BEYOND HUMAN, TECHNICAL AND FINANCIAL FEASIBILITY, "MASS-PRODUCTION" CONSTRAINTS OF A COLONY PROJECT SURGE.

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SpaceX achievements and announcements push the prospect of a Martian colony more and more frequently under the spotlights. But proponents of this concept should acknowledge that mastering the technical means (including a low-cost interplanetary transportation system) and the behavioral and sociological unknowns does not address the whole story. Even within the limited scope of building a first operational colony of 1000 residents in 20 years - probably a minimal objective to attract investors - at least three major challenges emerge, which result from the mere volume of facilities to set up.

The most prominent is the problem of energy production, because the extraction and processing of in situ resources need much power. And furthermore, if BFR-like interplanetary shuttles are used, refueling alone will necessitate up to 0.5 MW of mean electrical power per ship! While nuclear generators look fit for a temporary exploration mission (about 50 kW), it becomes more difficult to satisfy needs for power levels in the MWs range. The reason is not the reactor itself, but the size of the cold source. Photovoltaics look simpler to implement, but with an order of magnitude of 50 W/m² of mean annual power, fields of several hectares (10 000 m²) are to be considered. The power in W/kg is a decisive parameter, but also the easiness of deployment and cleaning, as well as cells life duration.

Another dimensioning domain is the in-situ production of food, based mainly on cultivation inside greenhouses. If we admit that 60 m² of cultivated surface is required by person, for 1000 residents, the surface of the greenhouses themselves should be in the range of 10 hectares (100000 m²). That's a lot. The actual scale depends on the chosen technologies, namely: natural vs artificial light (requiring tens of MW of electrical power), and plain soil vs hydroponic cultivation. The chosen atmospheric pressure is also a determining parameter for the total mass of the greenhouses.

The habitats constitute the third category of facilities which should be set up on a large scale. Our "realistic" hypothesis of a 1000 residents size in 20 years implies to add, as a mean value, an individual lodging capacity per week. The problem is even more demanding if the offer of residency services (for wealthy tourists and scientists) is the only scenario that we have for a financially plausible project. Because tourists would not like to spend their 18 months stay underground; more sophisticated architectures will be needed. A variety of technologies had been surveyed: tunnels, brick masonry, glass panels, inflatables, 3D printing… But their value at this "industrial" scale, in terms of consumption of manpower, energy and imported materials, remains to be more precisely estimated.