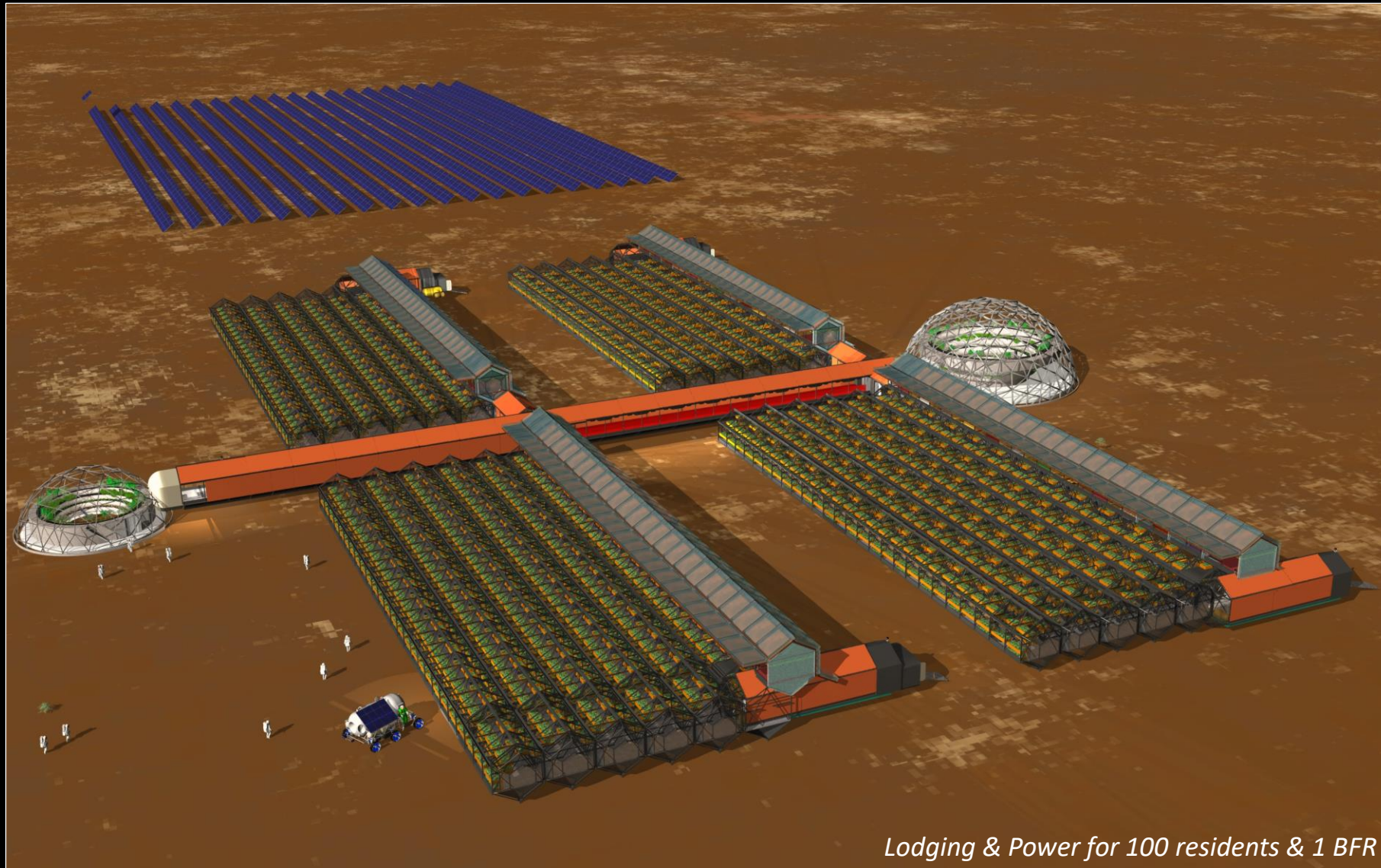


# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES



*Lodging & Power for 100 residents & 1 BFR*

*Doc. R.Heidmann/APM*



[www.planete-mars.com](http://www.planete-mars.com)

