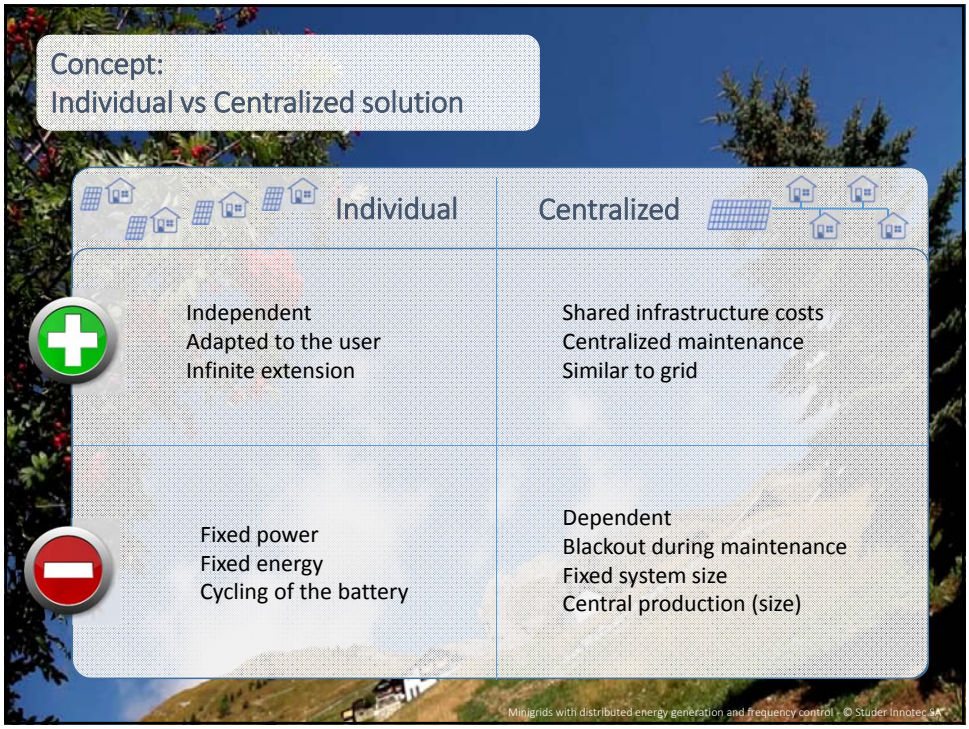
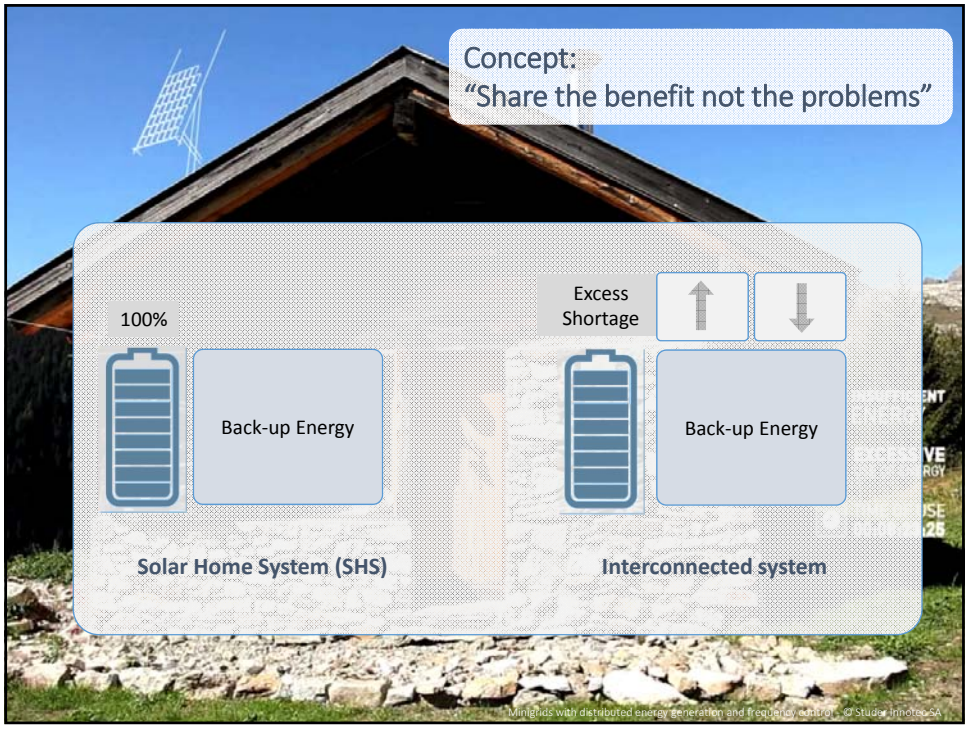
