand for Oil rises		Notification
 People demand raise of welfare spendings		Click to view
Possible, but not realised events		Event probability
 Severe drought		5,9%
 Flash floods		2,6%

'Demand for Oil rises' is just a notification – you don't have to take any actions. From now on the demand for liquid fuels will be tracked separately, you will also have access to oil as a new energy source.

'People demand raise of welfare spending' because your citizens are richer now and expect improved services such as health care, new roads, social security etc. You can listen to them, increasing their contentment (and your score), you can also decide that it is too expensive and deny their requests. This time let's agree.


It's also possible that pressure on consumerism will get strong enough to influence the society's outlook. If you let it pass, GDP growth will accelerate, but efficiency improvements will slow down and pollution will increase. You can also block the change, but people will be discontent. In case this option appear, embrace the change (for now, our priority is GDP growth, isn't it?). You could also change the outlook from Economy/Society panel, but inducing changes by your own would require considerable spending.

**Now you are in 1910.** Your GDP and budget are higher again. Energy demand and population are higher as well.

Go to Energy tab and satisfy the energy demand with coal. Note the appearance of oil as a new energy source. Demand for liquid fuels is 8 units. Before building them do the research of drilling/petrochemical technology, and then provide the oil.

Now it's also time to develop new agricultural technologies. Do the research – yields will rise to 130%.

Go to Food tab and sell the food surplus. Note, that in spite of rising yields, food surplus becomes smaller. One reason is the growing population, the other one changing food customs of richer people, who eat more and switch to meat diet. Maybe it would be wise to promote smaller families? Anyway, the food security will worsen, at least until the introduction of the "Green Revolution", helping rise yields significantly.

Go to the research screen. At the bottom right corner click the option displaying the technology tree .

Green background marks developed technologies, blue waiting for research. After you click the technology, its description will be displayed. Note high rise in yields related to agricultural technologies 8-10 lev. Another important moment will be the development of level 6 drilling technologies, unlocking natural gas resources. More advanced technologies are costlier – only strong economies will be able to develop them.

Here the tutorial ends. Satisfy the energy and food demands, develop technologies, control pollution and don't take excessive debts and you will reach 1950 with rich and happy society.

After you successfully play the 'Industrial boom' scenario, try 'Fate of the World', which basically is just the 'Industrial boom' extended to year 2200. Everything is the same, but you will be surprised, how much the World changes with time.

## Strategies

„World at the Crossroads” simulates the rise of the industrial civilization, from 1900 to 2200.

Playing the game you will notice that very often the most convenient in the short-term decisions are a seed of a future

**We all *know* what to do, we just *don't know* how to get *re-elected* after we've done it.**

**Jean-Claude Juncker on economic reforms**

trouble, and the actions aimed at a better future are costly and inconvenient in the short term. In the real world politicians prefer solutions that give quick payback – otherwise their chances for re-election would be dim. The ability to steer the country to the future, makes the

difference between a politician and the statesman. Will you be a real one?

During the first stage of the game, a player faces lack of funds, high birth rate and hunger, especially when not playing Europe or N. America. In a poor country (GDP/capita < 1000) most resources are consumed for current needs, leaving little for investment.

The way out of this circle of poverty, hunger and social discontent (and thus low score in the game), is to make people richer by economic growth. This is not easy. You have to command your resources wisely, preparing to the jump allowing getting out of the pickle. The poorest regions, unable to develop new technologies, will probably have to wait, until growth enabling technologies will “diffuse” to them from more advanced regions.

The growth of economy is invariably accompanied by increased energy use. The faster the growth, the more challenging the satisfaction of this demand becomes.

Let's consider an example: we have an economy with GDP=1000 bn and energy efficiency 0.4 mtoe/bn. This means we must provide 400 units (mtoe) of energy.

Energy sources (with exception of biomass and hydro power plants) are build for 50 years (regardless of whether we think of mines, power plants of factories), so every turn (lasting 5 years) we must re-create 10% of our energy infrastructure – in our case 40 mtoe.

If our economy grows at a modest 3%/year (during 5 years it gives 16% growth), then after 5 years the GDP will be 1160 bn and energy demand 464 mtoe. So we will have to not only re-create 40 mtoe of decommissioned infrastructure, but also provide 64 additional units – 104 altogether, or over 2.5x more, than in a non-growing economy.

What, if we have a “Chinese-like” economic growth on the order of 10% a year? After 5 years our GDP will reach 1610 and the demand for energy 644 mtoe – we will have to provide 40+244=284 mtoe – seven times more, than in a non-growing economy.