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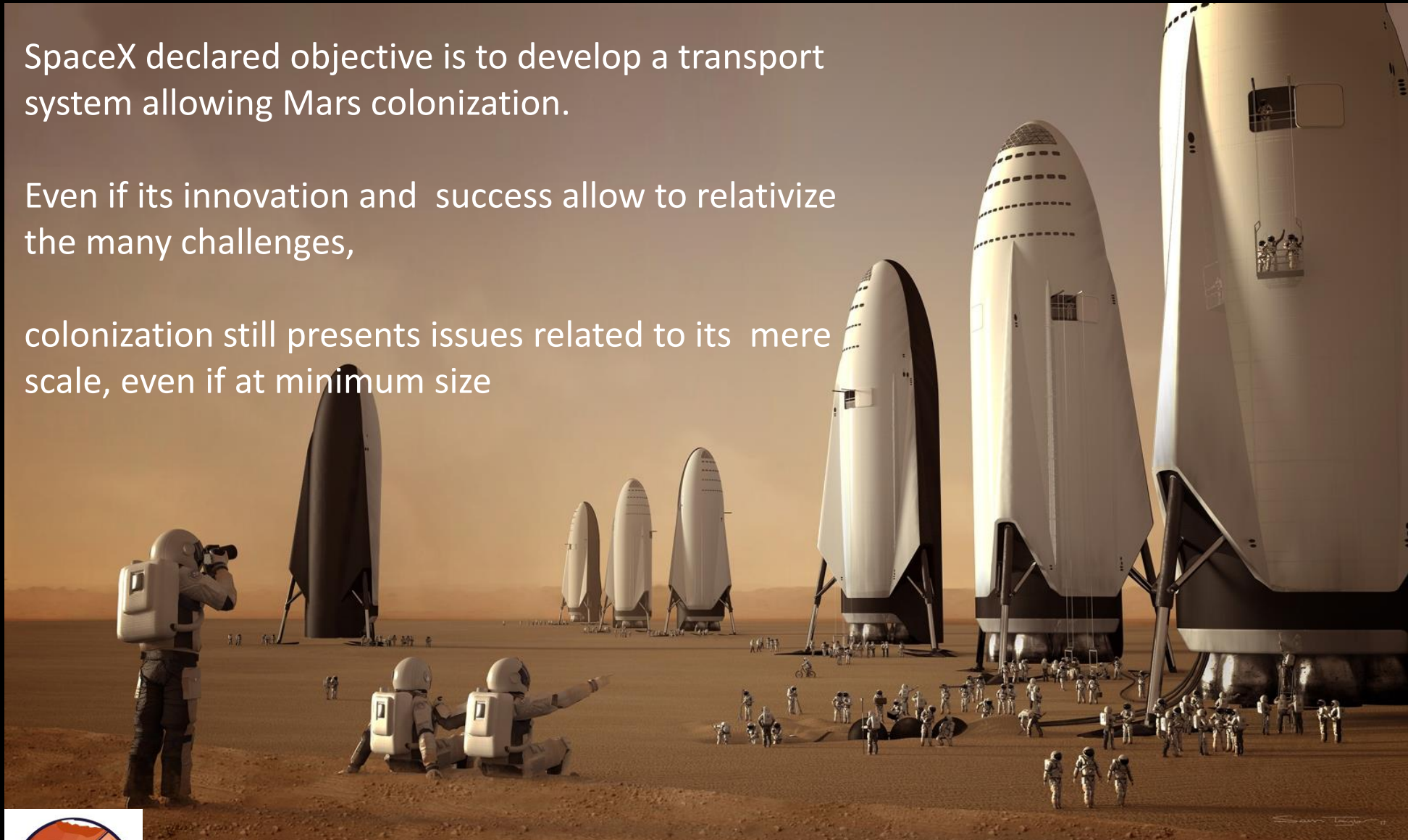
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# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

SpaceX declared objective is to develop a transport system allowing Mars colonization.

Even if its innovation and success allow to relativize the many challenges,

colonization still presents issues related to its mere scale, even if at minimum size



Doc. SpaceX





# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## A « REALISTIC » SCENARIO FOR A MINIMUM SCALE

Such a project needs investors,  
hence should be profitable (within ~ 20 years?)

Which business? Should be:

- Mars specific
- low mass transfer demanding
- able to attract a sizeable market

Found best fit: RESIDENCY SERVICES OFFER

An economic model\* (supposing success for the BFR  
and for creating a funding pool) led to:

- a minimum viable size of 1000 residents
- with 45% of (paying) customers
- built in 20 years



Doc. R.Heidmann/APM



*\*financial advisor: P. Brisson*

# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## A MINIMAL OBJECTIVE REQUIRING LARGE SCALE INFRASTRUCTURES

The 1000 residents size is considered minimal to obtain services completeness and productivity

20 years to completion considered a limit for investors

With that, this size is stressing the choices of technologies:

- food production

- habitation procurement

- energy production



# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## GIVING AN IDEA OF NEEDS AND GROWTH RATE

Food production: a demanding function:

- 1 kg dry matter/pers/day
- 100 m<sup>2</sup> cultivated terrain/pers
- manpower is the most scarce resource!