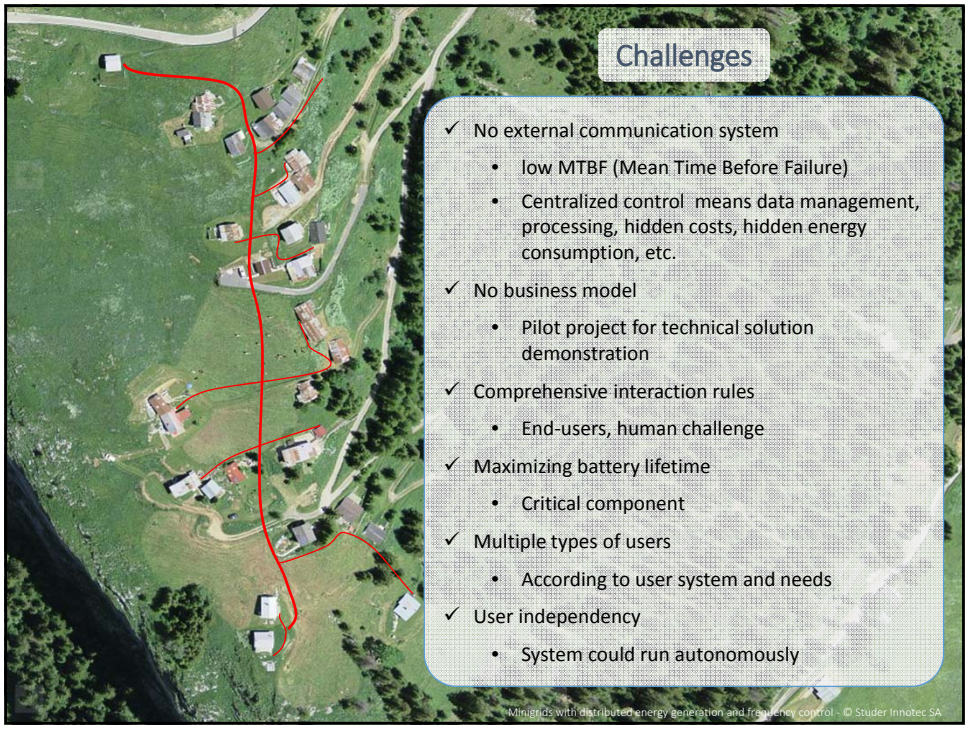
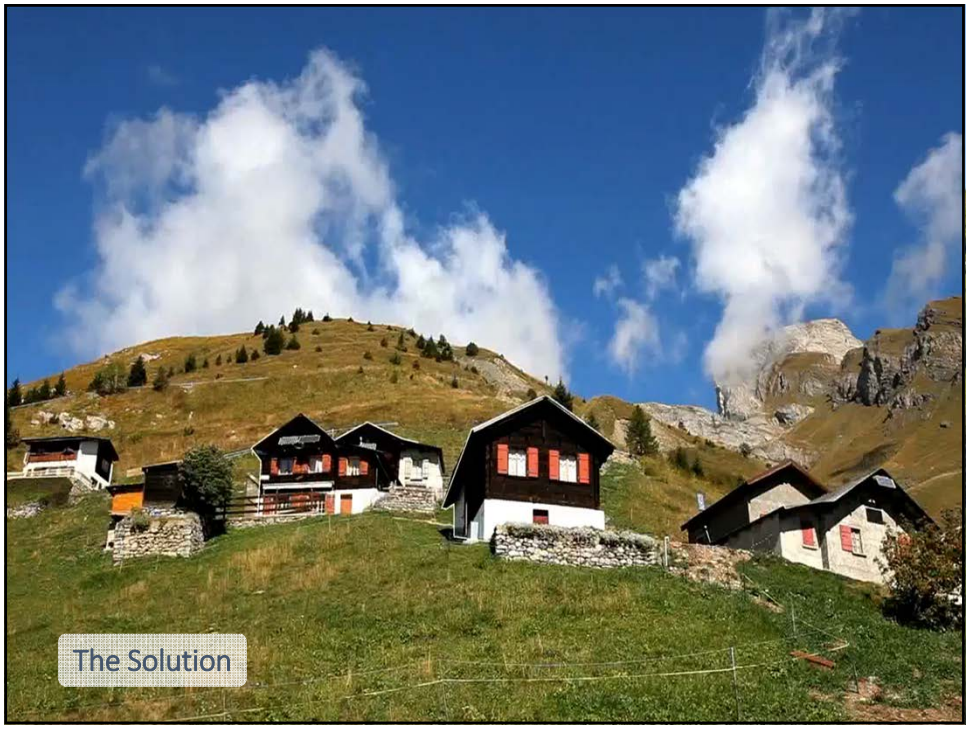

