User forum November 2022

- **Ph. D. Michael M. Belsnes**

SINTEF

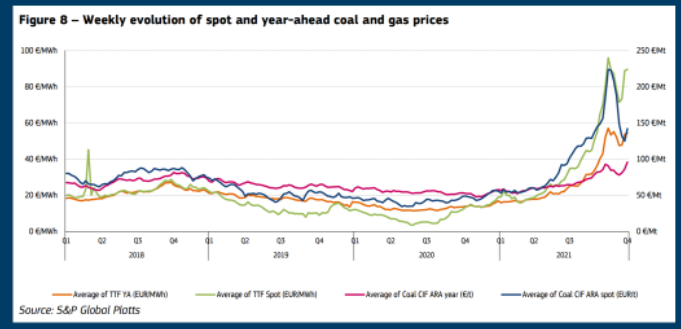
Agenda

09:00-10:00	15 min	10:15-11:00	15 min	11:15-12:15
Welcome General information • Fund distribution 2022 (prognosis) • Administrative information relevant to data management and incident handling • Error statistics • EMPS, ProdRisk and SHOP	Break	Recent key project results • Test system – LTM, Autonomous Planning, Efficiency curves in the models • Results and experience from POC of next generation market model	Break	Roadmaps drafts Breakout groups • input to roadmaps

Models are still important

From Statkrafts low-emission scenarios at the User-Meeting 2021

Gass- og kullpris i Europa



Source: S&P Global Platts

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Response to the energy price crisis and the war in Ukraine

EUROPEAN COMMISSION

Strasbourg, 8.3.2022
COM(2022) 108 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

REPowerEU: Joint European Action for more affordable, secure and sustainable energy

Source: European Commision

Objective

- Urgent actions on prices
  - Keep retail prices in check
- Security of supply
  - Refilling gas storage for next winter
- Cut dependency on Russian gas and coal
  - Define actions to ramp up the production of green energy
  - diversify supplies
  - reduce demand, focusing primarily on gas, which significantly influences the electricity market

Technology for a better society

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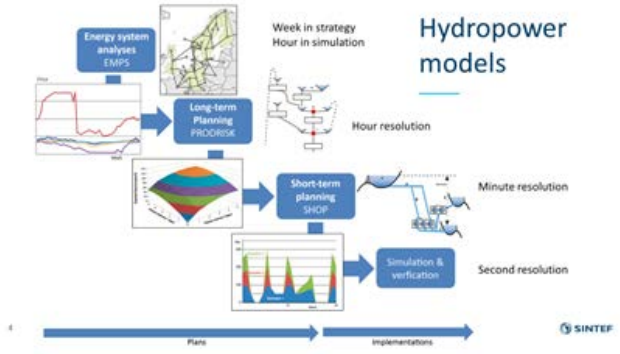
The maintenance project 2022



- SINTEF is a Not for-profit organization
  - What we invoice through the maintenance project is used in the model project.
- New sold licenses are used on the models
- Included in the project are:
  - SHOP and SHOP-SIM, ProdRisk, EOPS, EMPS and SamNett
- Related prototypes
  - SHARM, FANSI, EMPSW, ReOpt

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Project organization

Project manager
PhD Michael Belsnes

Coordinator
Kari Løbakk Hyll

Contracts
Arnt Ove Eggen

SHOP Manager
Seniorforsker
Hans Ivar Skjelbred

EMPS / EOPS / SamNett Manager
Sjefsforsker Birger Mo

ProdRisk Manager
PhD Hans Olaf Hågenvik

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Project board up to August 2022

Research manager Market
Stefan Jaehnert

Research manager Operation
Ellen Krohn Aasgård

Research manager Analysis
Christian Andresen

Project manager
Michael Belsnes

…investigating new organizations which may change the picture

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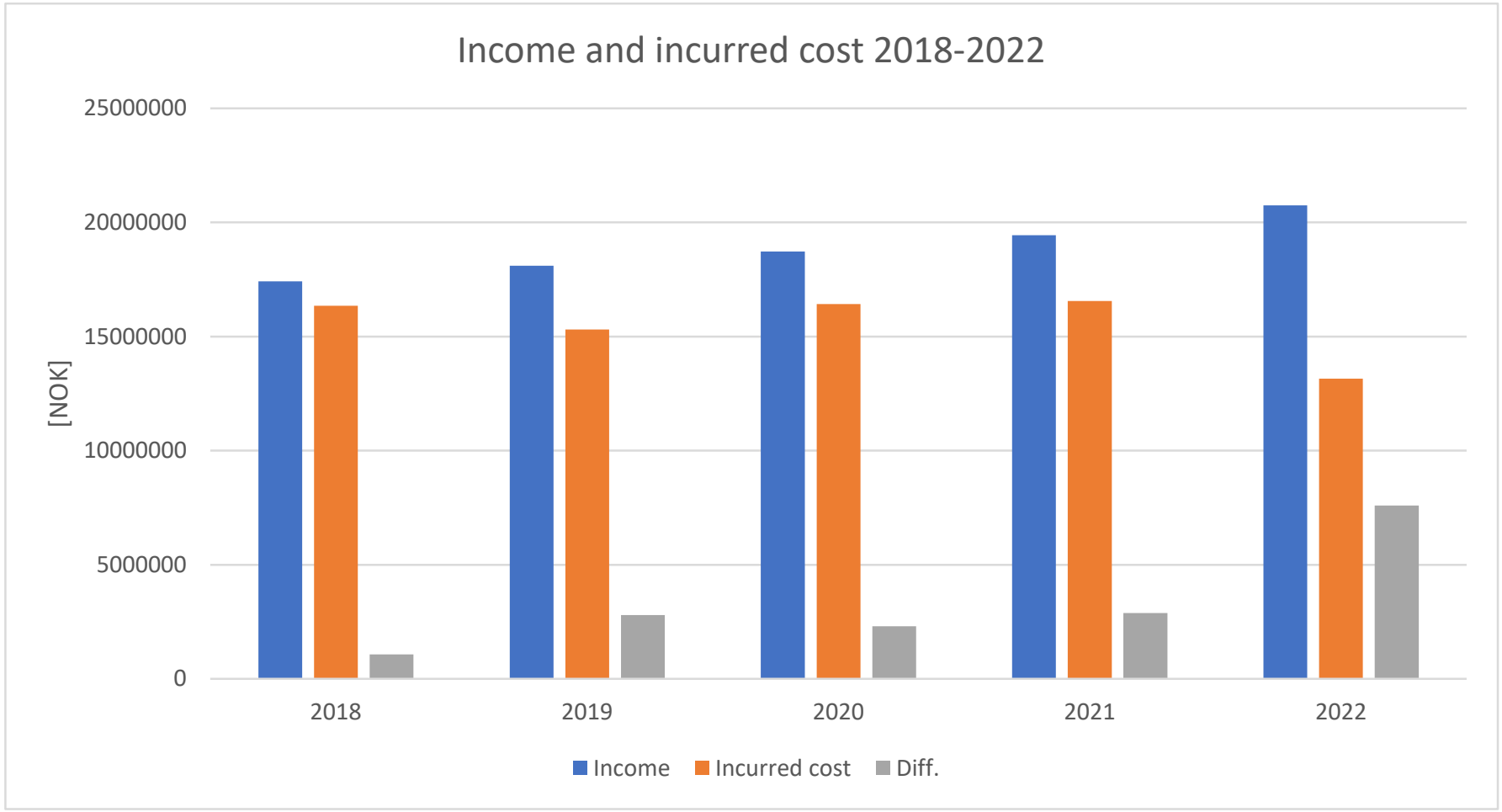
Budget and consumption 2018-2022



