

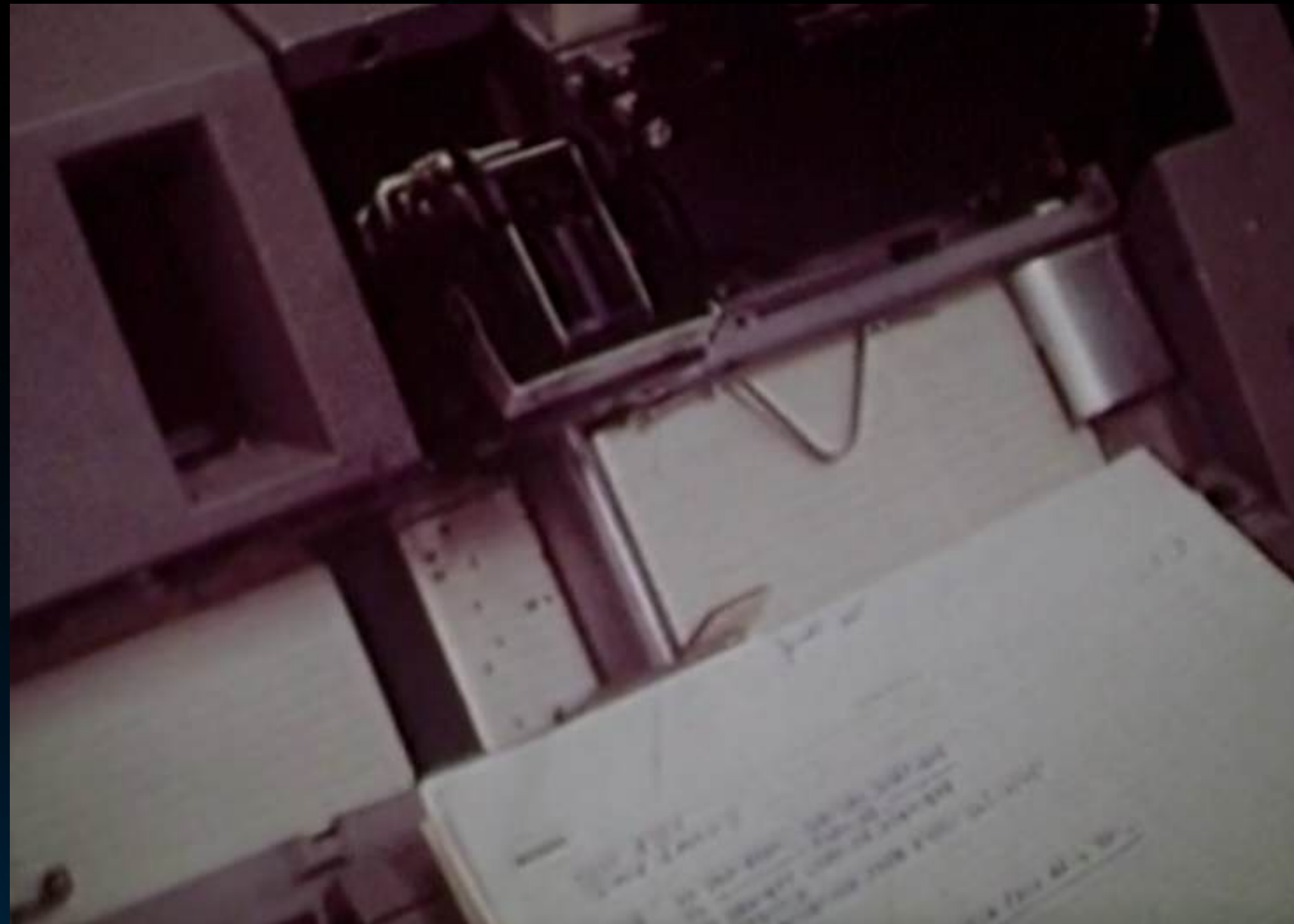
eRoots Analytics

GridCal – Open-source for Modern Power Systems

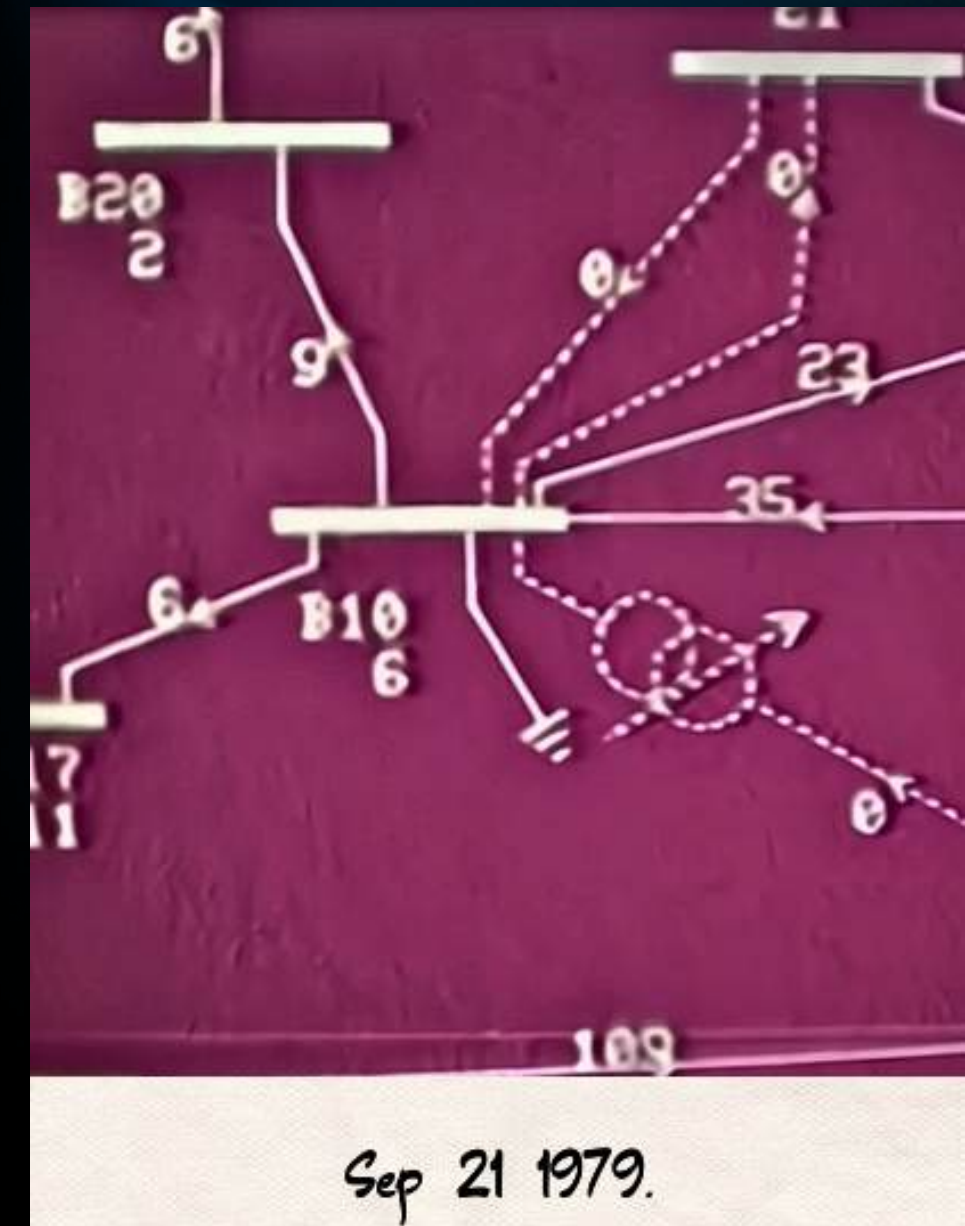
FERC, July 2025



Why simulate?



