Rural Electrification with Solar Home Systems
Experiences from Brazil

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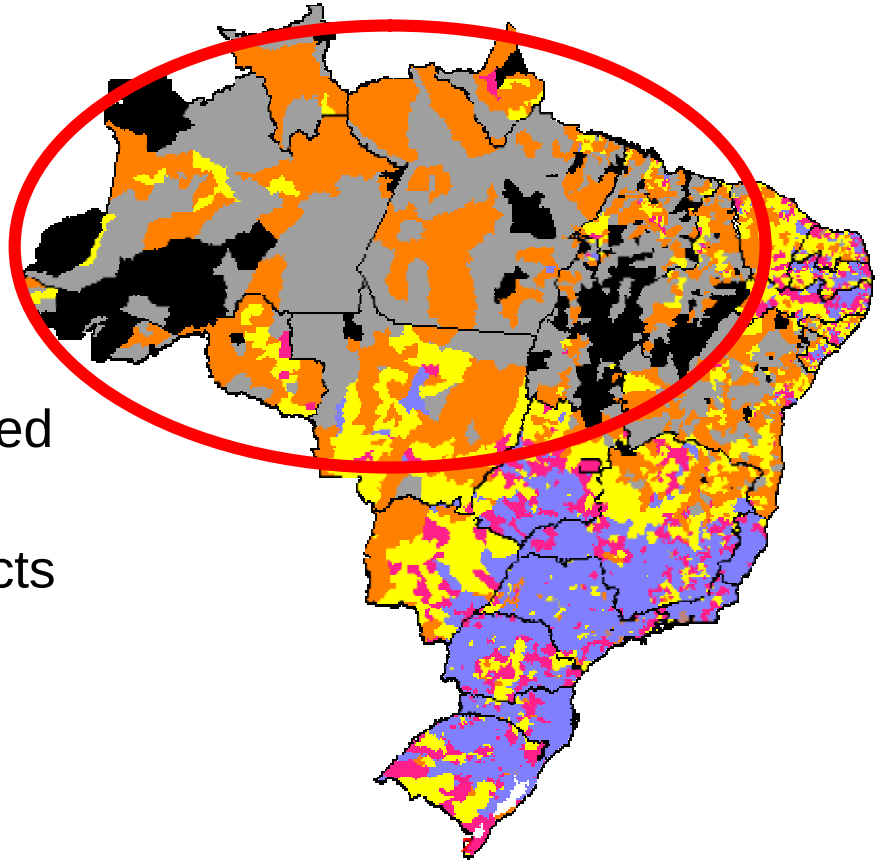
Context

- 100 GW grid based generation
- Electrification rate 98,5% (2000)
- *Luz Para Todos* (End of 2008)
  1,9 Mio. households newly electrified
  1,1 Mio. households still left
- Off-grid electrification in pilot projects
- Challenges are in northern Brazil
  - Low rate of electrification
  - Huge distances
  - Extremely difficult access
  - Extremely low grid availability