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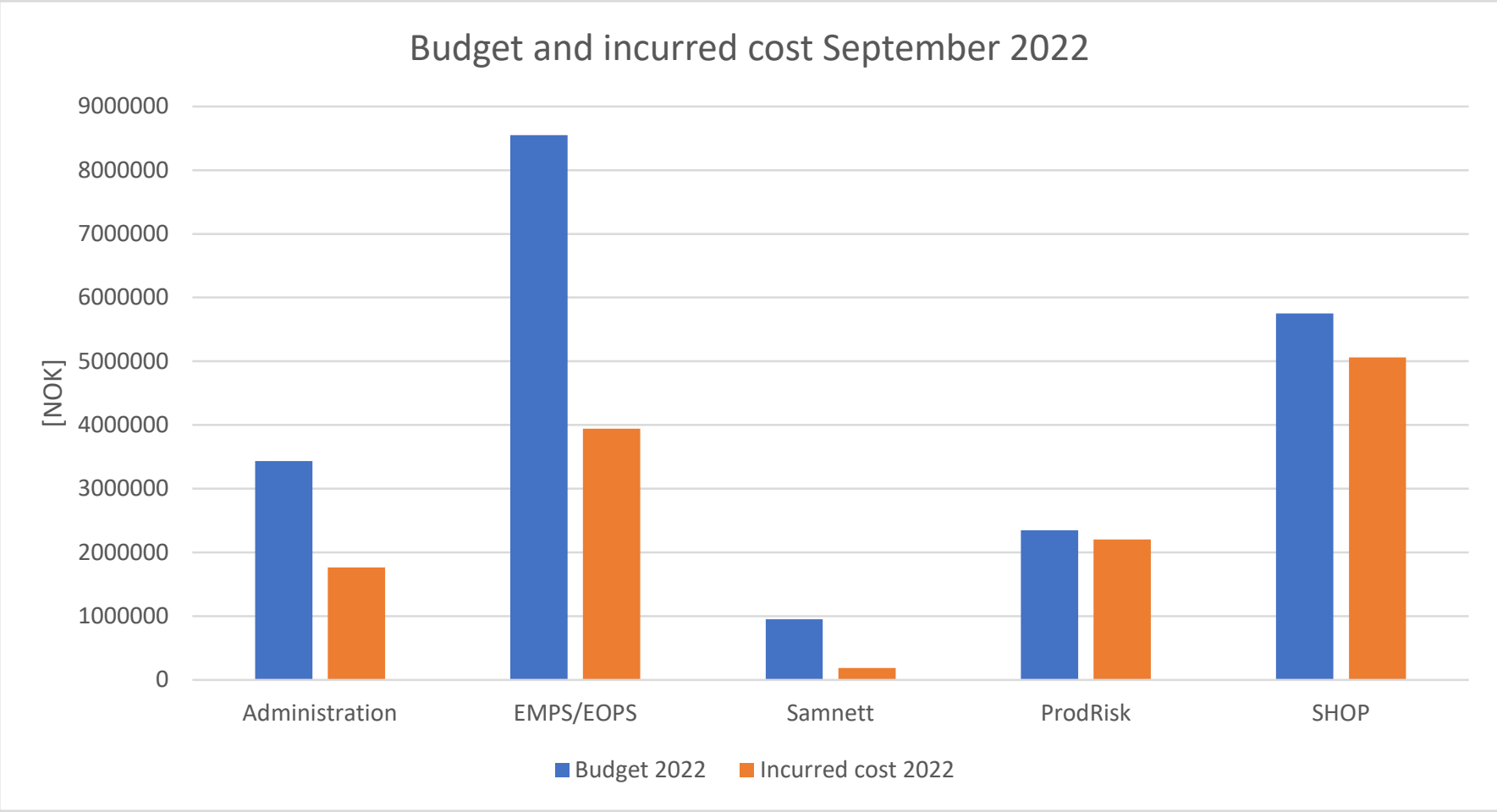
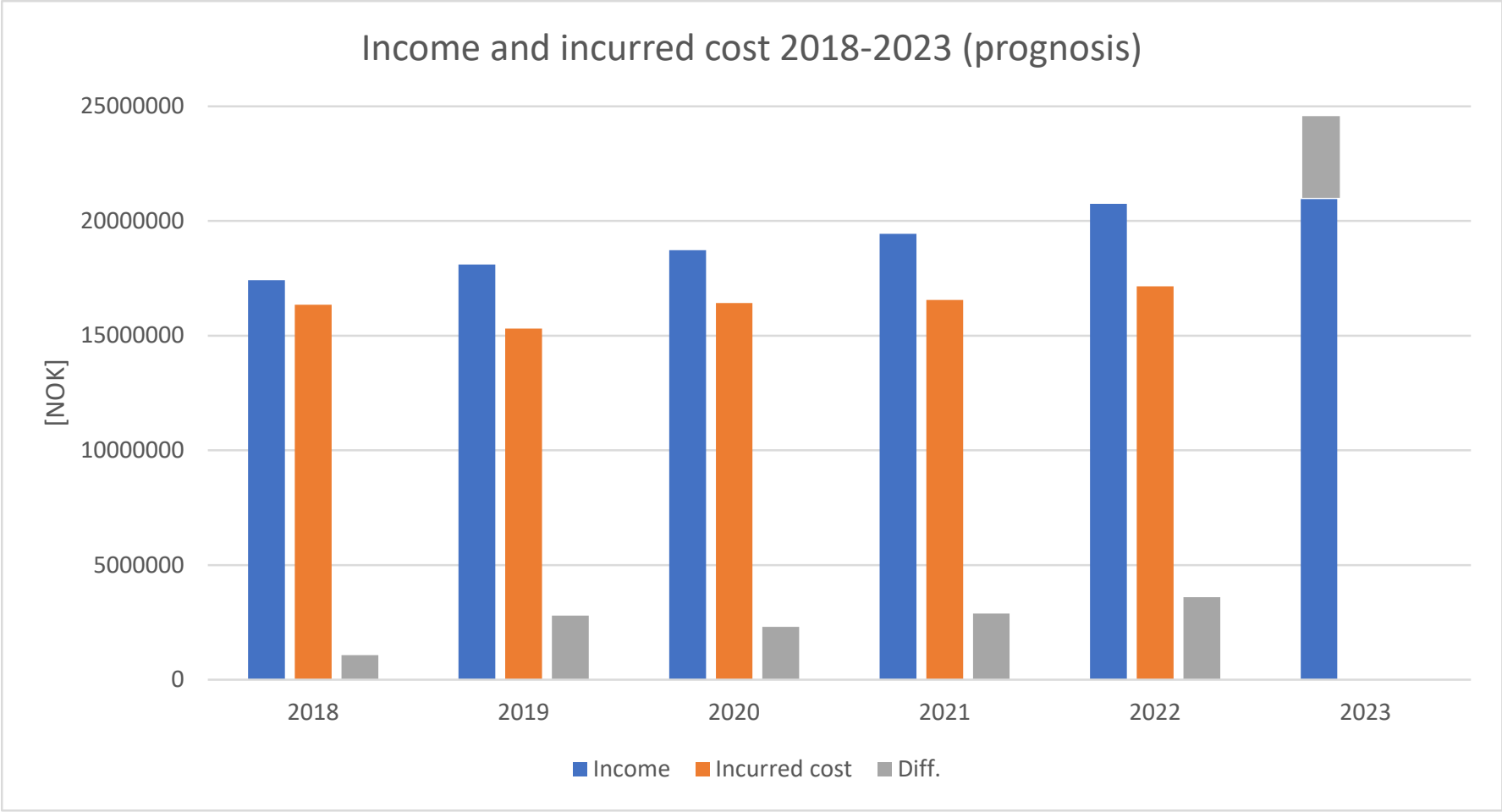
Budget and incurred so far in 2022