Source: IPSA, by TNEI. <https://www.ipsa-power.com/a-blueprint-for-power/>



Context

Legacy

Companies rely on software built 30+ years ago, with lacking functionalities, integration difficulties, and limited capabilities to tackle modern grids



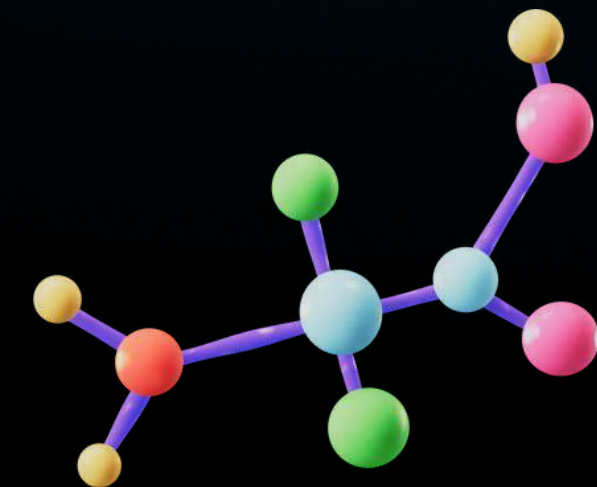
Blindness

Enterprises connect assets to grids they know very little off. Actionable insights for both planning and operation stages are non-existent



Grid complexity

Renewables, storage, data centers, HVDC systems, among others, create a rapidly changing landscape with greater uncertainty levels





From the micro computer to the super computer

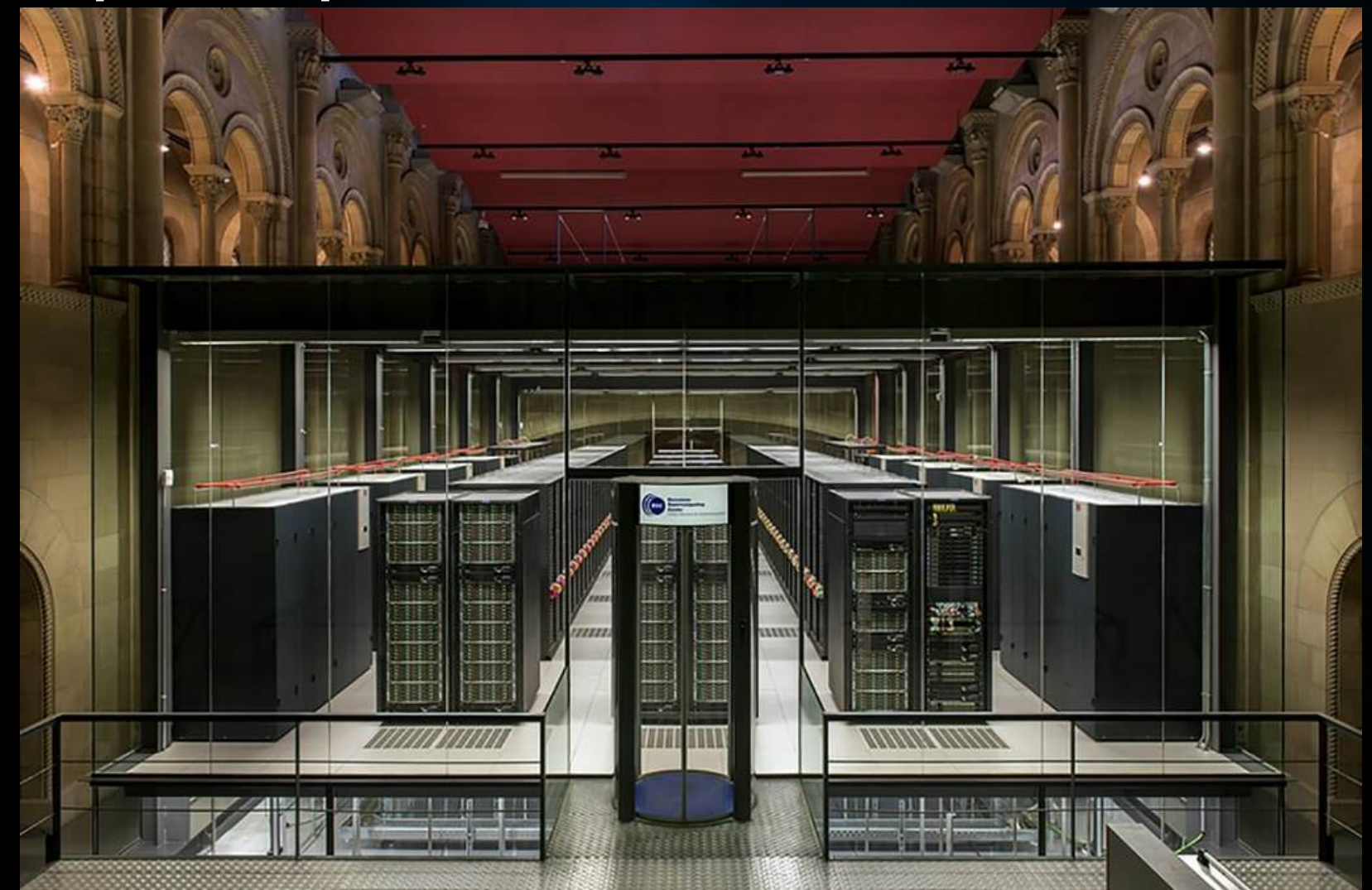
Real time micro PC



GridCal's engine has been used for real time control systems R&D as a lightweight simulation engine.

Scaling as the complexity requires

Supercomputer



GridCal has been used for large scale simulations at the Barcelona Supercomputing Center