Habitats building: a truly industrial challenge:

- 100 supplemental people/26 months ⇔ 1/week

2 types:

- underground for long duration residents
- on surface, with controllable protection, for short duration residents

Energy production: the basic, universal need:

- initial power: 2 to 3 MWe
- growth: 3 to 5 MWe/synodic period
- nuclear or photovoltaic?



# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## FOOD PRODUCTION: AN EXTENSIVE ACTIVITY

Two determining options:

- natural (greenhouses) or artificial light
- breathable or growth-optimal atmosph.

Necessity of extensive robotisation:

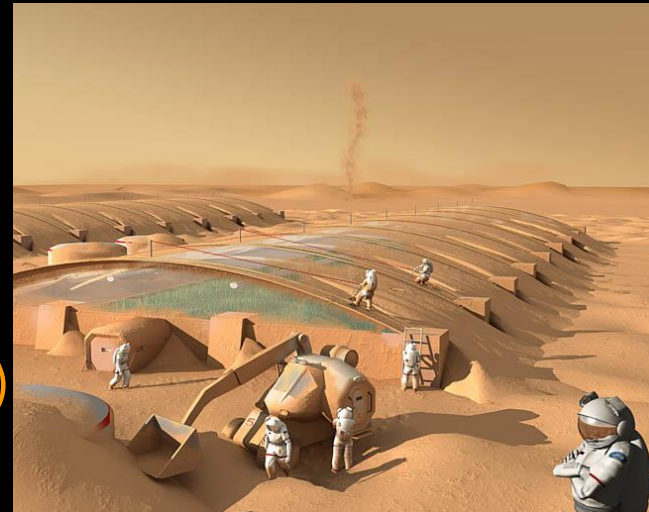
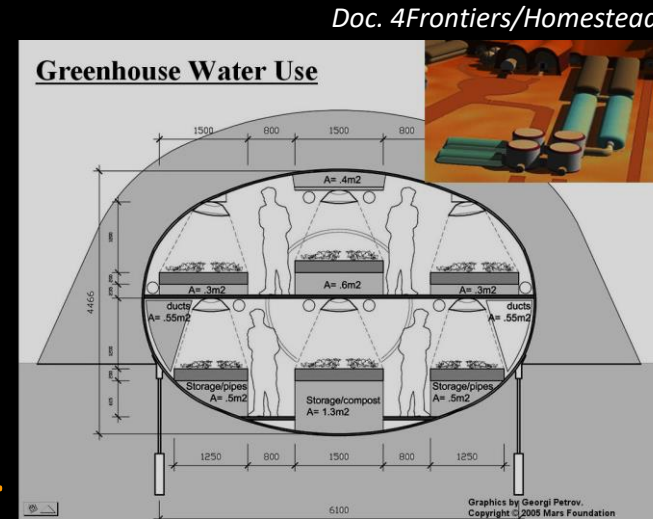
- manpower scarce and costly (*travel*)
- important surfaces (100 000 m<sup>2</sup>)
- need to monitor cultures
- cumbersome access if specific atmosph.

Crops processing and food preparation for 1000!

Waste processing, upstream and downstream

Supplemental resources management:

- imported goods (low weight, high value)
- pisciculture





# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## MASS PRODUCTION OF HABITATS

Need to deliver lodging for 1 person /week

Need to be attractive to tourists:

- non buried habs (rad exposure controlable)
- space tech look erased as possible

Besides, buried habs (with sparse windows) required for long-term residents; either:

- regolith covered modules
- bored tunnels
- natural caves (lava tubes)

Due to the production volume:

- maximize use of in situ materials
- minimize energy consumption
- minimize required manpower



# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## THE BASIC NEED: ENERGY PRODUCTION

Doc. NASA

Huge amounts of energy for:

- resources processing
- propellant production
- mining, drilling and soil moving
- life environment management
- greenhouses (if artificially lit: +50 Mwe!)