→ Project Eletrobrás – GTZ

  - Development & Testing of an off-grid electrification model with PV



Rate of electrification in rural regions

Basic conditions

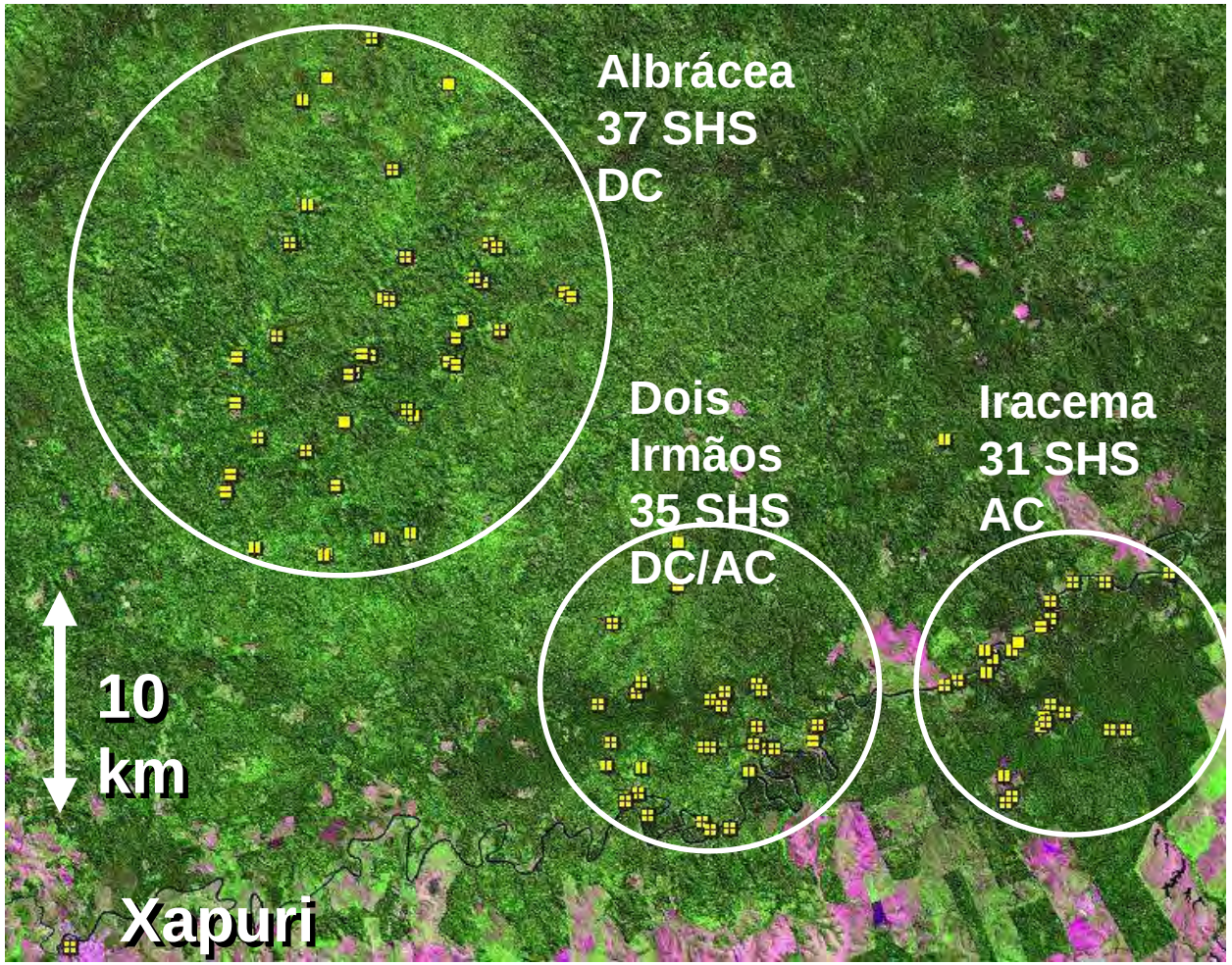
- According to energy law: Utilities are obliged to supply every household in their concession area with energy
- *Luz para Todos*: Grant finance for up to 90 % of the investment
- Regulation: Definition of Solar Home Systems (SHS) sizes according to monthly energy delivery and maximum power

Energy Service Class	Daily consumption [Wh/d]	Guarantied monthly energy availability [kWh/Month]	Autonomy [d]	Minimal inverter capacity [W]
SIGFI 13	435	13	2	250
SIGFI 30	1000	30	2	500
SIGFI 45	1500	45	2	700
SIGFI 60	2000	60	2	1000
SIGFI 80	2650	80	2	1250