One database, many simulations



3D Data
model



Power flow



Stochastic power flow



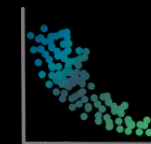
Optimal power flow



Voltage collapse



Short circuit

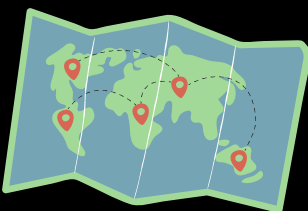


Investments analysis

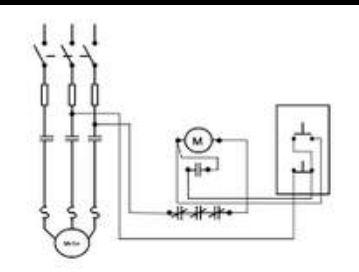


RMS dynamic simulation

User Interface



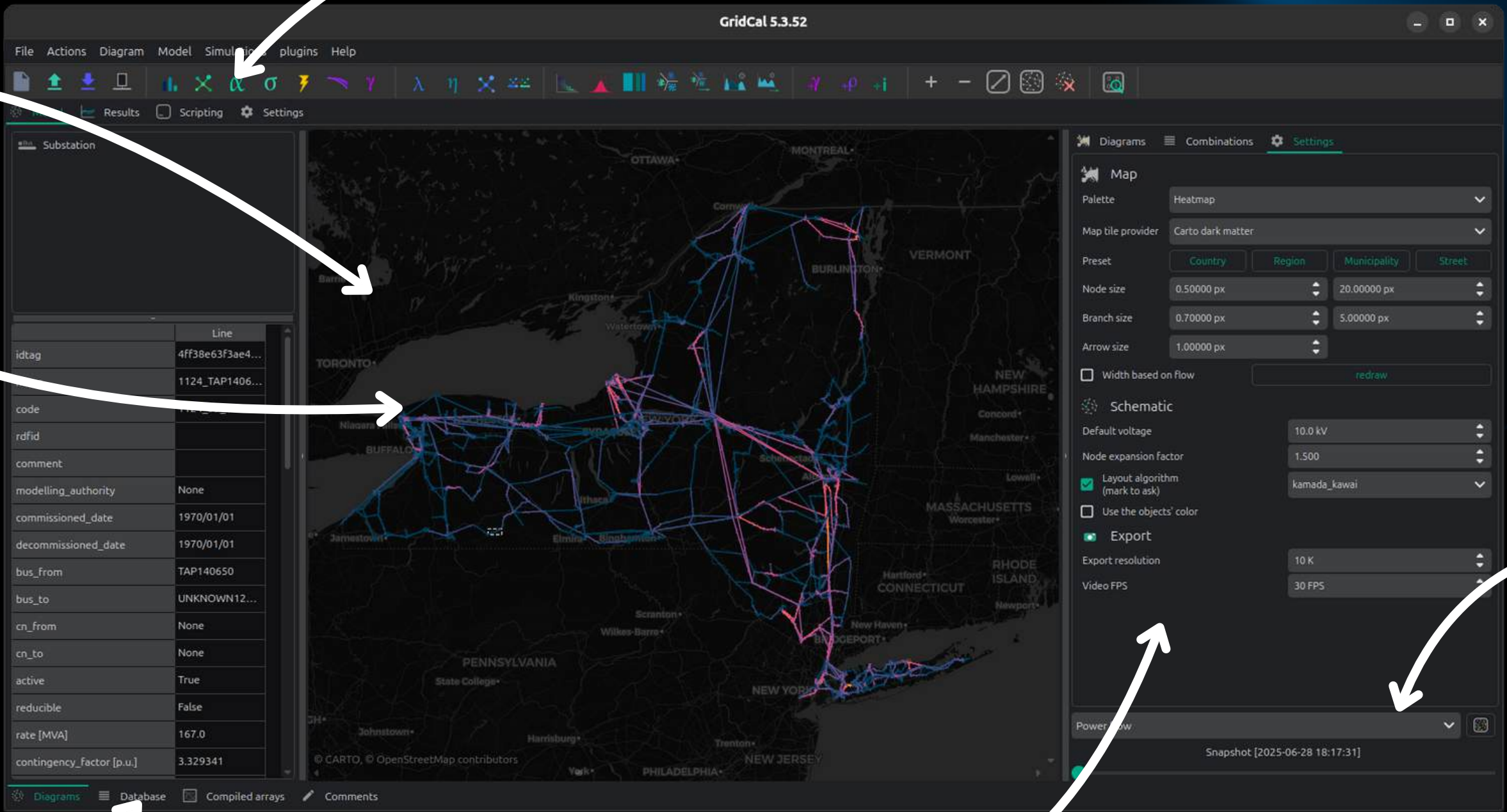
Unlimited
Maps



Unlimited
Schematics



3D Data model

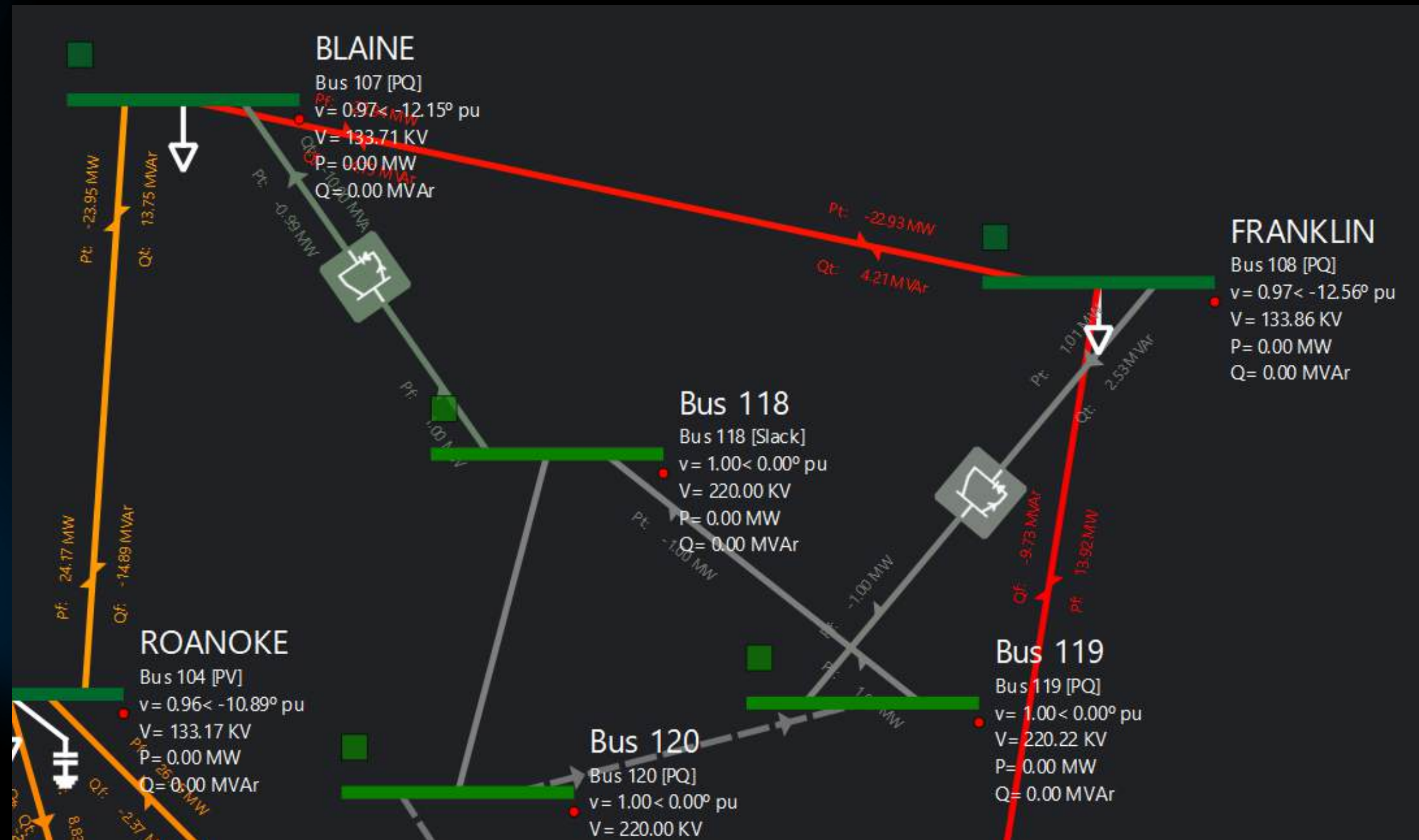


Interactive results
visualization



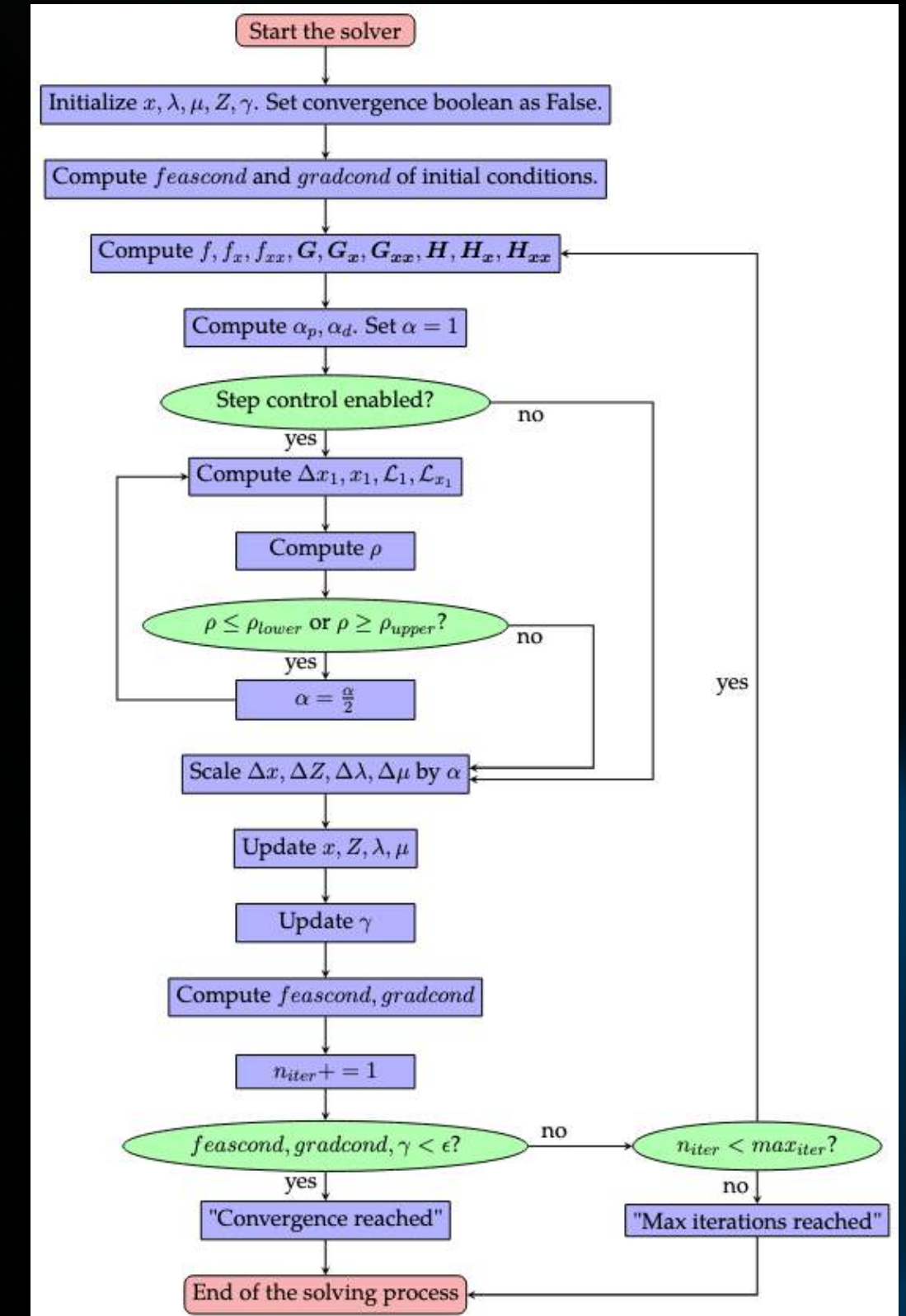
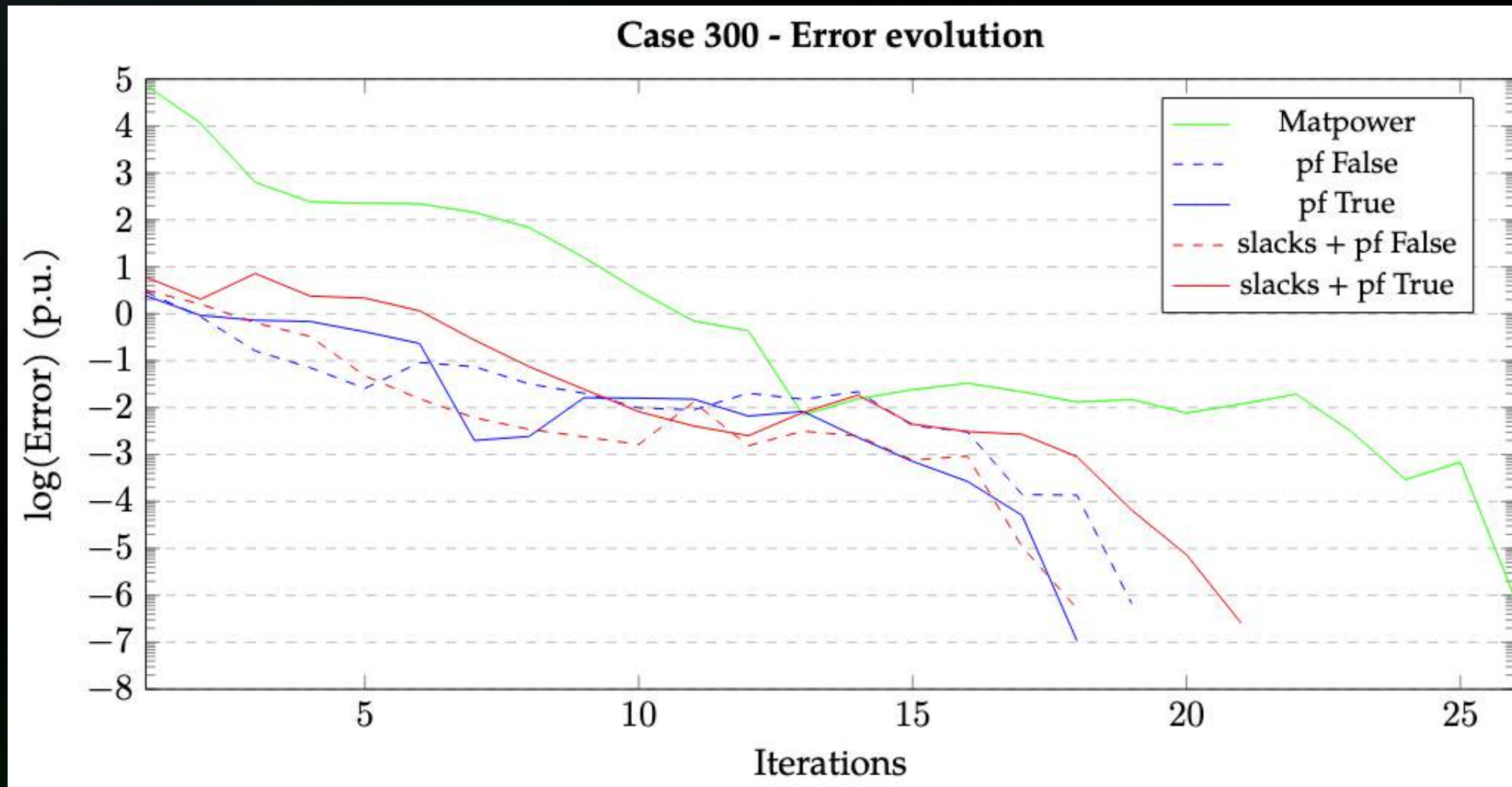
Picture & video
recording