Prognosis for 2022 and 2023



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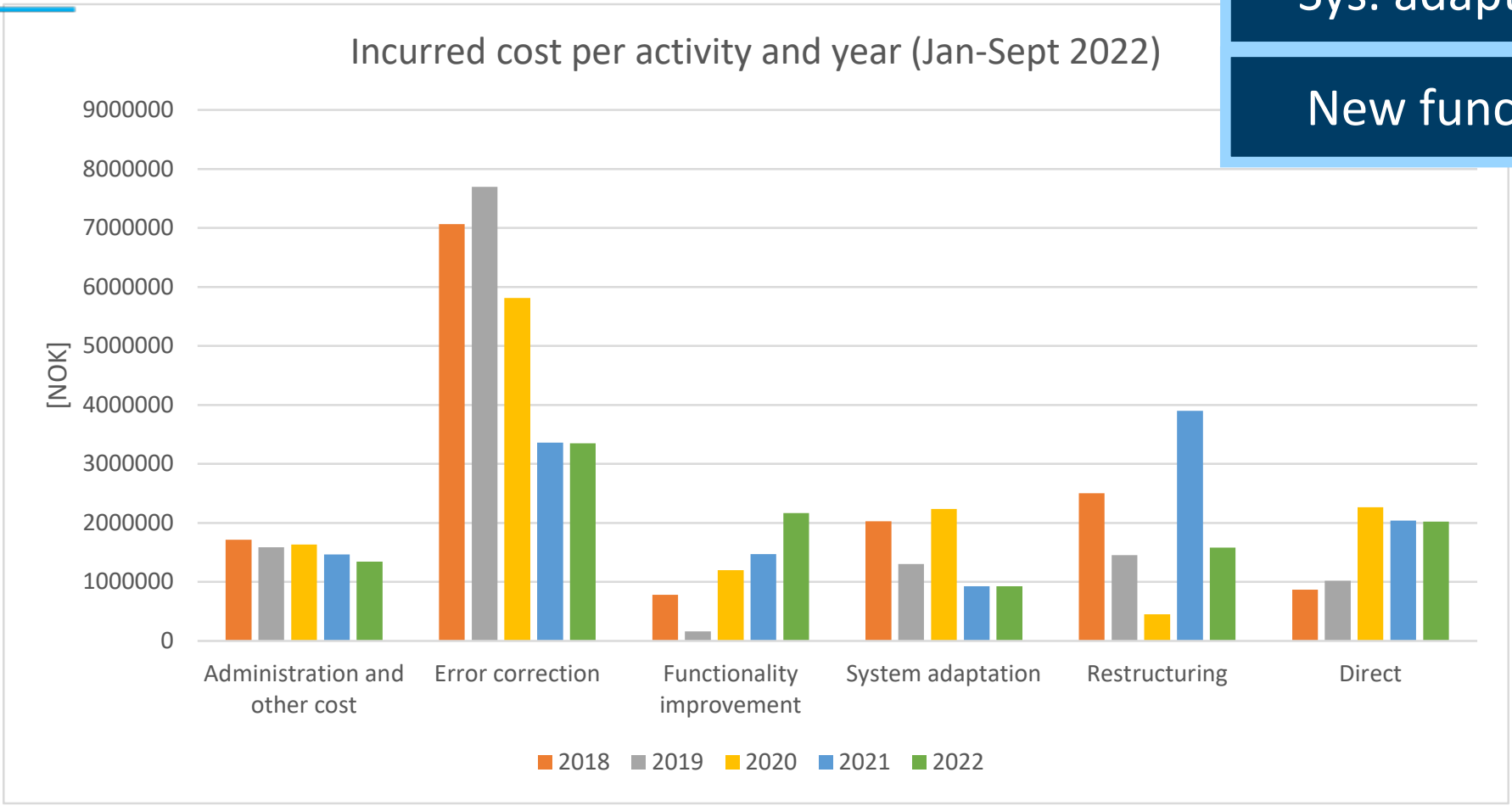
Incurred cost per delivery group