Minimal system availability	Per month	Per year
	70%	93%

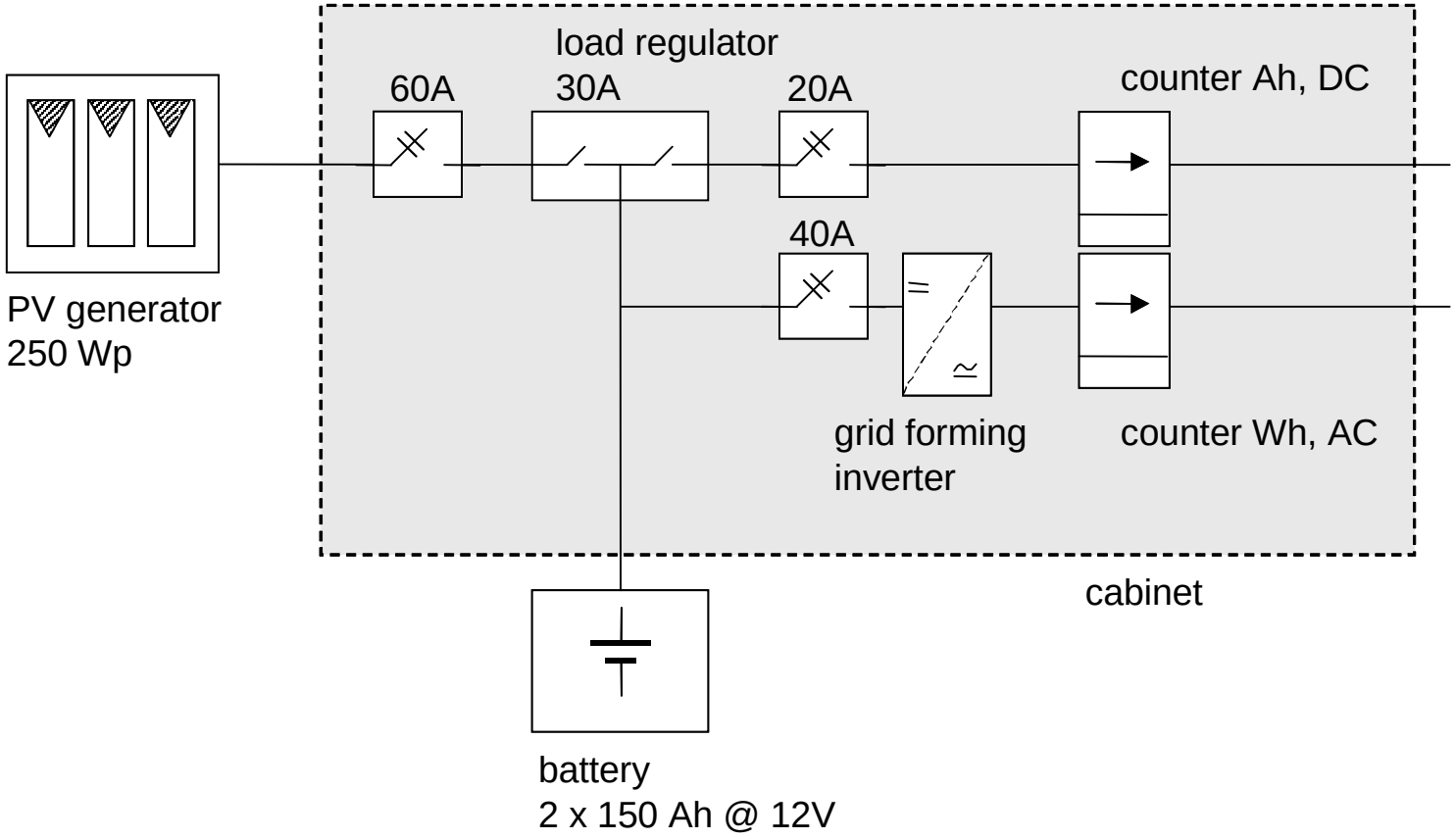
Basic data of the pilot project

- 100 SHS on 500 km² rainforest / nature reserve



- Challenging logistics
- On average 2 – 3 hours walking distance from one SHS to the other