AC/DC Grid Planning



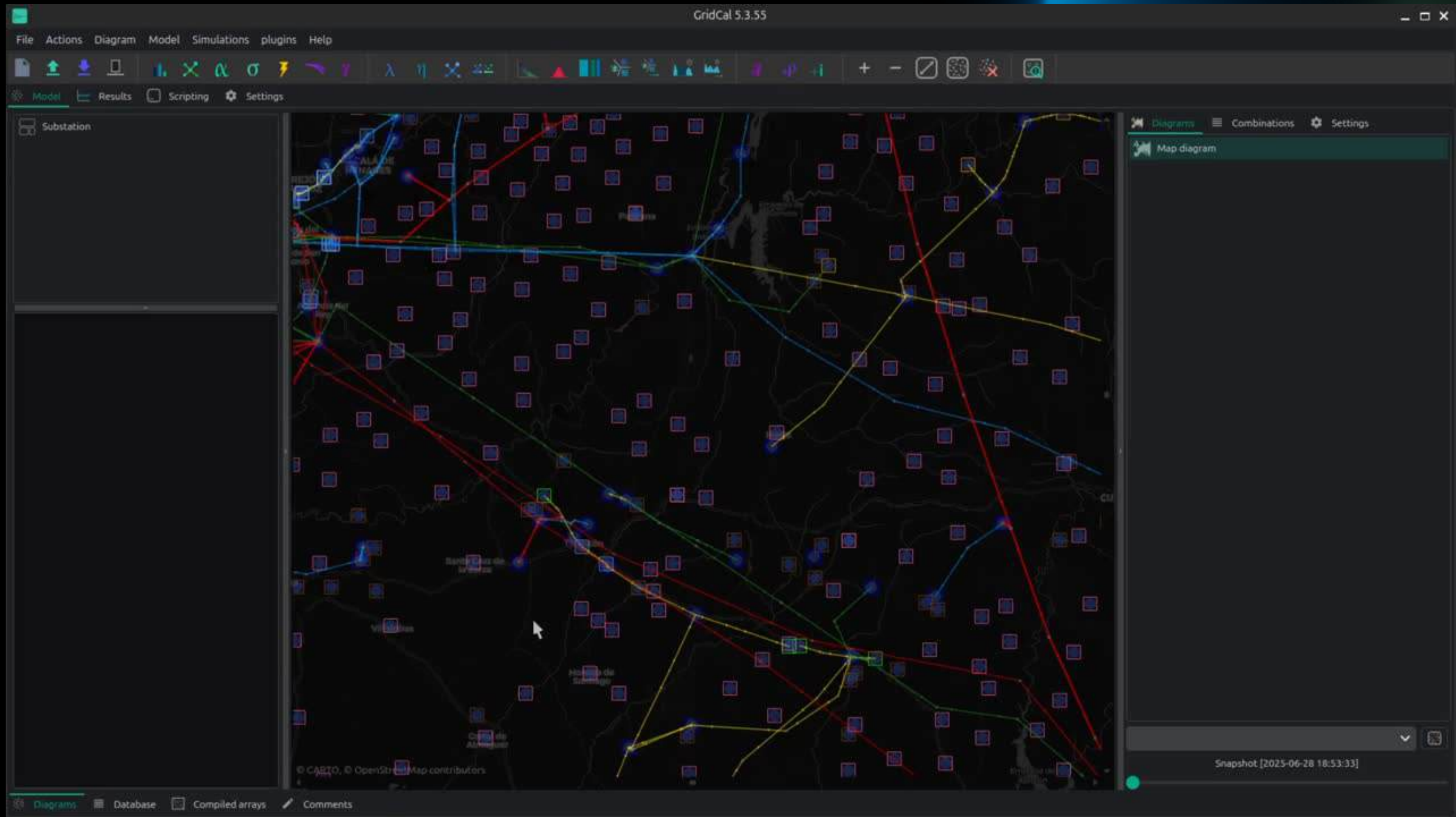
- AC/DC converter integration
- Current limit enforcement
- Controllable tap changers
- HVDC point-to-point connection
- Remote controls
- PQV buses
- 3000 buses solved in 40 ms
- Quadratic convergence