Error corrections	30%
Restructuring	30%
Sys. adaptation	20%
New functions	20%



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Administrative information

Contracts

Security protocol

High Performance Option 2022-24

Contracts

- Contract framework implemented for all customers
  - Purchase agreement defining the license
  - Maintenance agreement defining the content of the model project
  - New agreements are based on the public standard agreements (SSA) 2018 published by the Norwegian state.
  - Data management agreement (GDPR) is included in an appendix (currently appendix 10) in new agreements.

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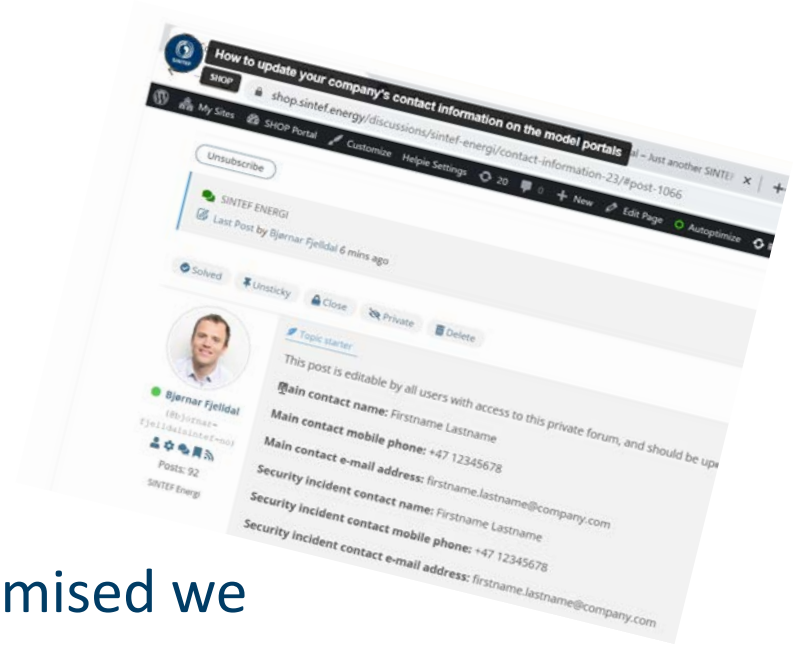
Security and incident handling



- If our solution for hydropower models is somehow compromised we need to be able to reach out to our users so that the problem can be contained.
- We have made a solution in the model portals where you can enter and update a contact point for security warnings in your company.
- The security contacts will get an automatic warning by SMS in case of an incident

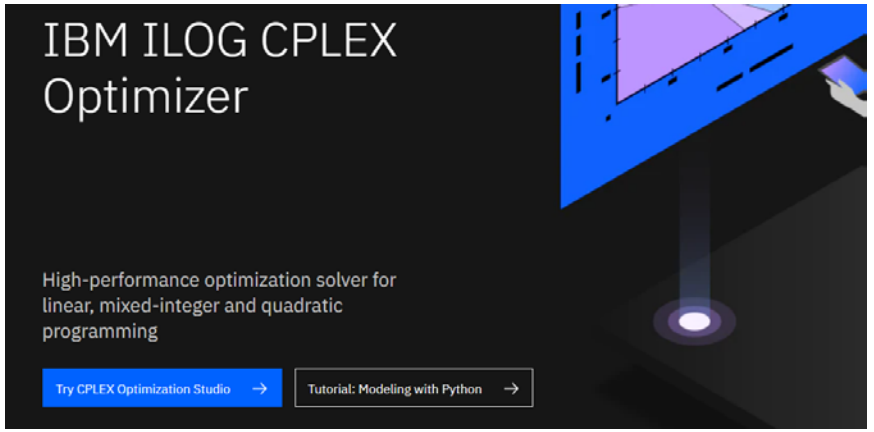
Status for the LTM portal with: Jonatan Lund

Security and incident handling

- Whenever the security contacts points are changed we will automatic update the list that goes into the automatic alarm call service and reprint a physical paper backup.
- The security management team consisting of SINTEF Energy's HMS and quality officer Grethe Aastorp and the management team for the hydropower tools will then take action and keep you informed about the incident and actions taken in SINTEF Energy until the situation is resolved.