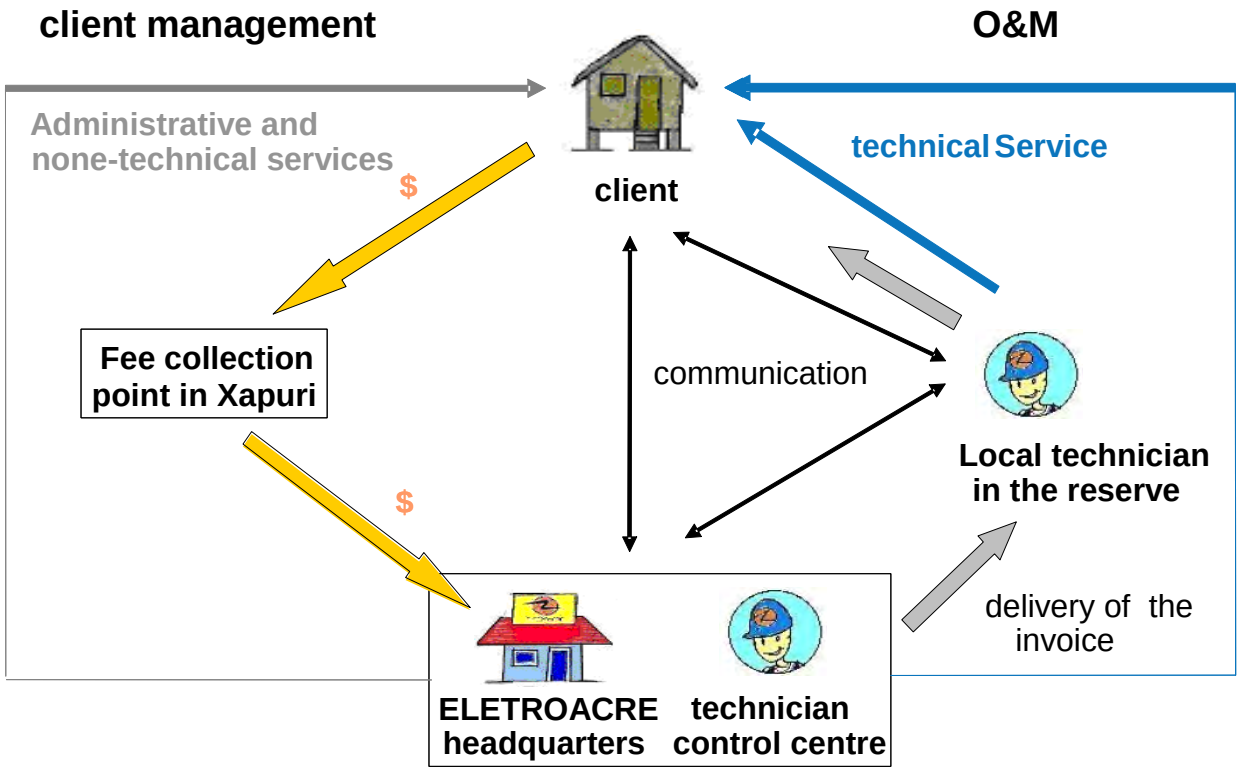
- 100 SHS
- Different system typed compared: AC, DC and DC+AC



