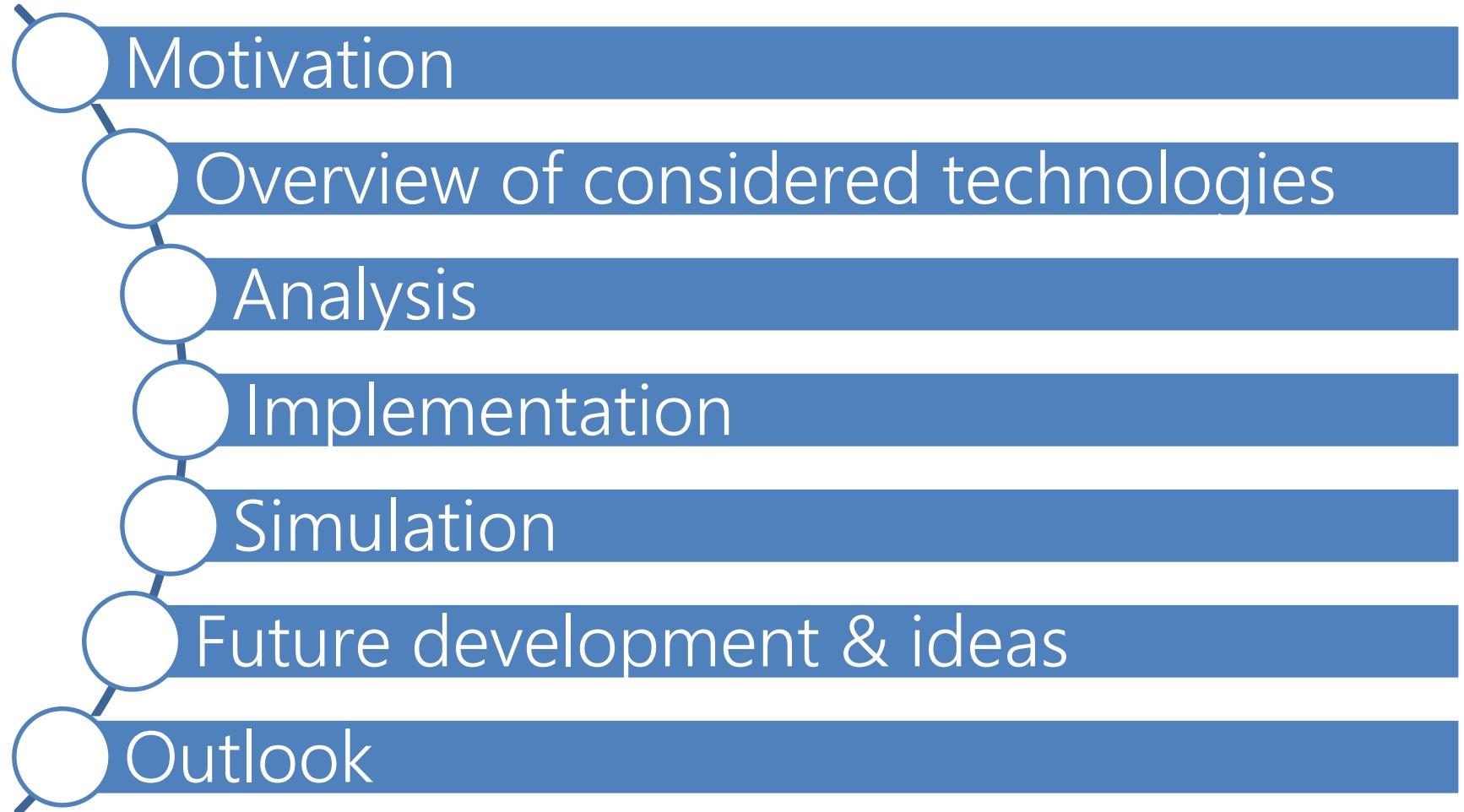


Smart Grid Controller Blockchain Platform For Virtual Power Plants with Hyperledger Fabric

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Table Of Contents



Motivation

- Challenges for energy system
 - Climate change
 - Renewable energy
- Emerging technologies
 - Internet-of-Things
 - Blockchain
- Raspberry Pi