Optimal Power Flow

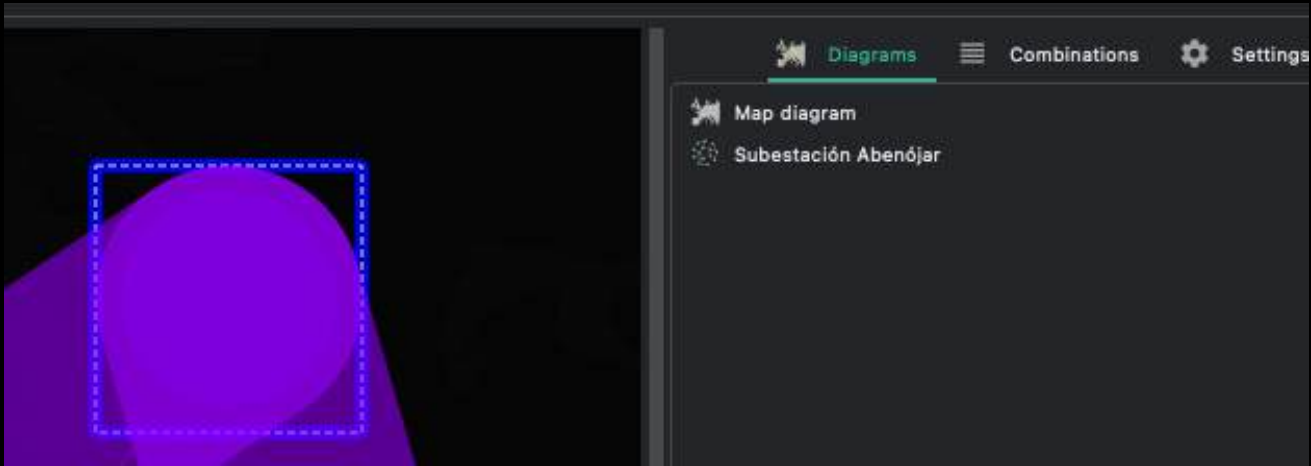


- Interior Point Solver for maximum performance
- No external dependencies

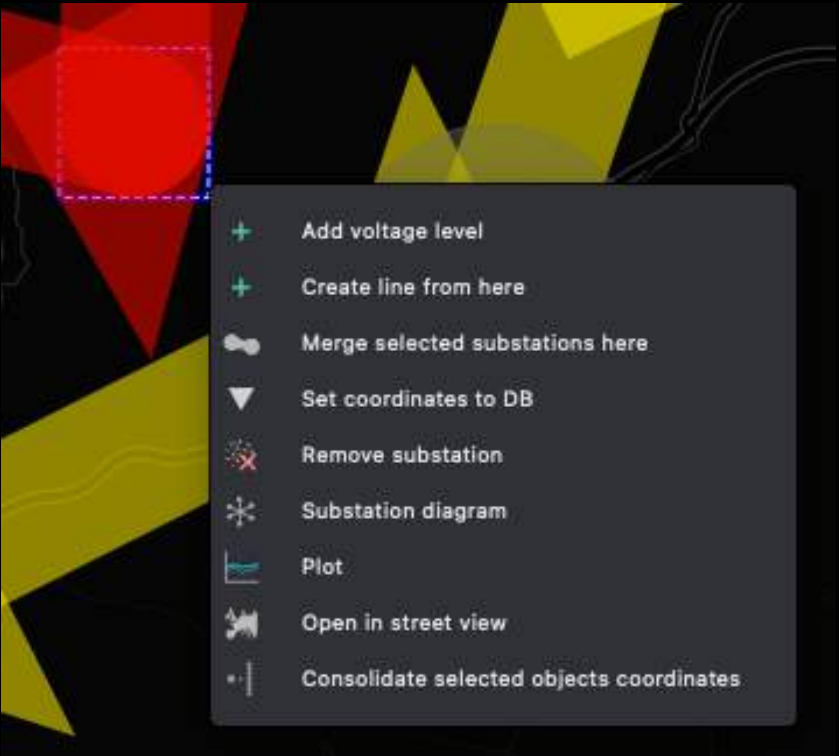
Maps



Topology Editing



Map and bus-branch diagrams



Substation edits

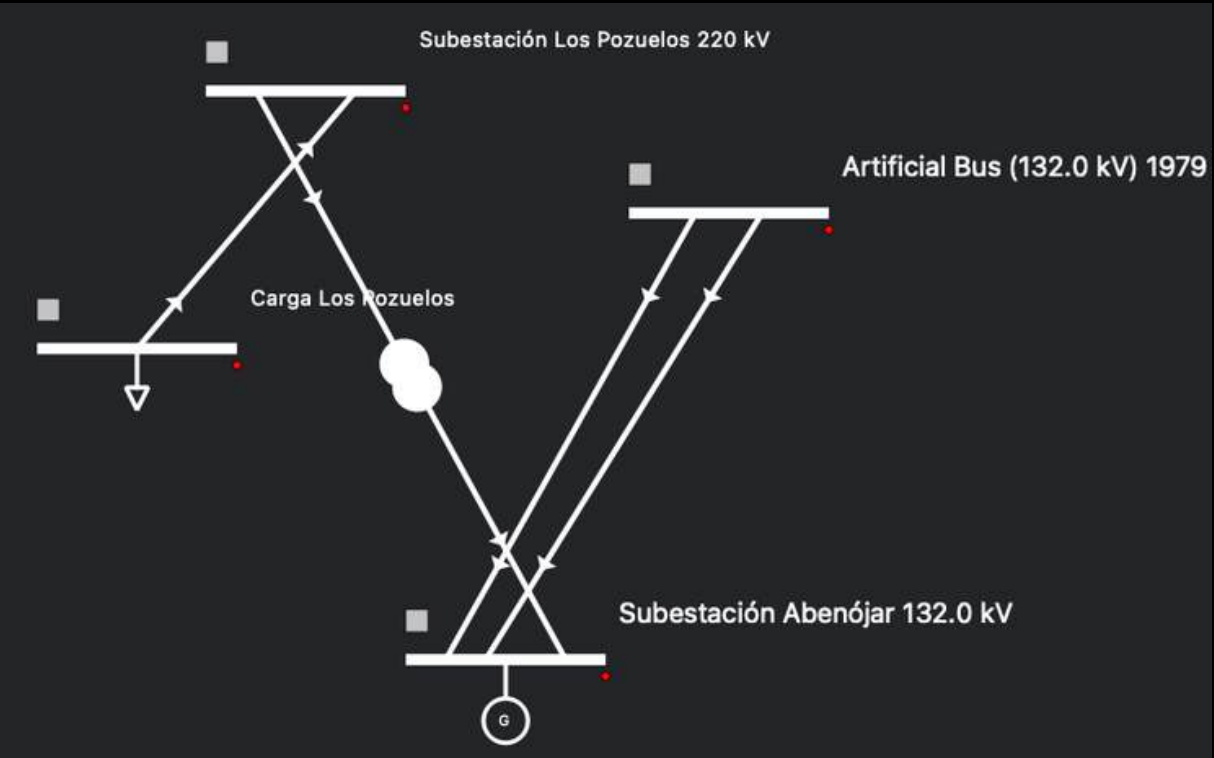
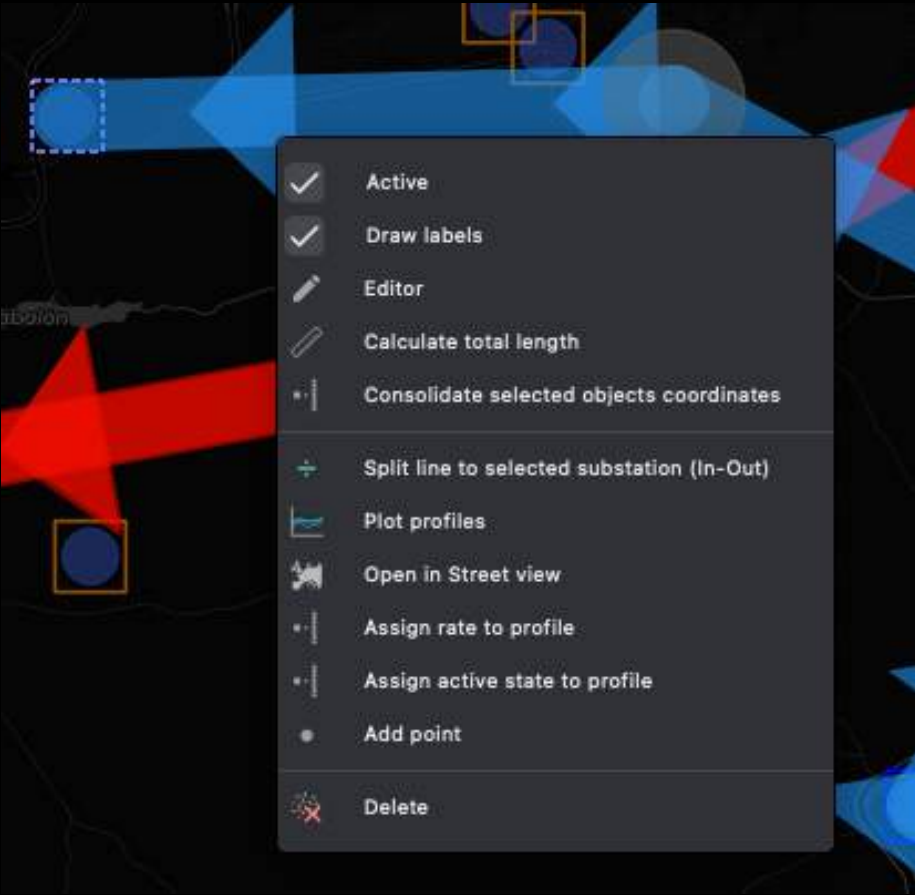


Diagram expansion



Line edits

Database Merge

- Differentiable grid model
- Allows seamless version control
- Easy collaboration between teams (like Git)
- Exchange of differential files