- Examples of installed systems in Xapuri - O Globo newspaper

Service and maintenance model

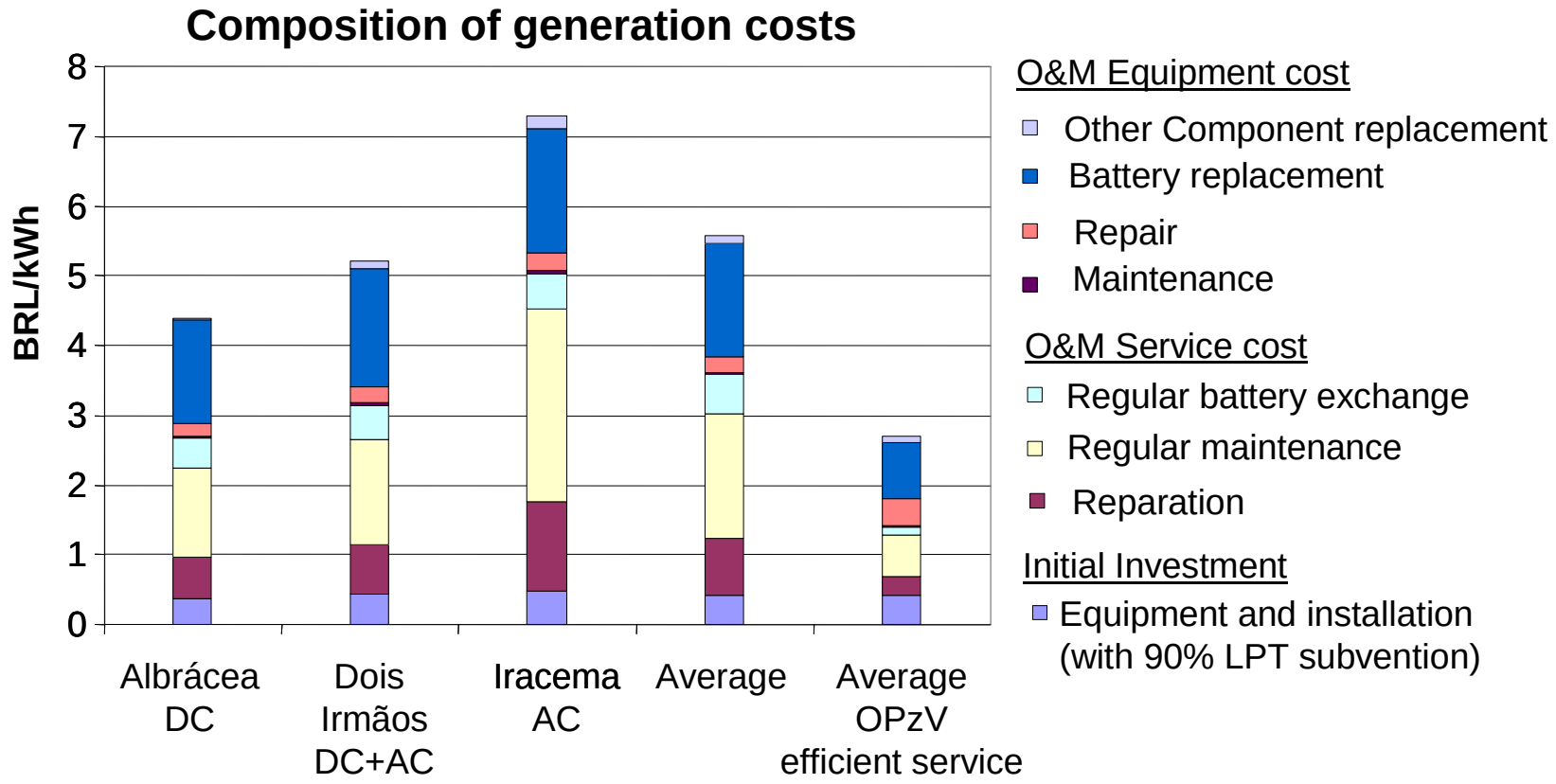
- Fee-for-service model: Utility to deliver electricity in same way as for on-grid customer



- Challenges
  - Transfer of responsibility to local technicians (residents)
  - Utility has lack of experience to operate “in the bush”
  - Institutional reservations against decentralized structures
  - Inadequate procedural requirements from corporate QM

Cost structure

- O&M service cost dominate
- Battery replacement dominates O&M Equipment cost
  → Savings potential OPzV / deep cycle battery and service structure



Tariff Regulation: Revenues versus Cost

- Monthly full costs for the system:
  72 BRL (30 EUR/month)
- Optimized (improved battery & efficient service structure):
  35 BRL (15 EUR/month)

- Monthly fixed capacity charge:
  3 BRL (1 EUR)
- By regulator accepted monthly costs:
  12 BRL (5 EUR)