HPO High performance option 2022-2024

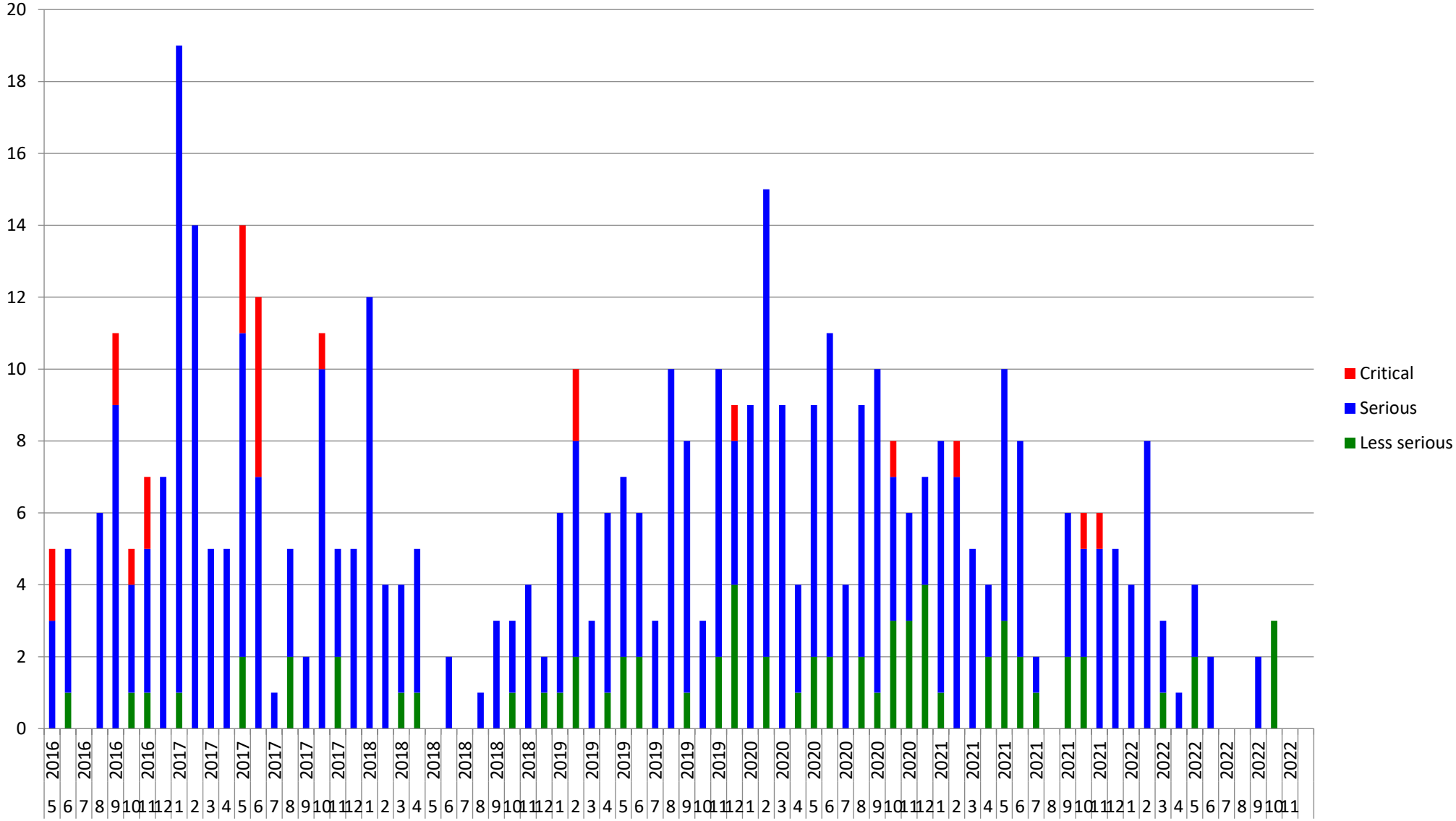
- We have renegotiated a three year contract for all-you-can-eat use of runtime license of CPLEX in the hydropower models and the associated prototypes.
- We have initiated a dialog with the development department in IBM with the aim of more efficient application and use of CPLEX in the models.
  - Set up a shared solution for exchange of cases, questions and answers.