Nuclear fission generators (5 Mwe, +1/synodic period):

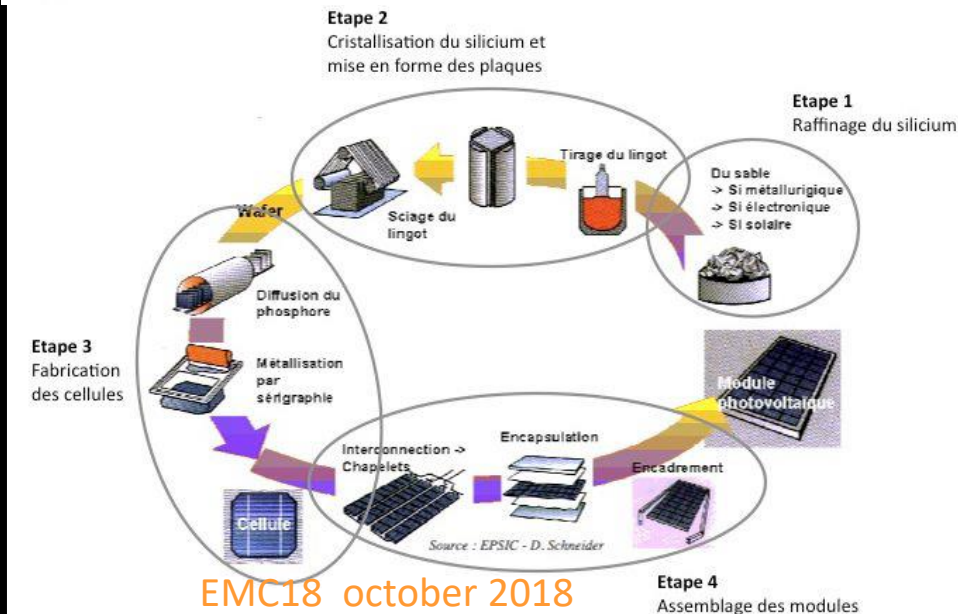
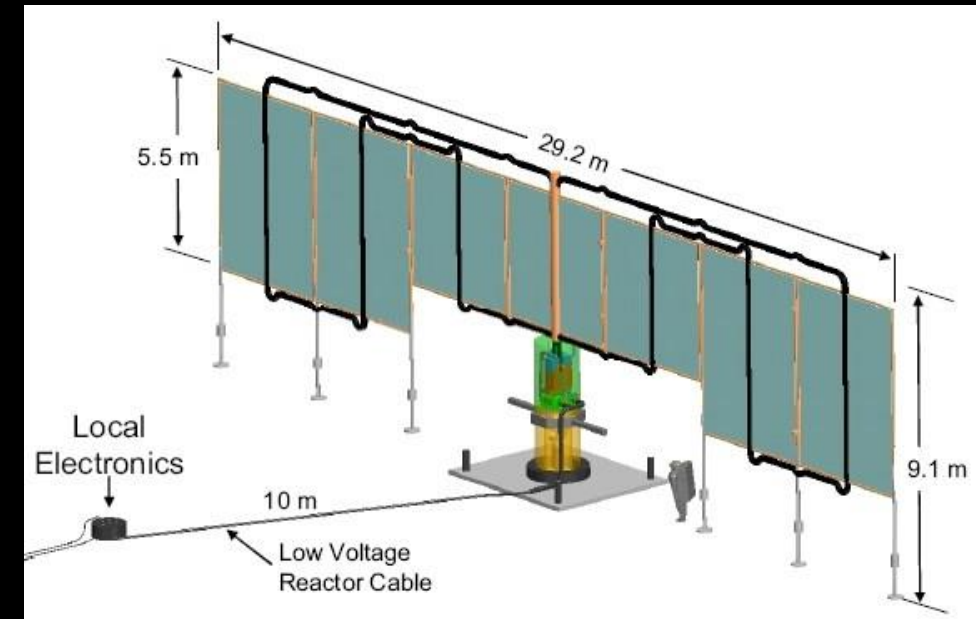
- should be politically accepted
- which cold source: radiator, underground?
- safety, maintainability, end of life
- cost?

Photovoltaic Panels:

- only 60 W/m<sup>2</sup> (mean value)
- life duration
- deployment, maintenance (dust)
- but promising progress (thin film, perovskite...)