Overview of considered technologies



ethereum



HYPERLEDGER
FABRIC



HYPERLEDGER
SAWTOOTH

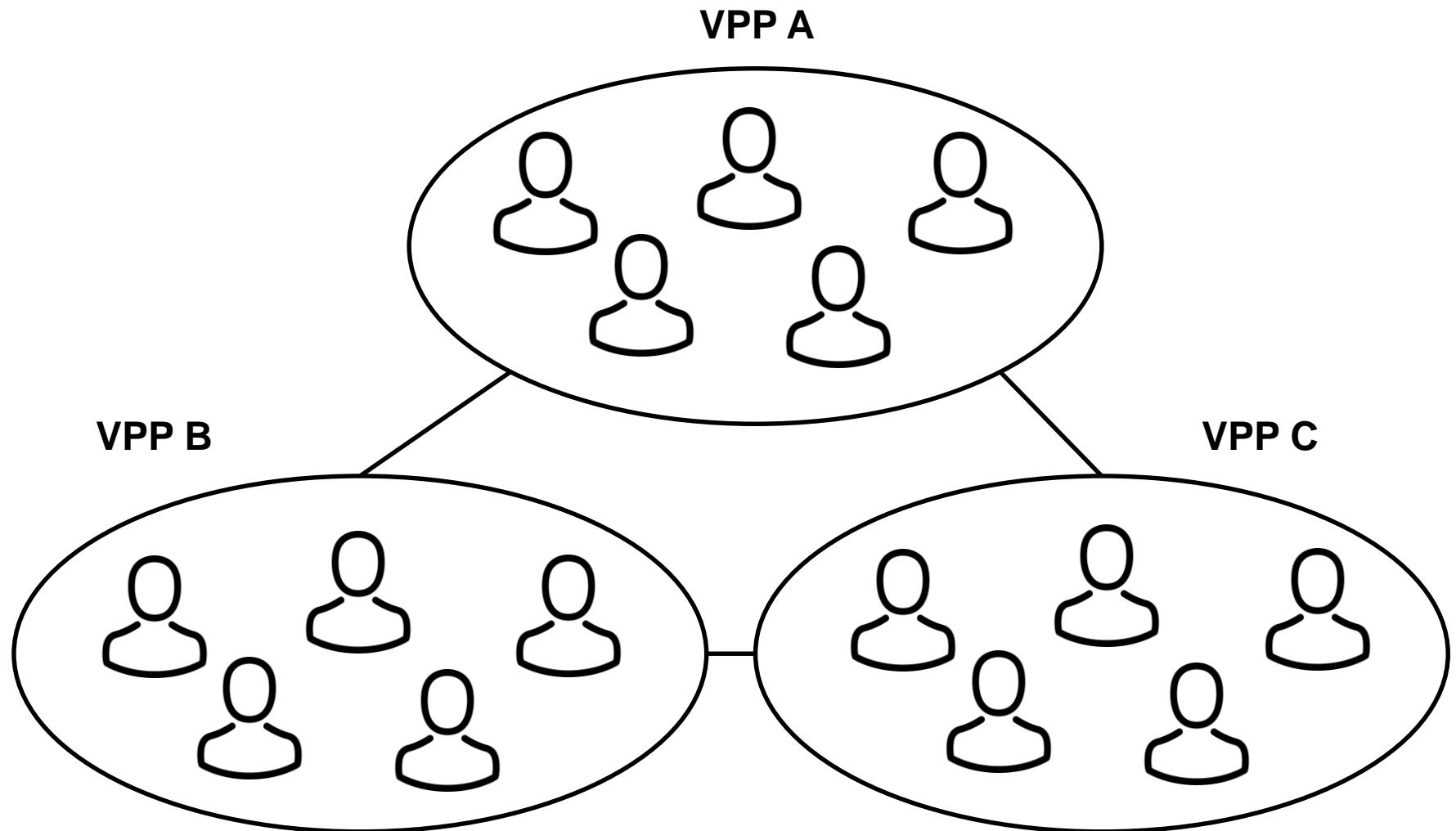


Quorum

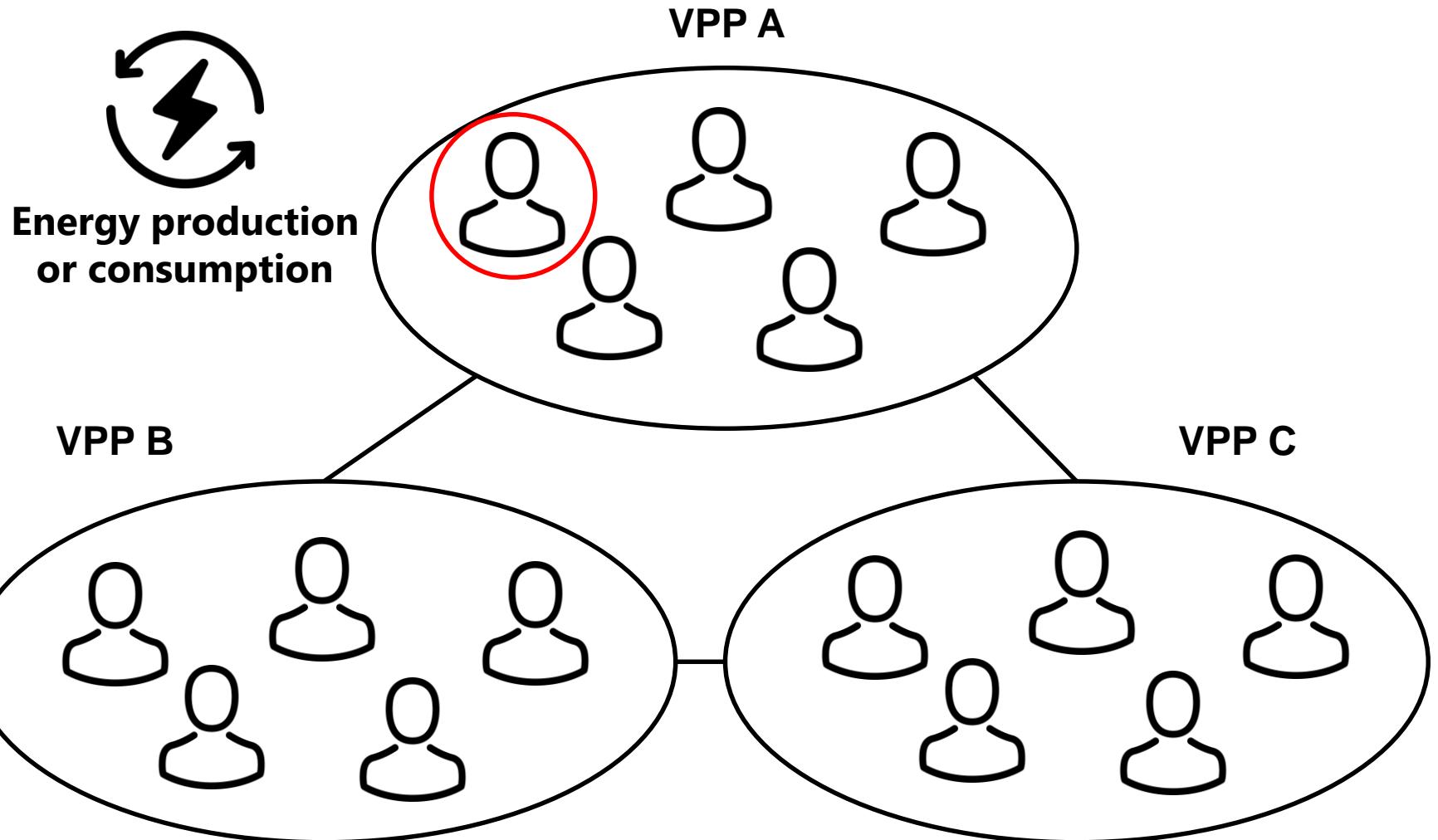


- Light energy footprint
- Modular
- Permissioned
- Privacy mechanisms
- Roadmap
- Resource-aware
- Smart contracts