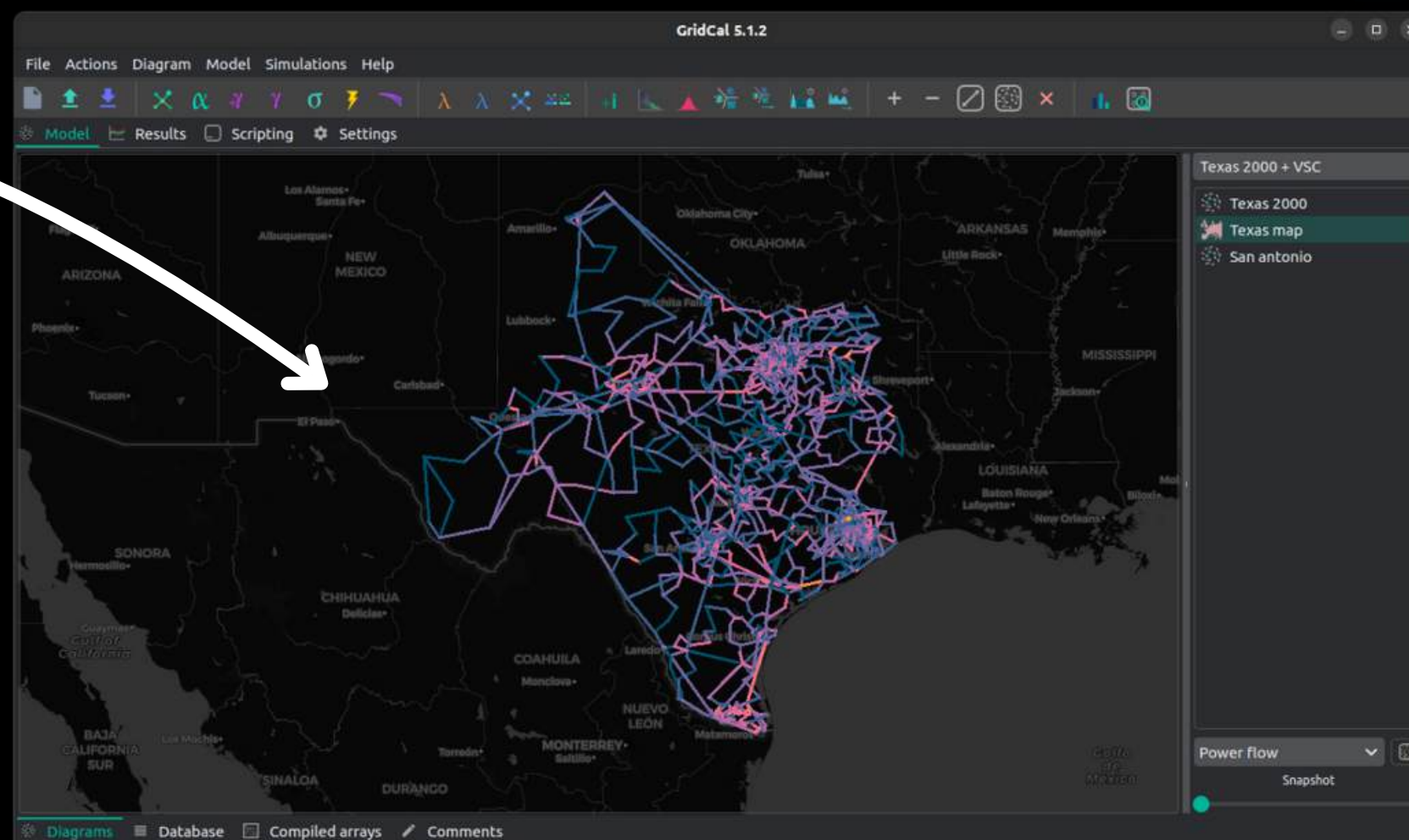


Interoperability



Drag & Drop files:

- raw & rawx (PSSe)
- EPC (Power World)
- Matpower
- CIM / CGMES
- Power Factory (dgs)
- Most open source
- Json
- Excel



Object type	Name	Index	Severity	Property	Lower Value	Upper
> There is no nominal power, this is bad.						
> There is no susceptance, this could hurt numerical conditioning.						
> The rating is negative. This cannot be.						
v The resistance is exactly zero						
Transformer	1_1_138.0_5...	0	Information	R	0.0	
Transformer	2_2_138.0_5...	1	Information	R	0.0	
Transformer	3_3_138.0_...	2	Information	R	0.0	
Transformer	6_6_138.0_...	5	Information	R	0.0	
Transformer	10_10_138.0...	8	Information	R	0.0	
Transformer	11_11_138.0...	9	Information	R	0.0	
Transformer	12_12_138.0...	10	Information	R	0.0	
Transformer	13_13_138.0...	11	Information	R	0.0	
Transformer	14_14_138.0...	12	Information	R	0.0	
Transformer	15_15_138.0...	13	Information	R	0.0	
Transformer	16_16_138.0...	14	Information	R	0.0	
> Transformer rating is too different from the nominal power						
v Tap module too high						
Transformer	2_2_138.0_5...	1	Warning	tap_module	1.07	1.05
Transformer	3_3_138.0_...	2	Warning	tap_module	1.07	1.05
Transformer	4_4_138.0_1...	3	Warning	tap_module	1.07	1.05
Transformer	20_20_138...	15	Warning	tap_module	1.06	1.05
Transformer	63_63_138...	17	Warning	tap_module	1.06	1.05
Transformer	65_65_138...	18	Warning	tap_module	1.06	1.05
v The short circuit value is suspicious						
Transformer	12_12_138.0...	10	Warning	Vcc	1.0	0.75
Transformer	13_13_138.0...	11	Warning	Vcc	1.0	0.33
Transformer	14_14_138.0...	12	Warning	Vcc	1.0	0.15
Transformer	15_15_138.0...	13	Warning	Vcc	1.0	0.15
Transformer	16_16_138.0...	14	Warning	Vcc	1.0	0.3
Transformer	34_34_138...	16	Warning	Vcc	1.0	0.74006756...
v Tap module too low						
Transformer	34_34_138...	16	Warning	tap_module	0.946	0.95
v The set point looks too high						
Generator	7_1	6	Warning	Vset	1.063	1.05
v There is too much reactive power imbalance						
Grid snapshot		-1	Error	Reactive p...	0.0	1971.759999...