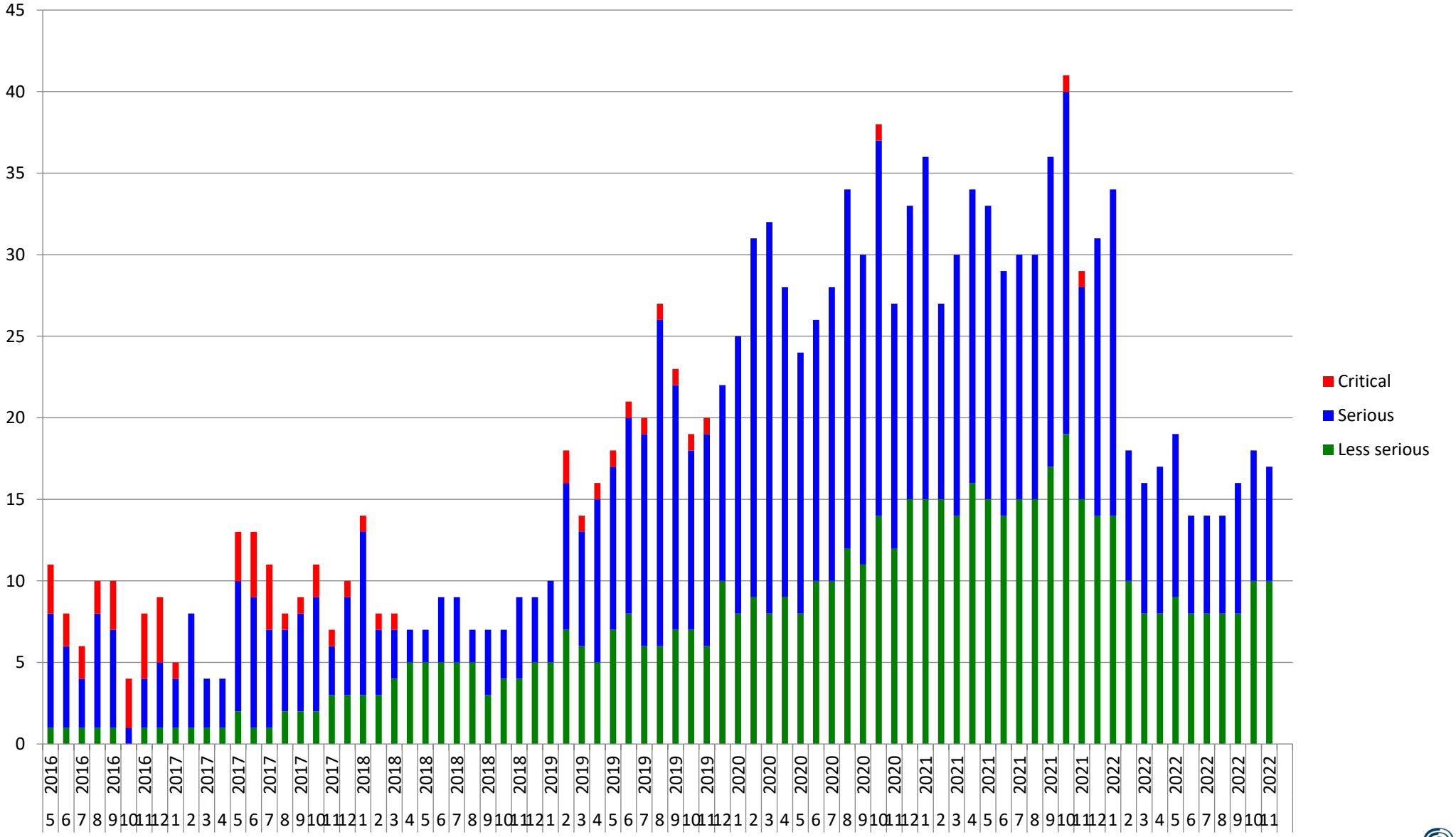
Error statistics

Bernt Garten Galtrud, Hans Ivar Skjelbred,
Hans Olaf Hågenvik,

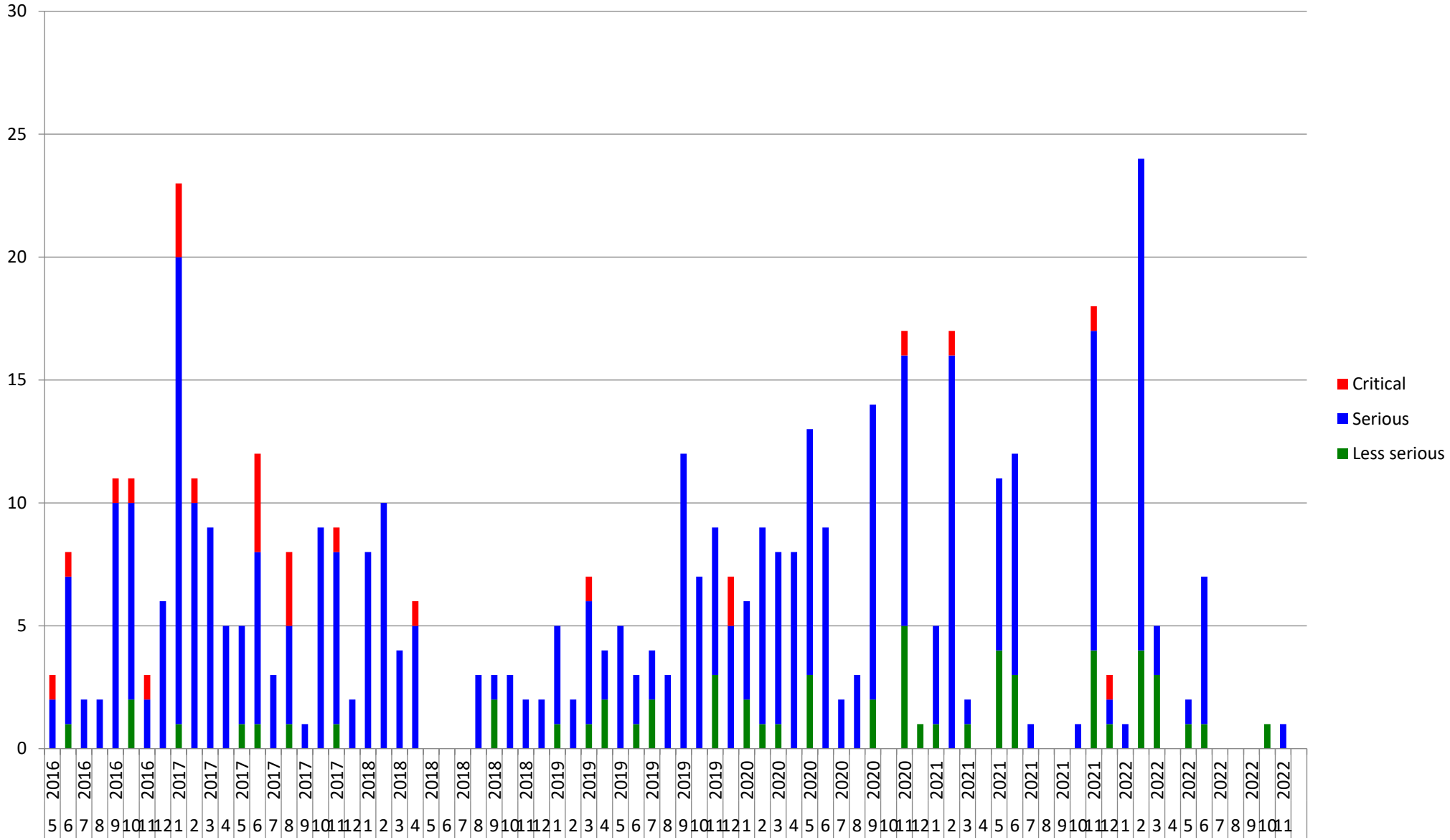
Reported bugs LTM