GDP start	Energy	Growth %/r	GDP +5 years	Energy +5 y.	Decommission	Must be build
1000	400	-2%	900	360	-40	0
1000	400	0%	1000	400	-40	40
1000	400	3%	1160	464	-40	100
1000	400	5%	1276	510	-40	150
1000	400	10%	1610	644	-40	284

If you expect not-that-rich economy to grow quickly, you can do it only basing your energy system on very cheap energy sources – this means fossil fuels, especially coal.

After your economy grows and people become richer, previous painful problems disappear. You will have a financial surplus, birth rate will fall, new technologies will rise agricultural yields and lower energy cost.

If you think in short time frame or play a scenario ending in XXth century (or early XX1st century), you will get the highest score (measured by material standard of living and society's contentment), maximizing the GDP growth and directing funds to high quality of life (maybe putting aside some money for research and pollution control). GDP growth, cheap fossil fuels and consumerist outlook will be your friends. You may perceive all is fine and the Golden Age has dawned.

Unfortunately, if you became lulled by the ease of the game, dismiss the early warning signals and stick to the course for too long – you will have a crude awakening.

Exponentially rising fossil fuel consumption will explode, quickly depleting easy and cheap fields. Of course coal, oil and gas will not run out, but the remaining resources will get harder and more expensive to extract. Rising environmental costs – air, water and soil pollution, biologically active chemicals (especially insidious due to their global scope, persistency, latency and entrenchment in our industries) as well as ever more serious consequences of the climate change will drag the economy down. Players, who have squandered the Golden Age, ignoring energy and food efficiency, pollution controls and alternatives to fossil fuels, the situation will get nasty – the surplus will shrink, quality of life will have to be reduced (this will not come easy with the society accustomed to them), that in turn may cause social discontent, possibly even leading to wars. One can only desperately fight the crises, waiting for GDP crash, financial crisis and other “attractions”. Of course, this collapse may take decades, and, well managed at this stage, may even stop higher than the current North Korean standard of life.

Players, who invested in the future, making good use of the Golden Age of the turn of the centuries, when the freedom of action was the highest, are in a much better position. The economy is strong, soils are in a good state, energy efficiency is superb and the alternatives for fossil fuels are ready for deployment. But there are challenges as well. The alternatives to fossil fuels, though available, are much costlier, what is not compatible with high economic growth. Regarding fossil fuels you have three main options:

- **Develop unconventional fossil fuels.** You will have to face the Climate Change. Reduce GHG emissions with the use of CCS, use geoengineering and/or adapt to climate change. All of it is expensive, but maybe a strong economy can handle it.
- **Develop nuclear.** There are risks involved: nuclear power plants disasters, nuclear weapons proliferation, terrorist attacks with nuclear weapons. This path may work, but only in stable societies with heavy security measures.
- **Develop renewable.** Clean and safe, but very costly, especially when dominate the grid. With some structural reforms (Green Tax Reform, Green Industrial Reform) you may afford it, but forget about the high GDP growth of the late XXth century.

If you consequently invest in new technologies, maintain social stability and won't have selfish neighbours, ignoring pollution and GHG emissions, your success may be spectacular.

At this stage you also have to take into account the consequences of widespread proliferation of advanced nuclear and biotechnologies. When every smart handyman knows, how to create an insidious virus, things may get quite 'interesting'. Even if you have introduced the highest security measures, even banning some research, when the virus is created in some other region, you will not avoid a disastrous plague.

To sum up, there are 3 key stages:

1. Getting out of poverty
2. The Golden Age of growth
3. Depletion of fossil fuels, environmental problems, new techno-threats

Possible strategies:

- **North Korea/Dark Ages.** Become a tyrant. Keep people poor and hungry. “Diffusion” of technologies from other regions may allow to improve the life of your people, eventually. Do not count on high score.

- **„Greenmen”**. After getting out of poverty, stop growing. Limit population. Change societal outlook to green, introduce Green Tax Reform, Green Industrial Reform. Invest heavily in food and energy efficiency. Society will be moderately content, growth very slow (though safe and stable), similarly technological progress. If other regions won't grow at breakneck speed, powering themselves with fossil fuels and spreading pollution, things will go OK, though your score will not be a record one.
- **World of GDP Growth**. Grow as fast as possible, maximizing GDP, provide well being on a minimal (but due to high GDP still quite high) level, sideline long-term actions. If you can avoid traps such as runaway debt explosion, the score until early XXIst century may be very good. But then... you will have a crude awakening... and this will hurt – possibly not only us, not only humans, but most other species as well.
- **Western World**. Grow quickly and invest a lot in the quality of life. In XXth century base your energy system on fossil fuels, but develop the alternatives, improve the efficiency and reduce pollution. This is a tricky path, somewhere in between “The Greenmen” and “The World of GDP Growth”. On one hand, if well balanced, it can give the best score, but on the other hand it is like walking on the razor blade – be careful not to overshoot and fall from the cliff of the failed growth.

You are in charge of the civilization. Good luck!