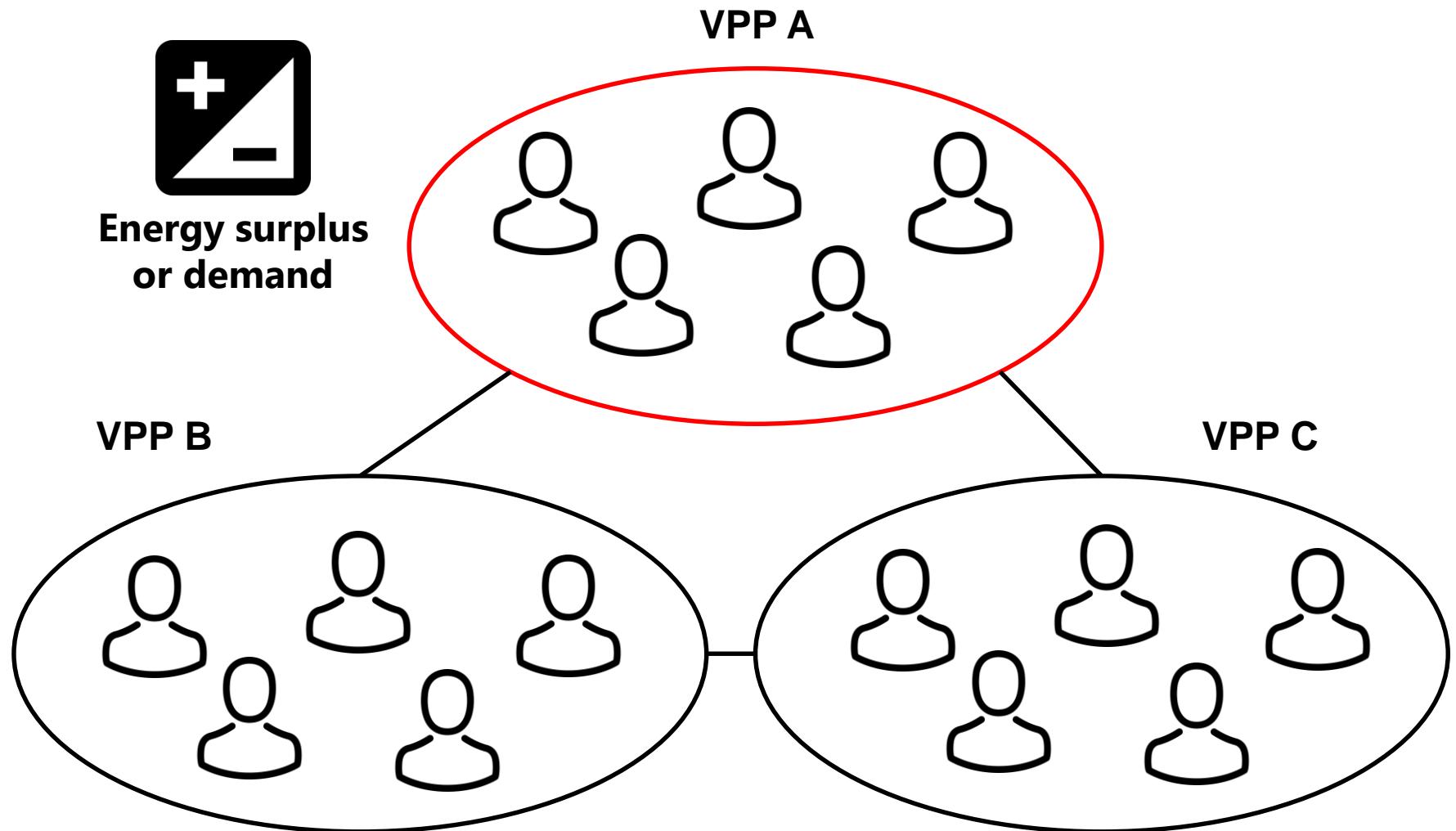
Analysis – VPP example



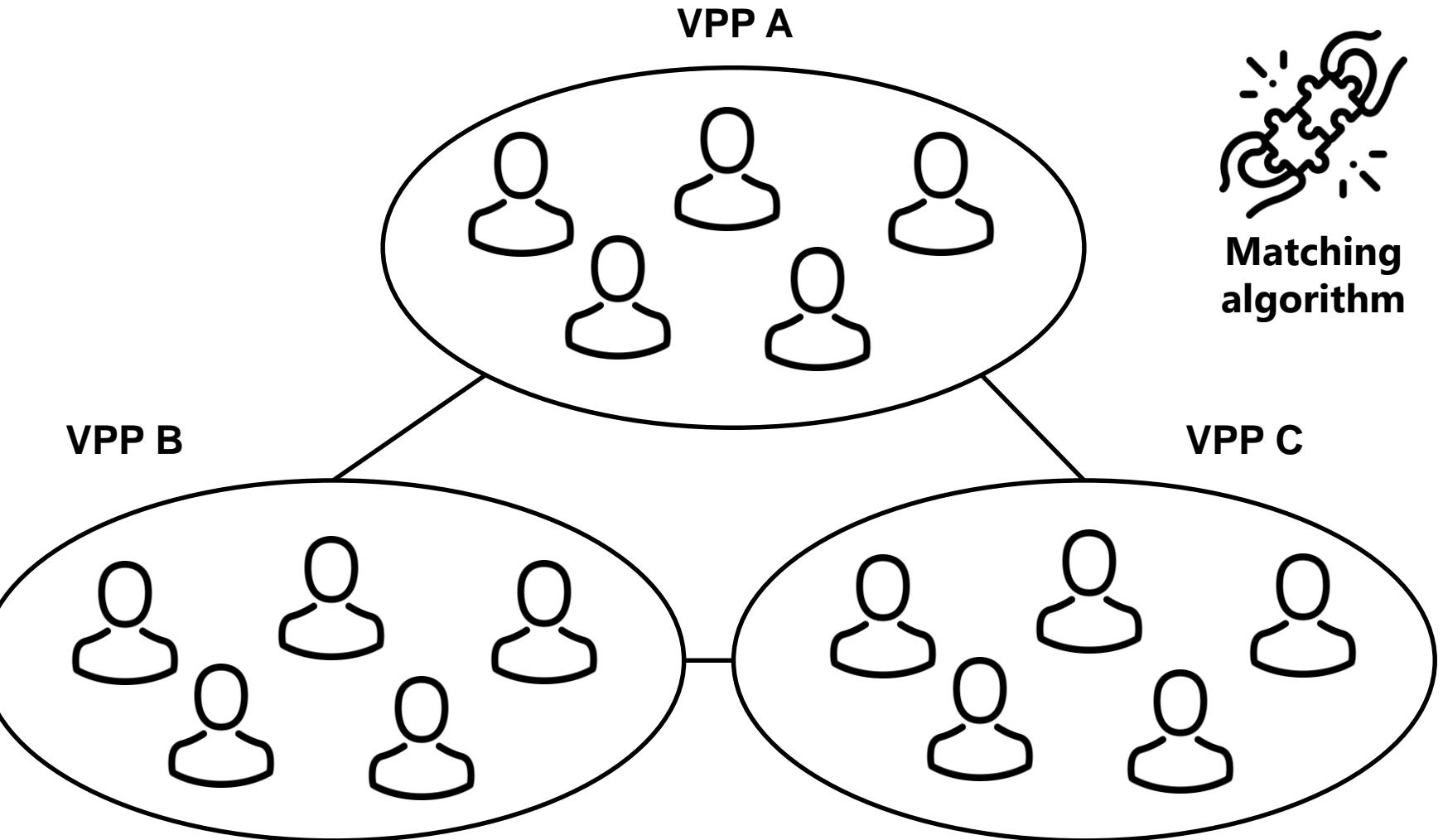
Analysis – VPP example



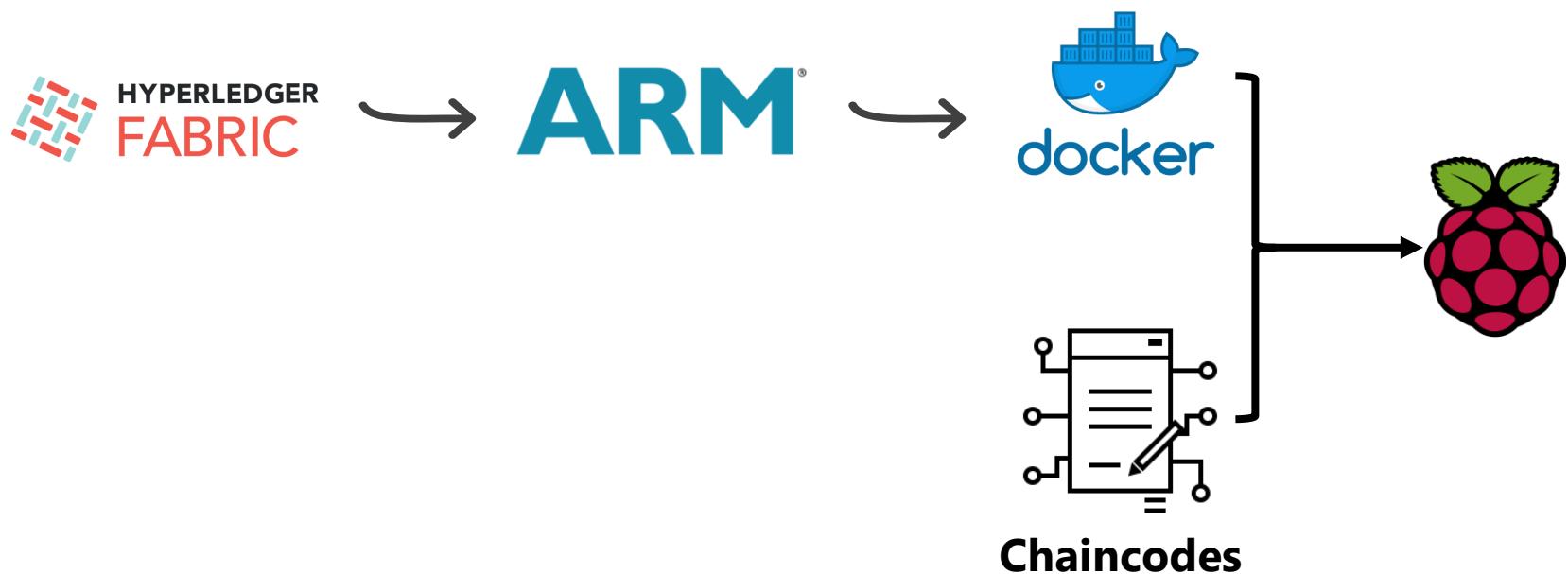