Minigrid with distributed energy generation and frequency control
Six years of operational experience of a pilot project in Switzerland
STUDER
Nicolas Zuchuat, Pablo Muñoz
Studer Innotec SA
ID-86
3rd International Hybrid Power Systems Workshop
8 - 9 May 2018
Tenerife, Spain

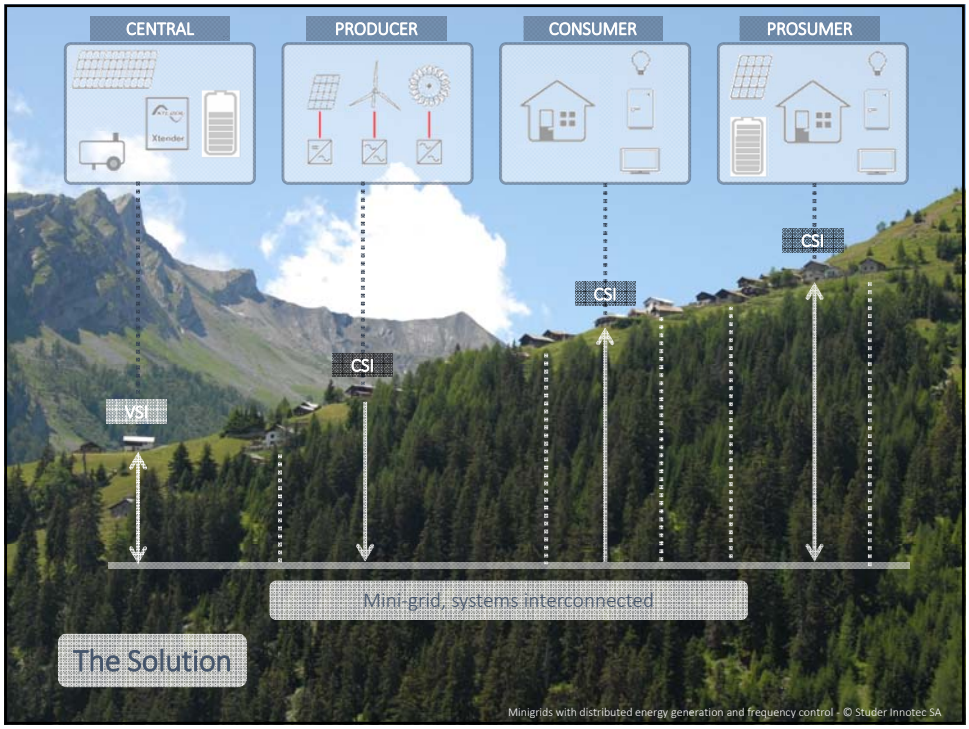

• In the heart of the Alps (1700m)
• 32 individual buildings
• Previously equipped with SHS
• Occupied during summer
• Road access closed during winter
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA