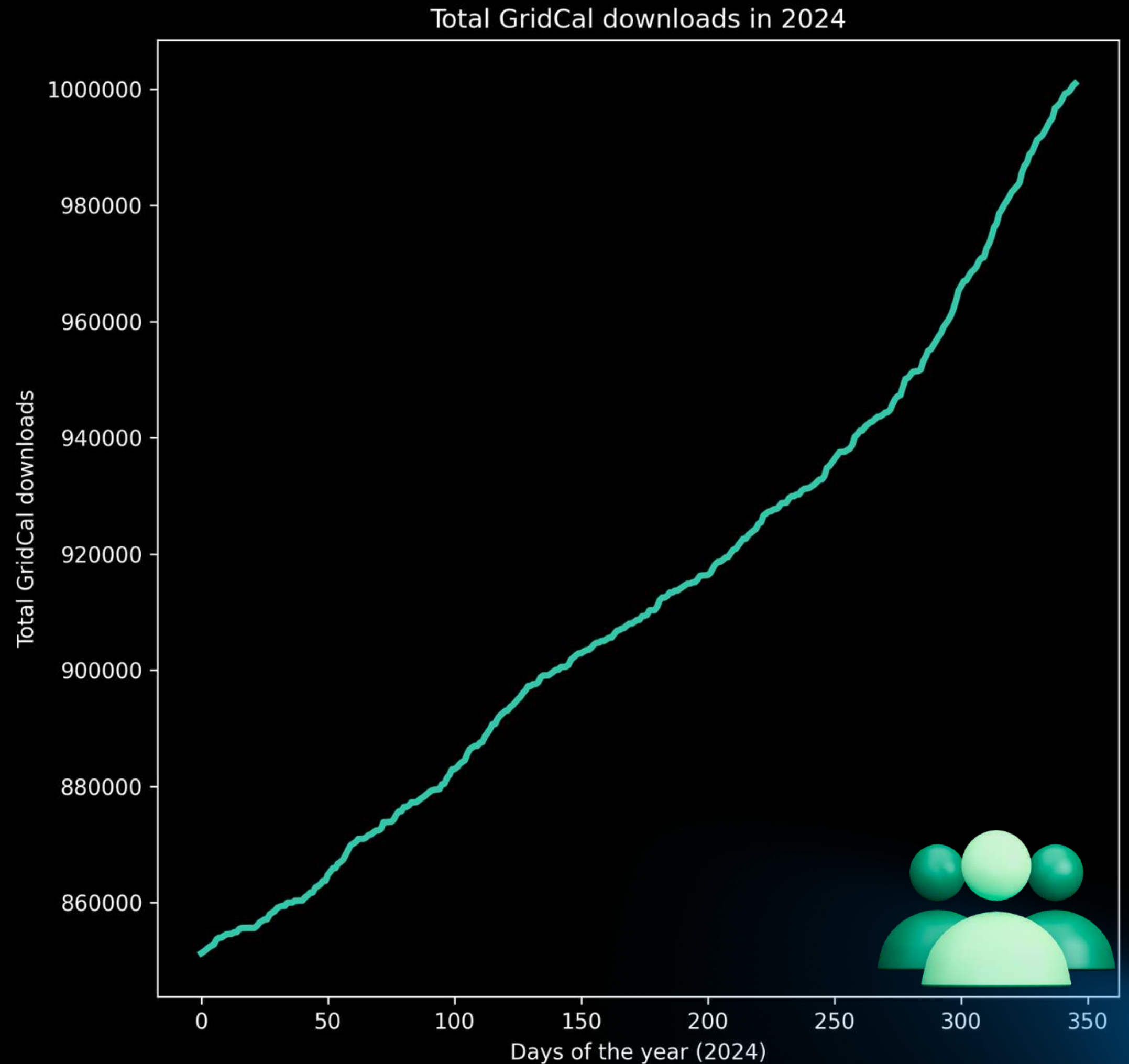
Model logger

Time	Class	Property	Device	Value	Expected value
v Error					
v Global UUID5 duplicate					
13:52:42	generator		3_1	f860ba666e...	
v The area slack bus is not marked as slack					
13:52:42			0		
13:52:42			0		
13:52:42			0		
13:52:42			0		
13:52:42			0		
v Warning					
v Calculated tap position is not integer					
13:52:42	Transformer		1_54_1	42	
13:52:42	Transformer		2_58_1	42	
13:52:42	Transformer		3_62_1	42	
13:52:42	Transformer		4_19_1	42	
13:52:42	Transformer		5_20_1	42	
13:52:42	Transformer		6_22_1	42	
13:52:42	Transformer		8_25_1	42	
13:52:42	Transformer		9_29_1	42	
13:52:42	Transformer		10_31_1	42	
13:52:42	Transformer		11_32_1	42	
13:52:42	Transformer		12_36_1	42	
13:52:42	Transformer		13_17_1	42	
13:52:42	Transformer		14_41_1	42	
13:52:42	Transformer		15_42_1	42	
13:52:42	Transformer		16_18_1	42	
13:52:42	Transformer		20_19_1	42	
13:52:42	Transformer		34_35_1	42	
13:52:42	Transformer		63_64_1	42	
13:52:42	Transformer		65_64_1	42	
Save Copy Accept					

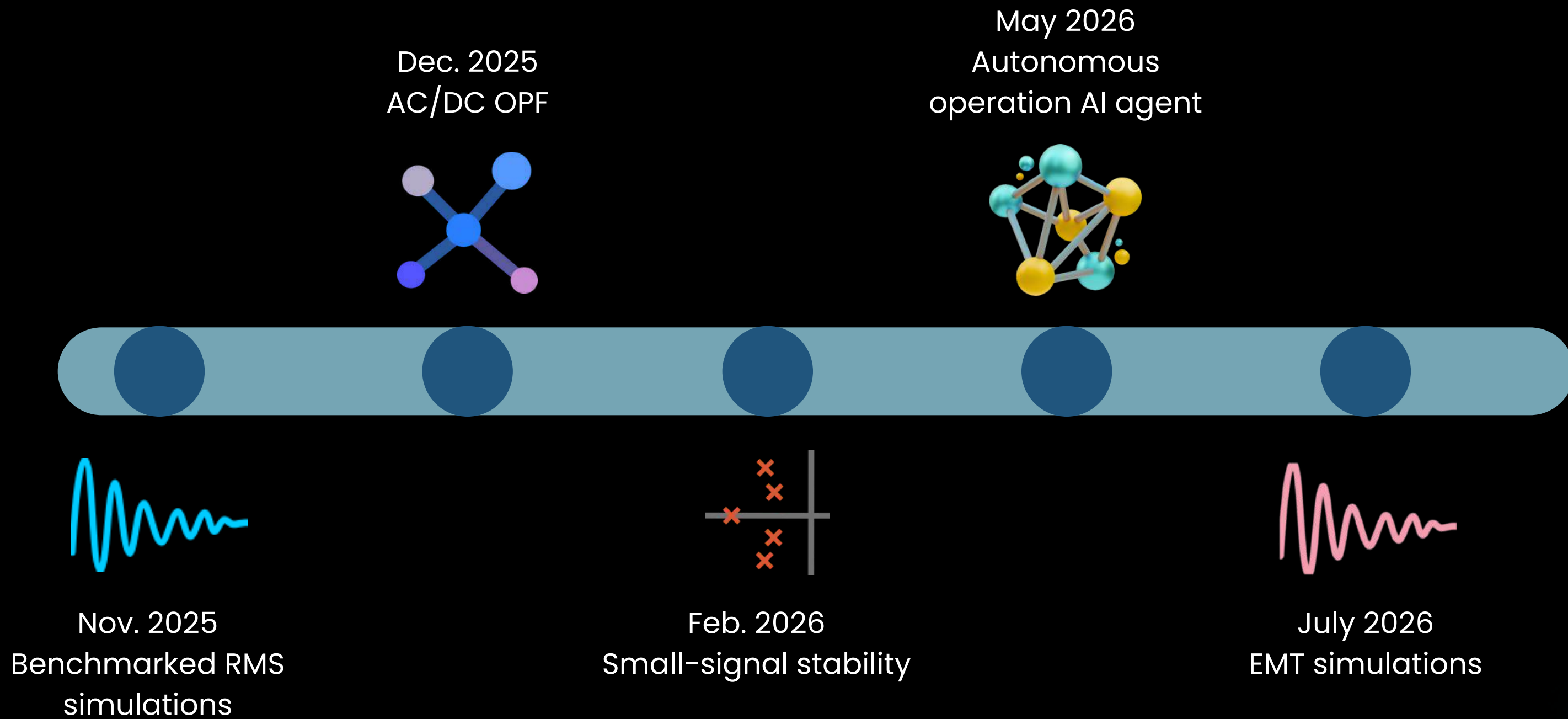
Model debug & fix

Adoption

- Used at electrical companies & consultancy
- 100+ GitHub forks
- 450+ GitHub stars
- Industrial projects in 4 continents
- 5+ European R+D projects



Roadmap



Conclusions

- Simulations are central to power systems planning and operation
- GridCal offers best-in-class algorithms: power flow, OPF, short-circuits, contingencies, dynamics, etc.
- Distinctive to other tools, GridCal comes with a feature-rich user interface
- Performance and user-friendliness, for both academia and industry, are at the core of GridCal
- Innovation and business models around GridCal are possible

eRoots Analytics

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