Analysis – VPP example



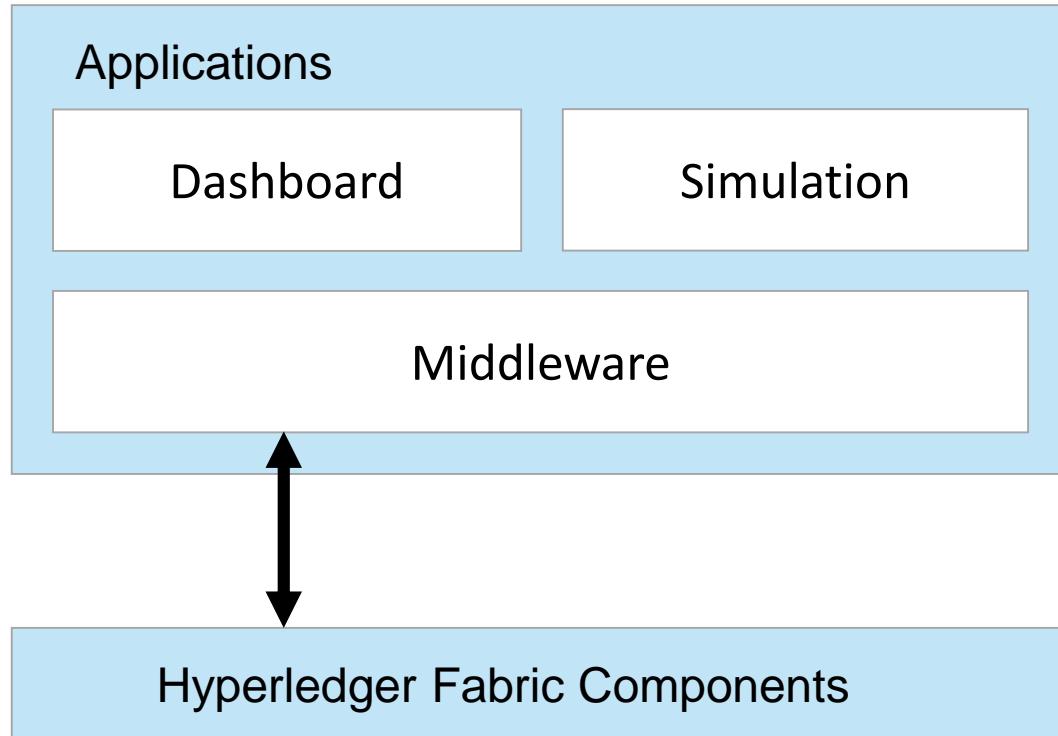
Analysis – VPP example



Implementation – HLF Components



Implementation – Applications



Calendar

Date						
January 2019						
Su	Mo	Tu	We	Th	Fr	Sa
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Transaction Table