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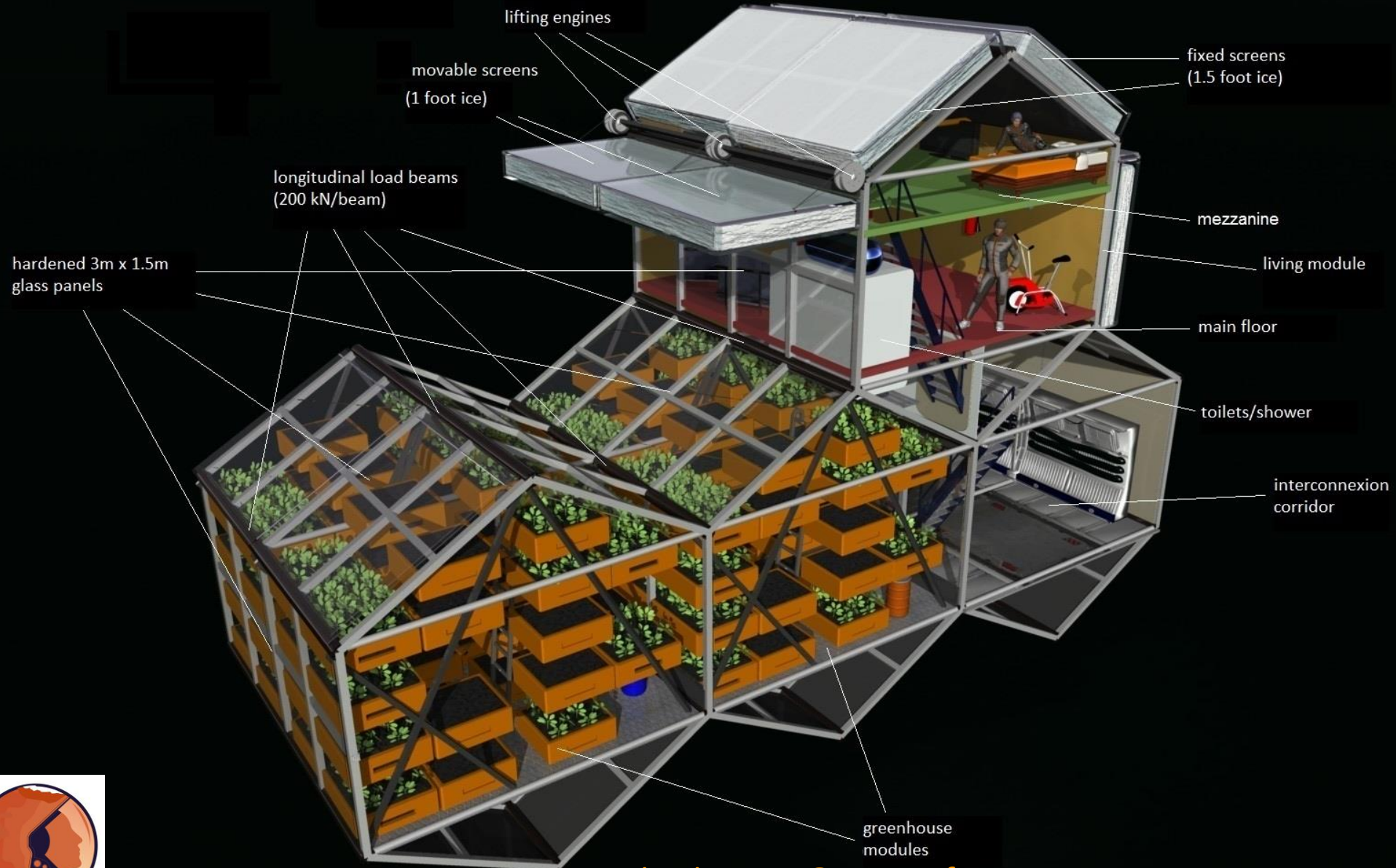