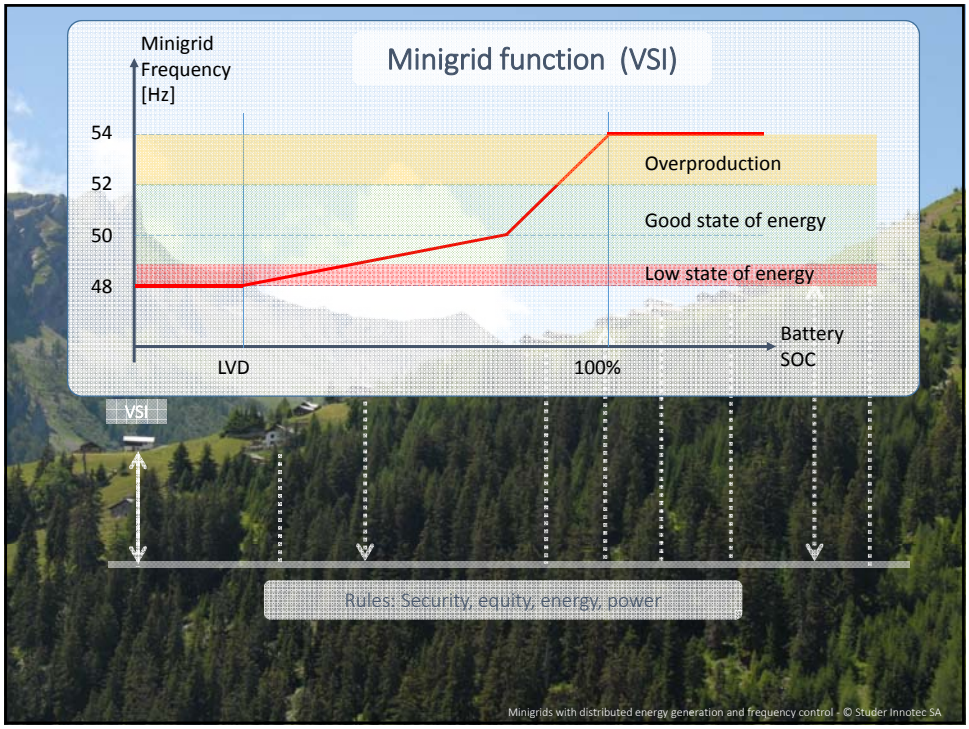

Concept:
Individual vs Centralized solution
Individual
Centralized
Independent
Adapted to the user
Infinite extension
Shared infrastructure costs
Centralized maintenance
Similar to grid
Fixed power
Fixed energy
Cycling of the battery
Dependent
Blackout during maintenance
Fixed system size
Central production (size)
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA

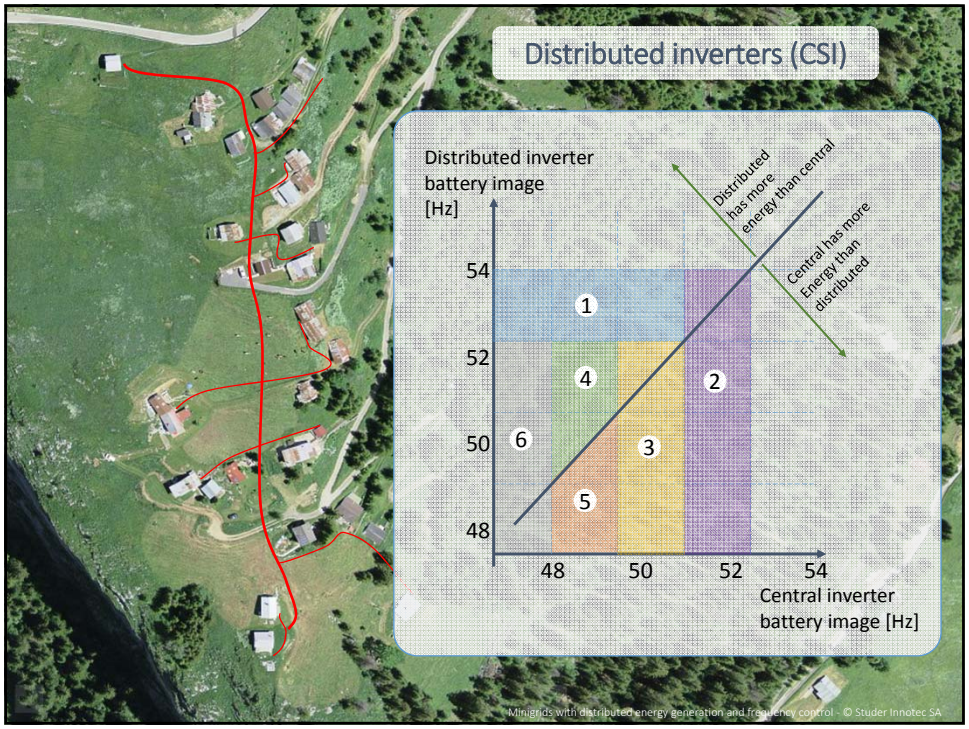

Concept:
"Share the benefit not the problems"
100%
Back-up Energy
Solar Home System (SHS)
Excess
Shortage
Back-up Energy
Interconnected system
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


Challenges
✓ No external communication system
• low MTBF (Mean Time Before Failure)
• Centralized control means data management, processing, hidden costs, hidden energy consumption, etc.
✓ No business model
• Pilot project for technical solution demonstration
✓ Comprehensive interaction rules
• End-users, human challenge
✓ Maximizing battery lifetime
• Critical component
✓ Multiple types of users
• According to user system and needs
✓ User independency
• System could run autonomously
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA