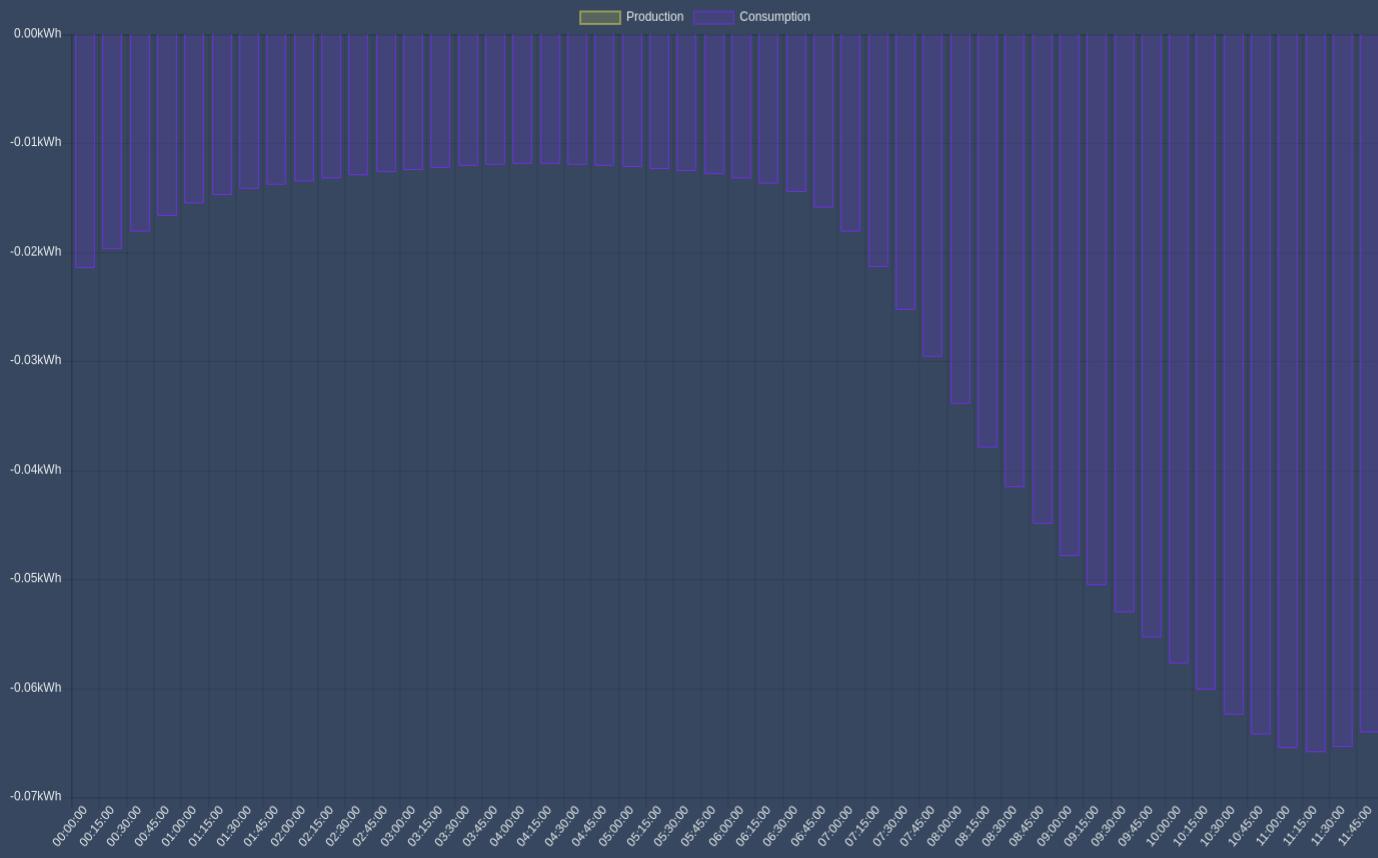
Time	Type	Amount in kWh
00:00:00	Consumption	0.02149
00:15:00	Consumption	0.01971
00:30:00	Consumption	0.0181
00:45:00	Consumption	0.01667
01:00:00	Consumption	0.01552

1 2 3 Next Last

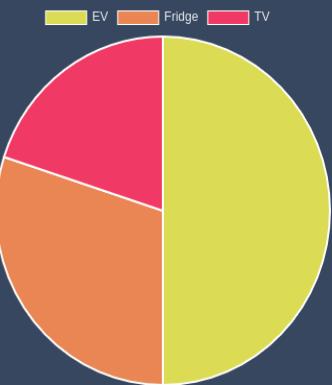
Smart Grid Controller Blockchain Platform



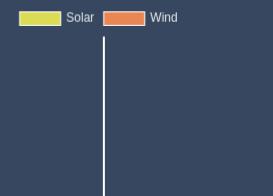
Energy consumption and production of participants in kWh per timeslot