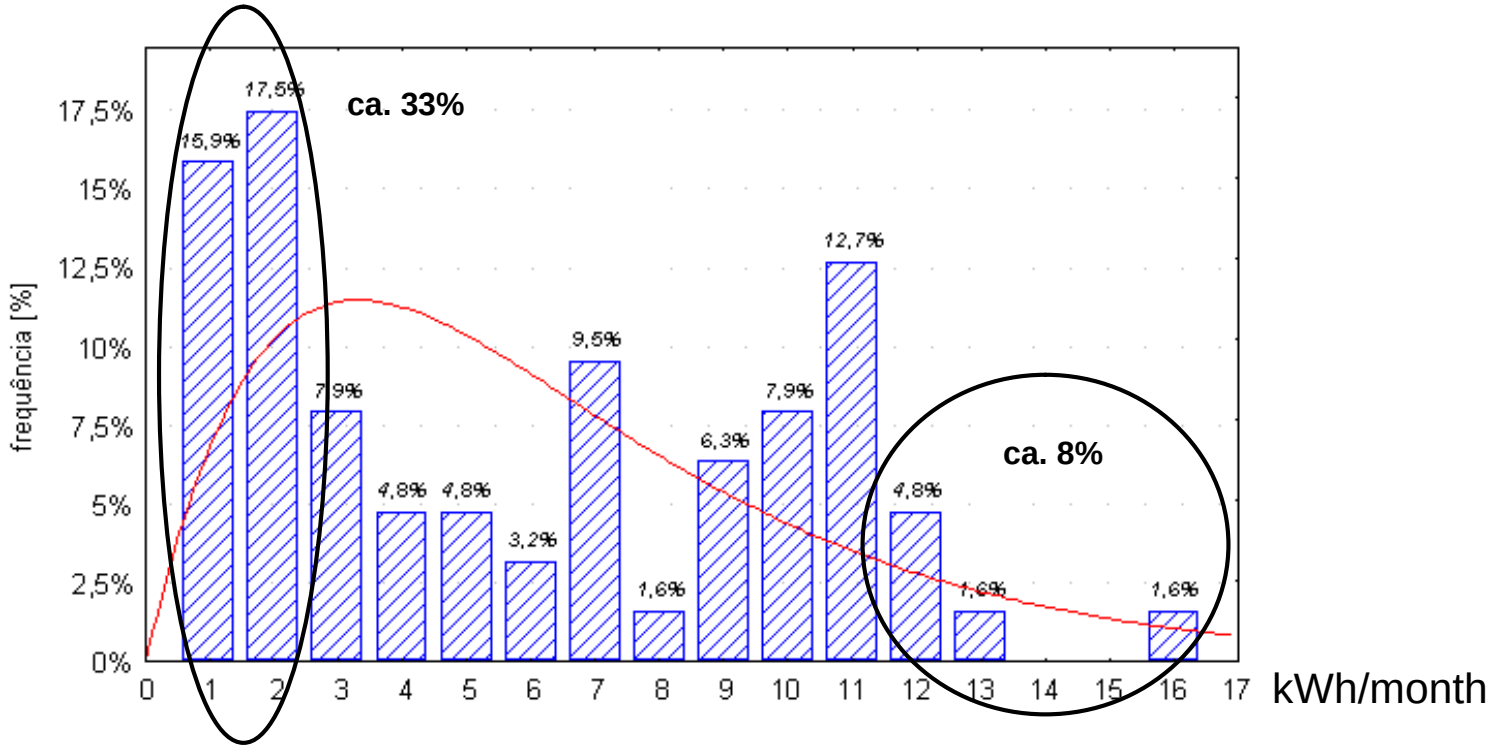
- Deficit of 9 EUR (optimal case) to 24 EUR per month and System

→ Electrification of remote rural areas with SHS financially extremely unattractive

- Connection to the grid even less attractive

→ Utilities avoid to supply off-grid areas

Utilization of the energy provided (after 18 month)



- Only 8% use the full capacity of the SHS
- 60% of the user use less than half of the energy provided
- 33% own no electrical appliance besides the lamps received

→ System for 90% of consumers oversized

Conclusions

- Impact
  - Consumers are extremely happy with access to electricity
  - Most important is entertainment (TV), communication (cell phone) & light
- Technology
  - SHS is reliable, adequate batteries to be identified in Brazil (or imported)
- Service and maintenance model
  - Service has to be completely decentralized based on trained local people
  - Business partnership between utility and local service entrepreneurs
- Regulatory framework
  - SHS business highly unprofitable → Utilities avoid off-grid
  - “cost plus” tariff to be established
  - Smaller system classes to be introduced & modularization of classes
  - AC in small SHS extremely costly: low efficiency, high failure rate
  - Performance indicators (energy, availability) defined but not yet monitored

Thanks for your attention!

Many thanks to all partners of the project:

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