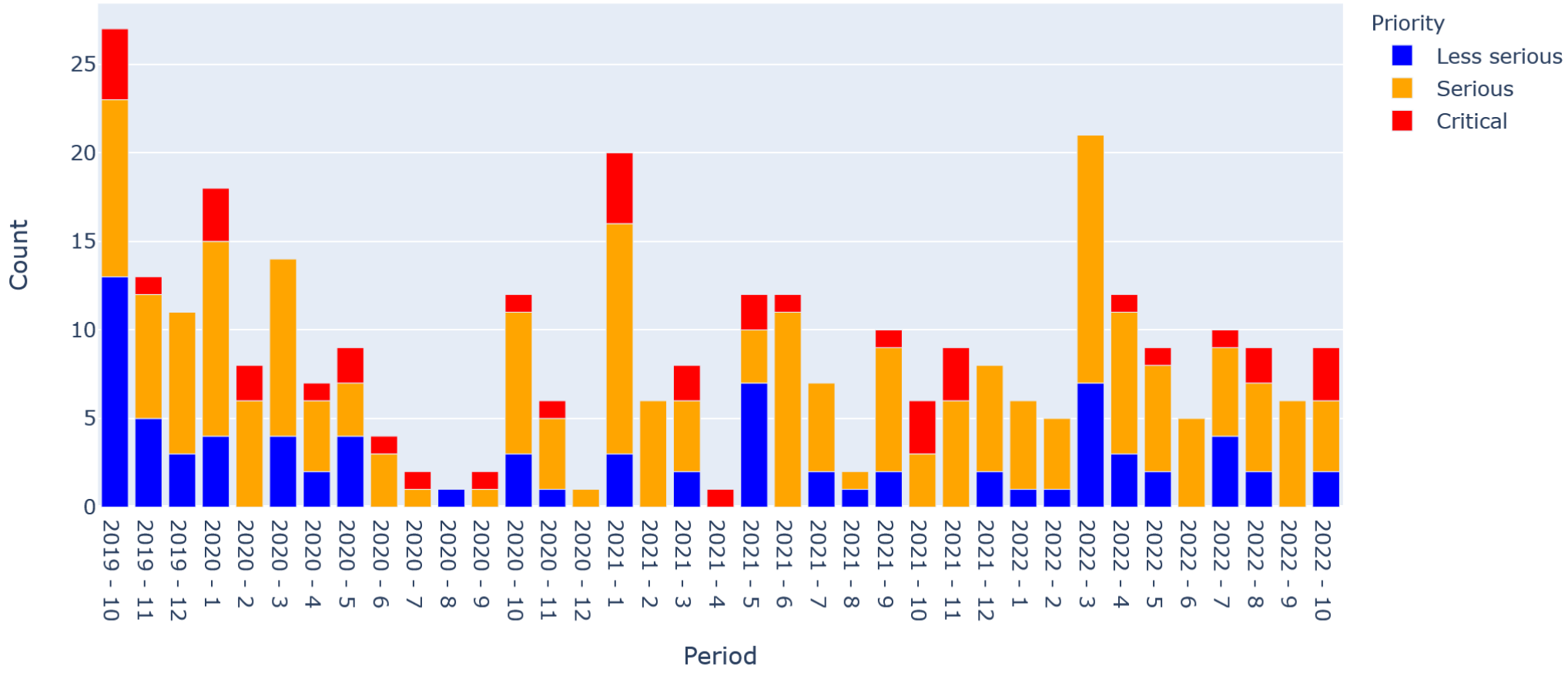
Open bugs LTM



Closed bugs LTM



Reported bugs SHOP



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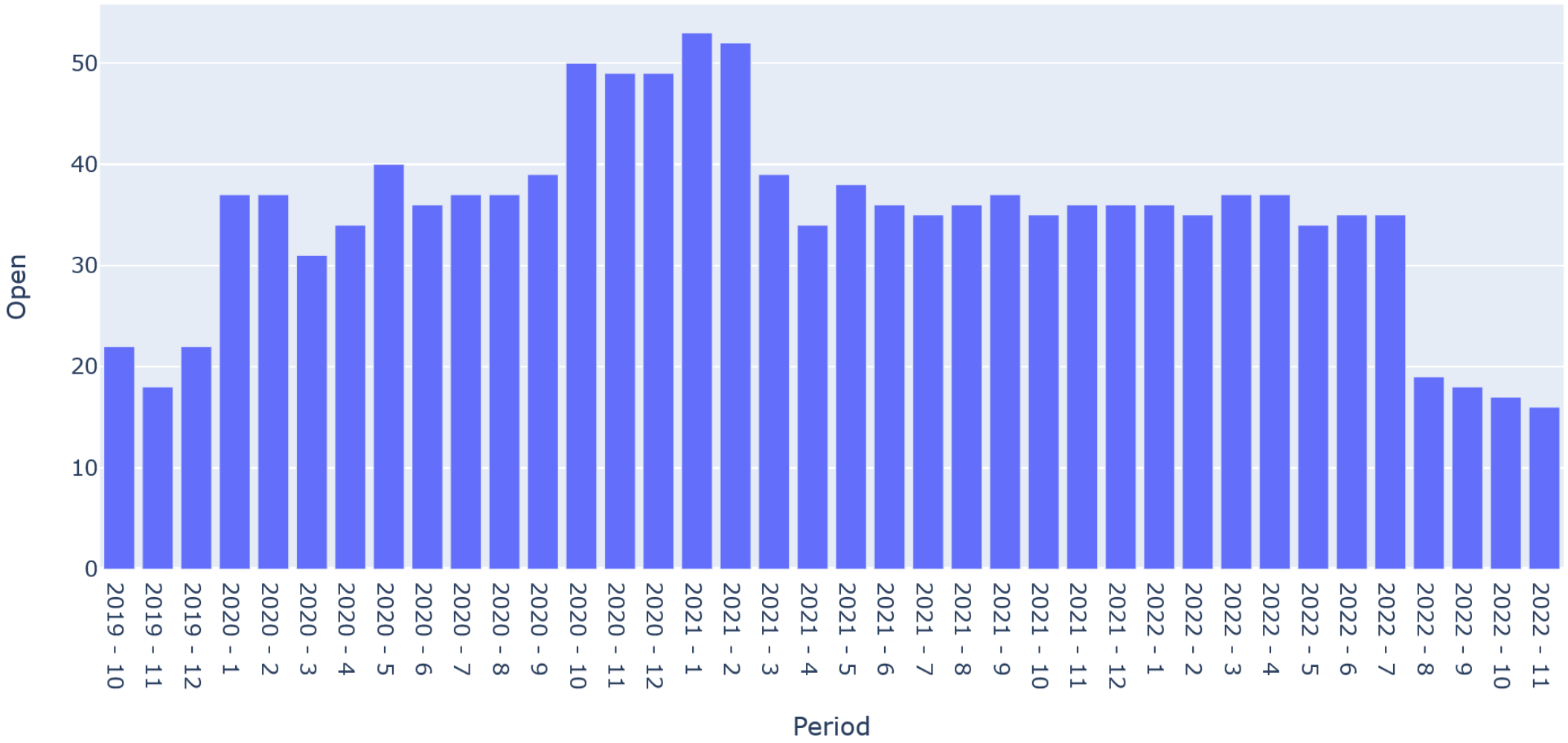
Open bugs SHOP