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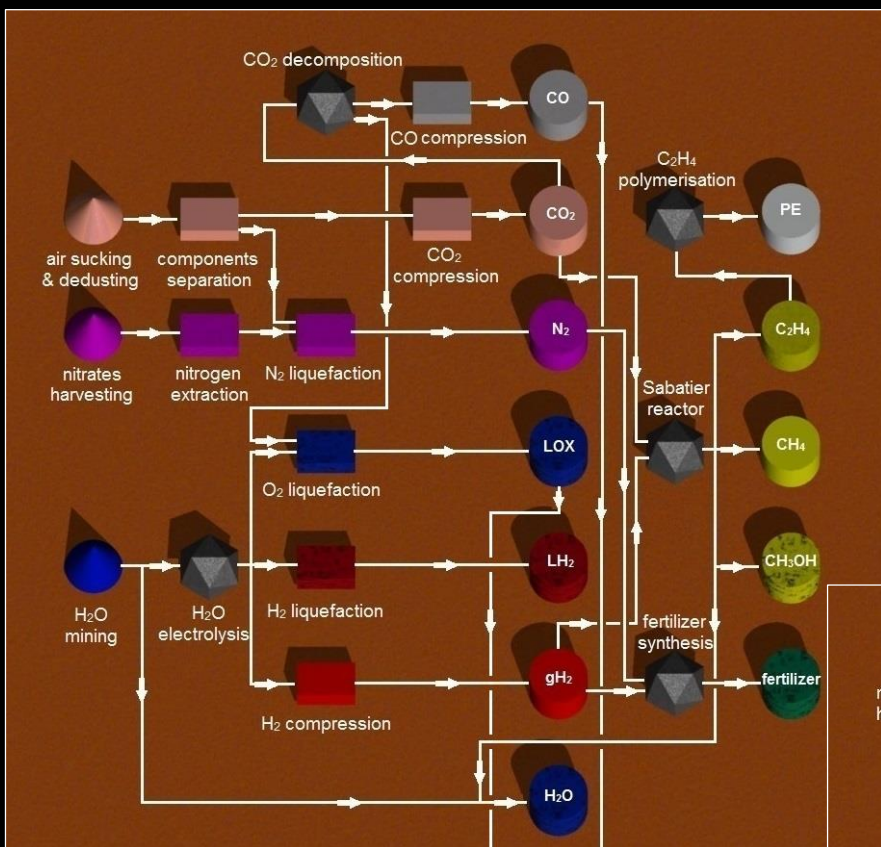


# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

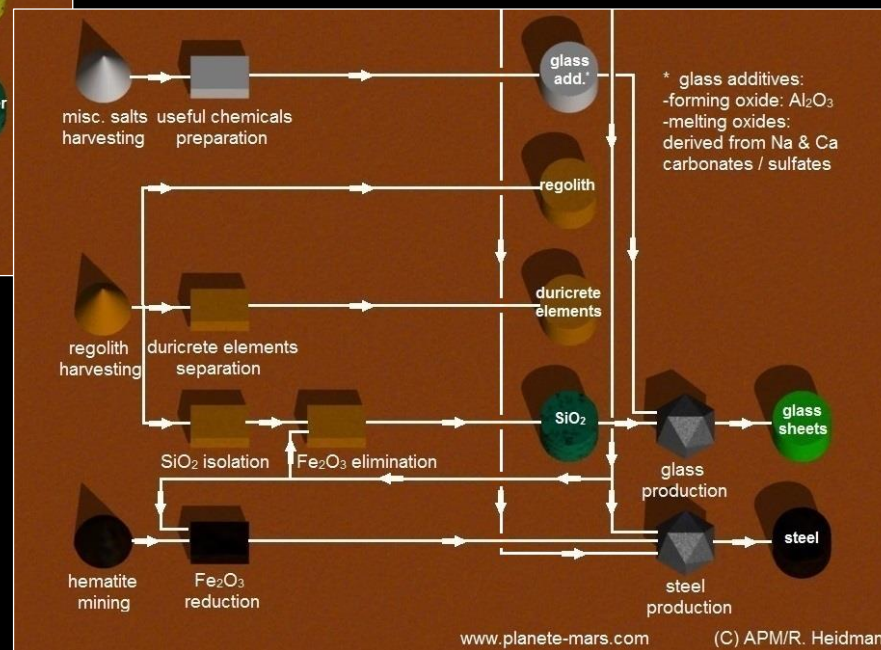
## MODULAR HAB DESIGN EXAMPLE (USING GLASS SHEETS)



# MARS RESOURCES POTENTIAL



Doc. R.Heidmann/APM



www.planete-mars.com (C) APM/R. Heidmann



# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## IN CONCLUSION

True, the Red planet possesses a large panel of resources

A first colony could be set up as the destination of choice for adventurous wealthy tourists, as well as for scientists

But to become a reality, this prospect must get:

- a BFR-class transportation system
- a pool of funding partners

Then, beside the development of the equipment, the size is stressing technologies and designs for:

- food production
- habitations procurement
- energy production





# A MARS COLONY: MAIN SIZE-RELATED CHALLENGES

## QUESTIONS?