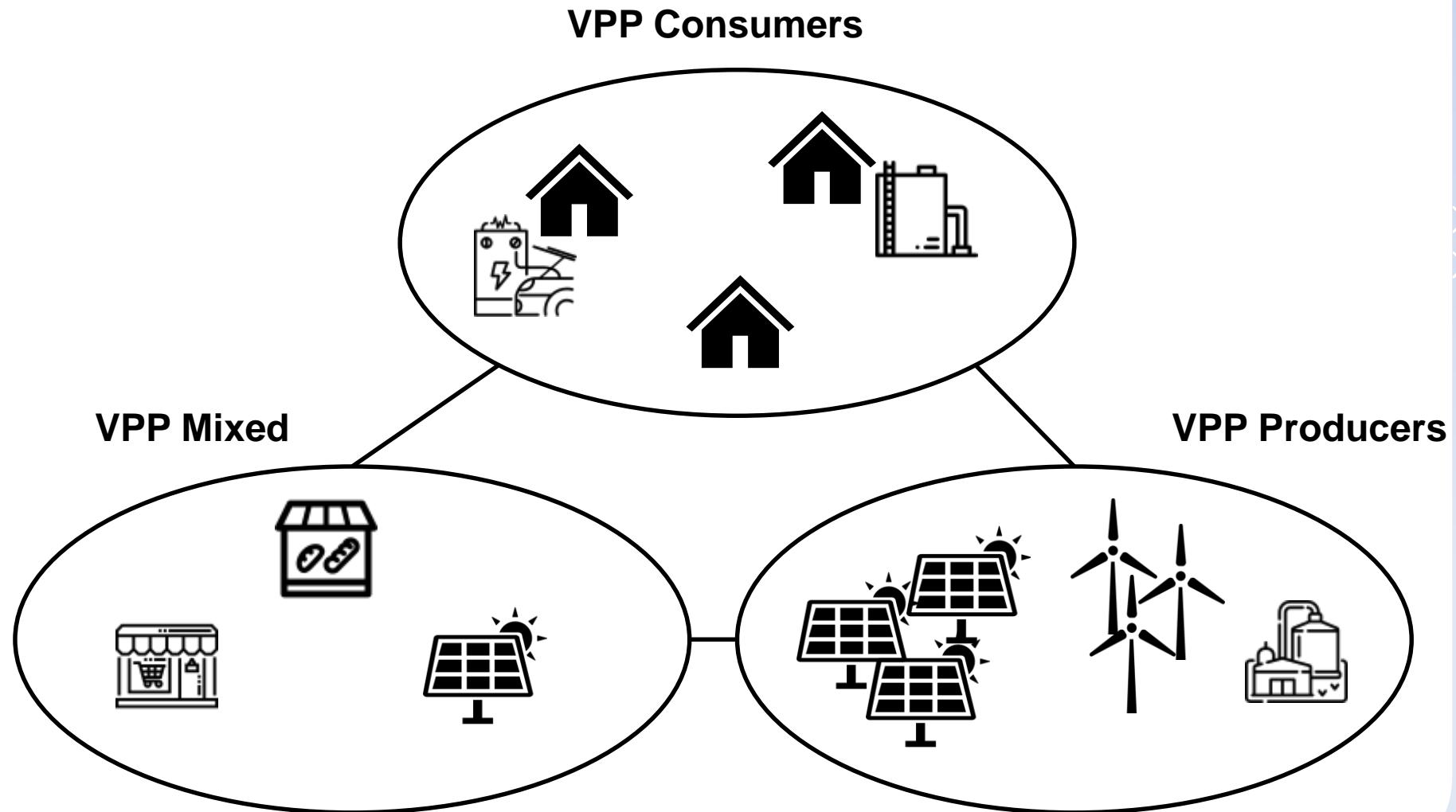
Energy consumption by device in kWh



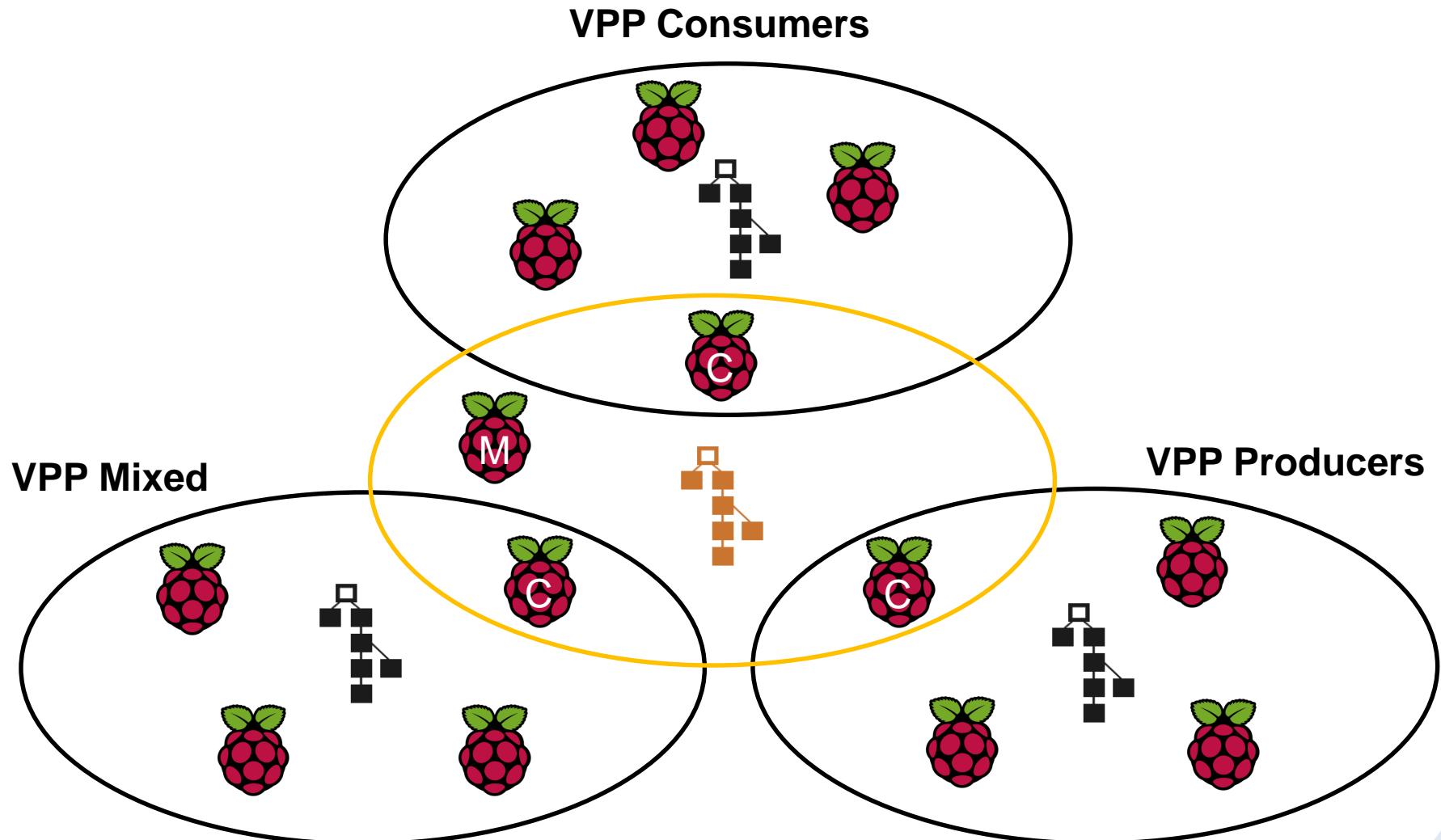
Energy production by device in kWh



Simulation – Simulation Model



Simulation - Setup



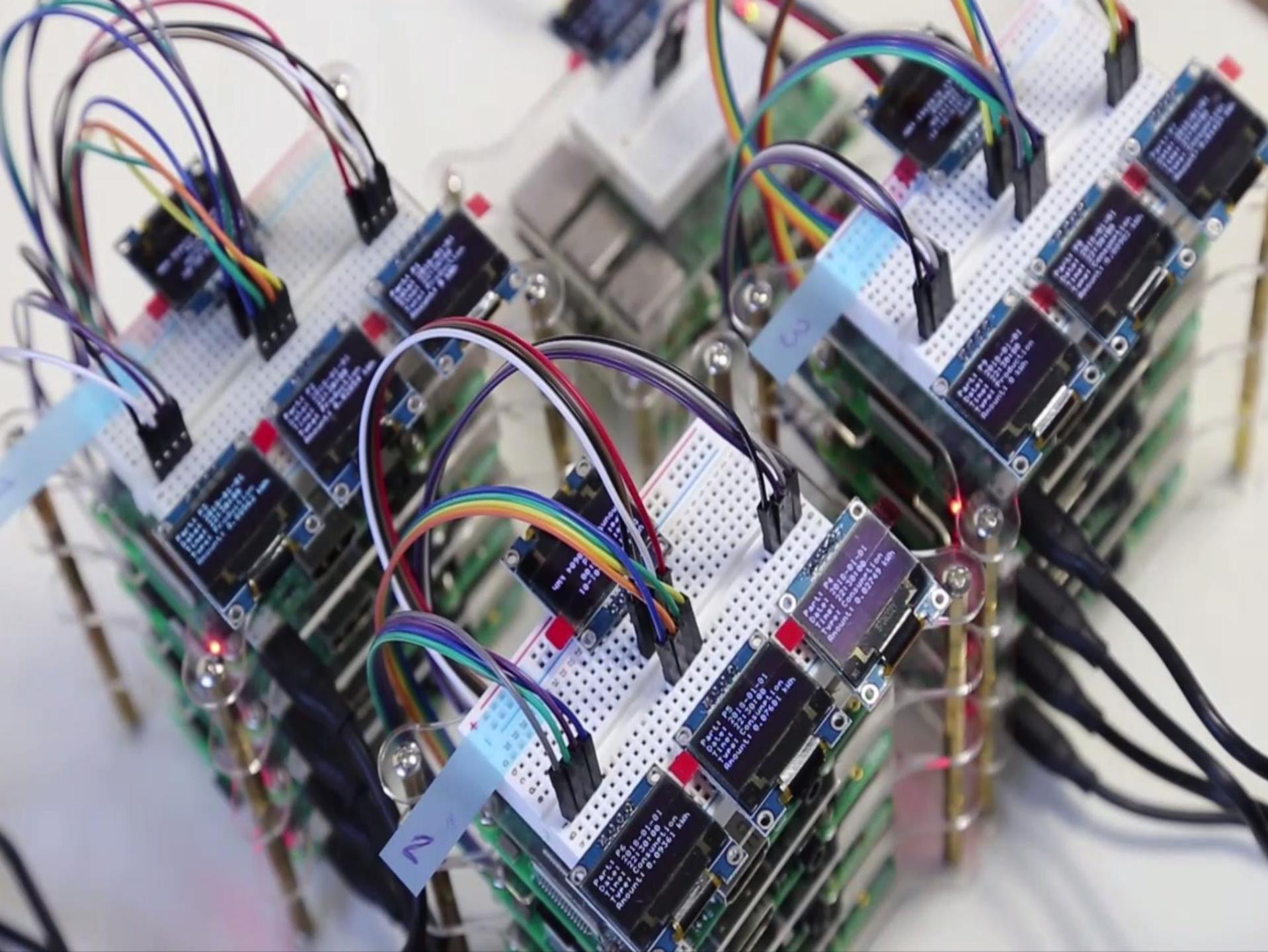
Organizations

```
13 - Name: Participants1Org
14   Domain: participants1.sgcbp.com
15   EnableNodeOUs: true
16 - Template:
17   Count: 3
18 - Users:
19   Count: 1
--
```

```
24 - Name: Controllers1Org
25   Domain: controllers1.sgcbp.com
26   EnableNodeOUs: true
27 - Template:
28   Count: 1
29 - Users:
30   Count: 1
```

Channels

```
33 Vpp1Channel:  
34     Consortium: SGCBPConsortium  
35 Application:  
36         <<: *ApplicationDefaults  
37 Organizations:  
38         - *Controllers1Org  
39         - *Participants1Org  
40 Capabilities:  
41         <<: *ApplicationCapabilities  
42  
43 InterChannel:  
44     Consortium: SGCBPConsortium  
45 Application:  
46         <<: *ApplicationDefaults  
47 Organizations:  
48         - *Controllers1Org  
49         - *Controllers2Org  
50         - *Controllers3Org  
51         - *MatchingOrg  
52 Capabilities:  
53         <<: *ApplicationCapabilities
```



Future development & ideas



Outlook



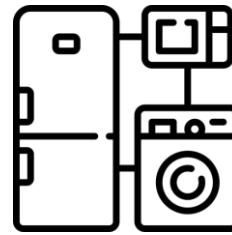
Potential



Gold digging



Challenges



M2M



THANK YOU!

Bundesministerium
Verkehr, Innovation
und Technologie

