

### Unique Selling Points (USPs) ASTREA Photobioreactors

- ✓ completely closed photobioreactor system
- ✓ reproducible biomass qualities and productivities
- ✓ simple culture and plant up-scaling into industrial scale
- ✓ industrial production with high biomass concentration (... 5 g\*L<sup>-1</sup>)
- ✓ variable flow speed in the glass tubes in the range of 0.30 ... 0.80 m\*s<sup>-1</sup>
- ✓ fluctuations of flow in the glass tubes < 10%, even at minimal throughput
- ✓ homogenous distribution of suspension (... 32 modules/... 2x24 tubes in the module = ... 1,536 glass tubes per reactor)
- ✓ system design with minimal pressure difference (max. 80 kPa)
- ✓ scale up functionality of the overall system (4, 8, 12, 16, 20, 24, 28 and 32 module operation)
- ✓ low energy consumption (on average ~ 85 ... 130 W\*m<sup>-3</sup>)
- ✓ photosynthetic optimization of the growth processes in the glass tubes by light-guided pump speed control
- ✓ service performance (> 15 years) without signs of aging/performance drop
- ✓ vertically adjustable glass tube arrangements
- ✓ CAD guided plant engineering for system solutions up to 200 m<sup>3</sup>
- ✓ innovative control system (intuitive control) with climate control and light-guided system control for yield maximization
- ✓ innovative day and night control of electric pump performance for energy saving
- ✓ minimal biomass immobilization
- ✓ long cultural duration (> 10 months)
- ✓ test culturing in company-owned industrial plants up to 45,000 L single reactor volume
- ✓ turnkey system solutions (greenhouse, reactor and harvesting devices)