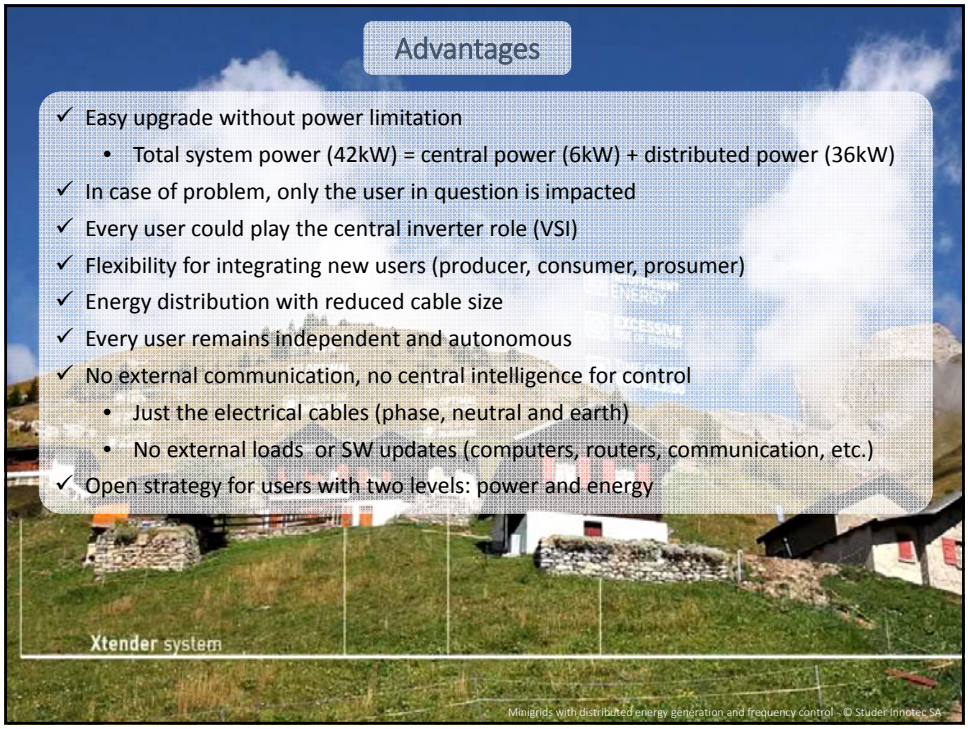

The Solution


CENTRAL
PRODUCER
CONSUMER
PROSUMER
Xtender
VSI
CSI
CSI
CSI
Mini-grid, systems interconnected
The Solution
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


Minigrid function (VSI)
Minigrid Frequency [Hz]
54
52
50
48
Overproduction
Good state of energy
Low state of energy
LVD
100%
Battery SOC
VSI
Rules: Security, equity, energy, power
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


Distributed inverters (CSI)
Distributed inverter battery image [Hz]
Distributed has more energy than central
Central has more Energy than distributed
54
52
50
48
1
2
3
4
5
6
48
50
52
54
Central inverter battery image [Hz]
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


Lessons learned
Mini-grid operating successfully since 2011
✓ Upgrade in energy quotas and power limitation
✓ Use of generator dramatically reduced
✓ No more deep discharge in winter
✓ Increased sense of community
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


Advantages
✓ Easy upgrade without power limitation
• Total system power (42kW) = central power (6kW) + distributed power (36kW)
✓ In case of problem, only the user in question is impacted
✓ Every user could play the central inverter role (VSI)
✓ Flexibility for integrating new users (producer, consumer, prosumer)
✓ Energy distribution with reduced cable size
✓ Every user remains independent and autonomous
✓ No external communication, no central intelligence for control
• Just the electrical cables (phase, neutral and earth)
• No external loads or SW updates (computers, routers, communication, etc.)
✓ Open strategy for users with two levels: power and energy
Xtender system
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


Perspectives
SUFFICIENT ENERGY
OPTIMAL USE OF ENERGY
TIME OF USE 00:08:30:13
ENERGY STORED IN 100%
OPTIMAL USE OF ENERGY
• Business model
• Lithium Battery
• Compatibility
  • Grid-tied inverter
  • Wind/hydro
• Smart meters
• Load management (deferrable loads)
Minigrids with distributed energy generation and frequency control - © Studer Innotec SA


STUDER
Thank you for your attention
Minigrid with distributed energy generation and frequency control
Six years of operational experience of a pilot project in Switzerland
Nicolas Zuchuat, Pablo Muñoz
Studer Innotec SA
ID-86
3rd International Hybrid Power Systems Workshop
8 - 9 May 2018
Tenerife, Spain