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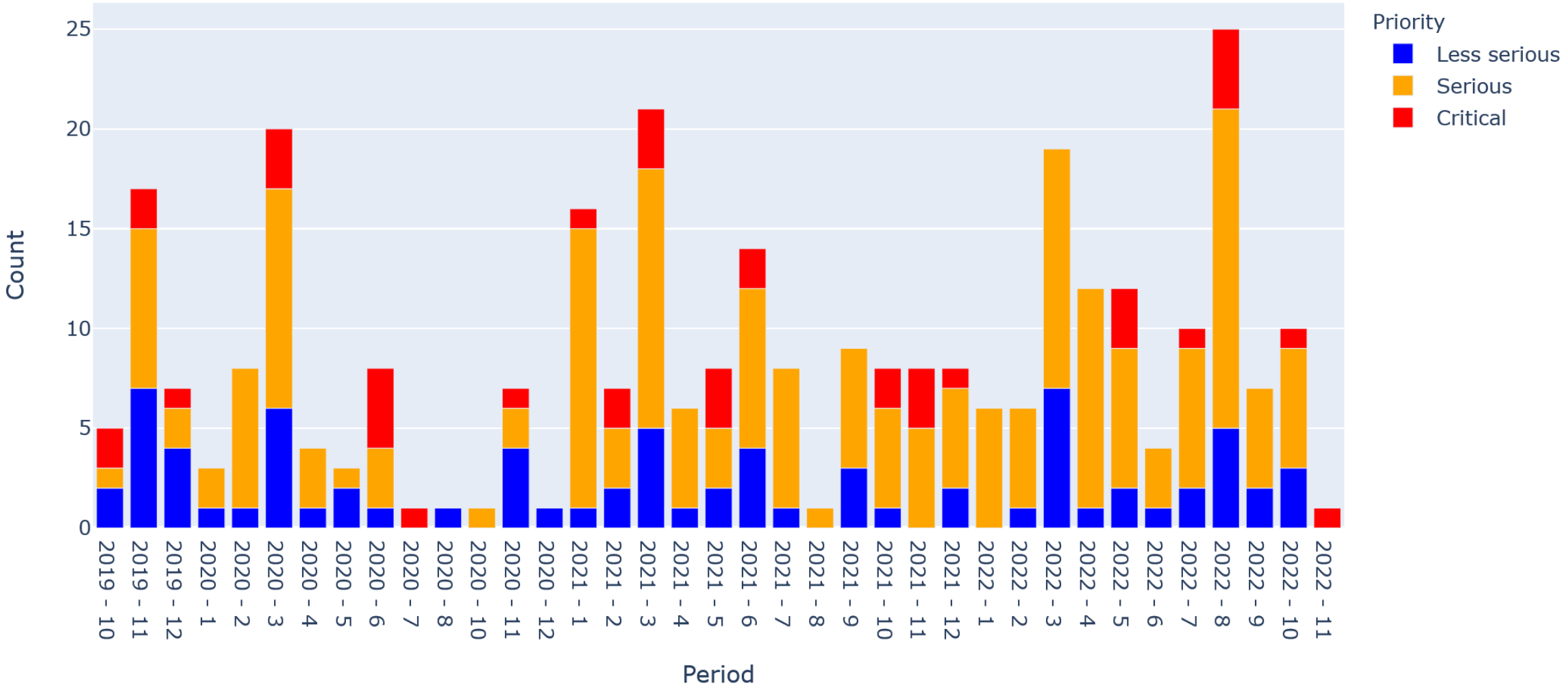
Closed bugs SHOP



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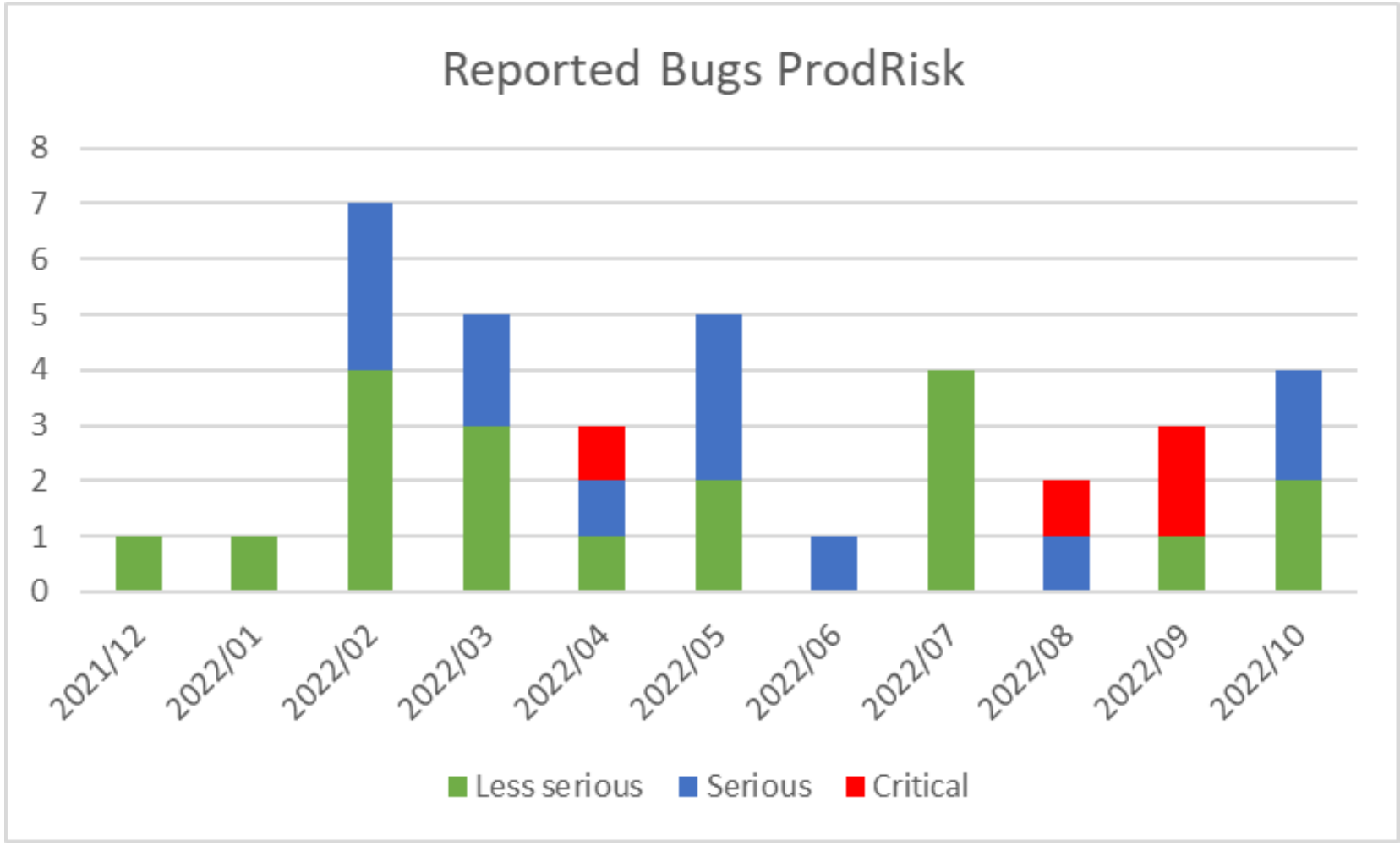
Reported bugs ProdRisk



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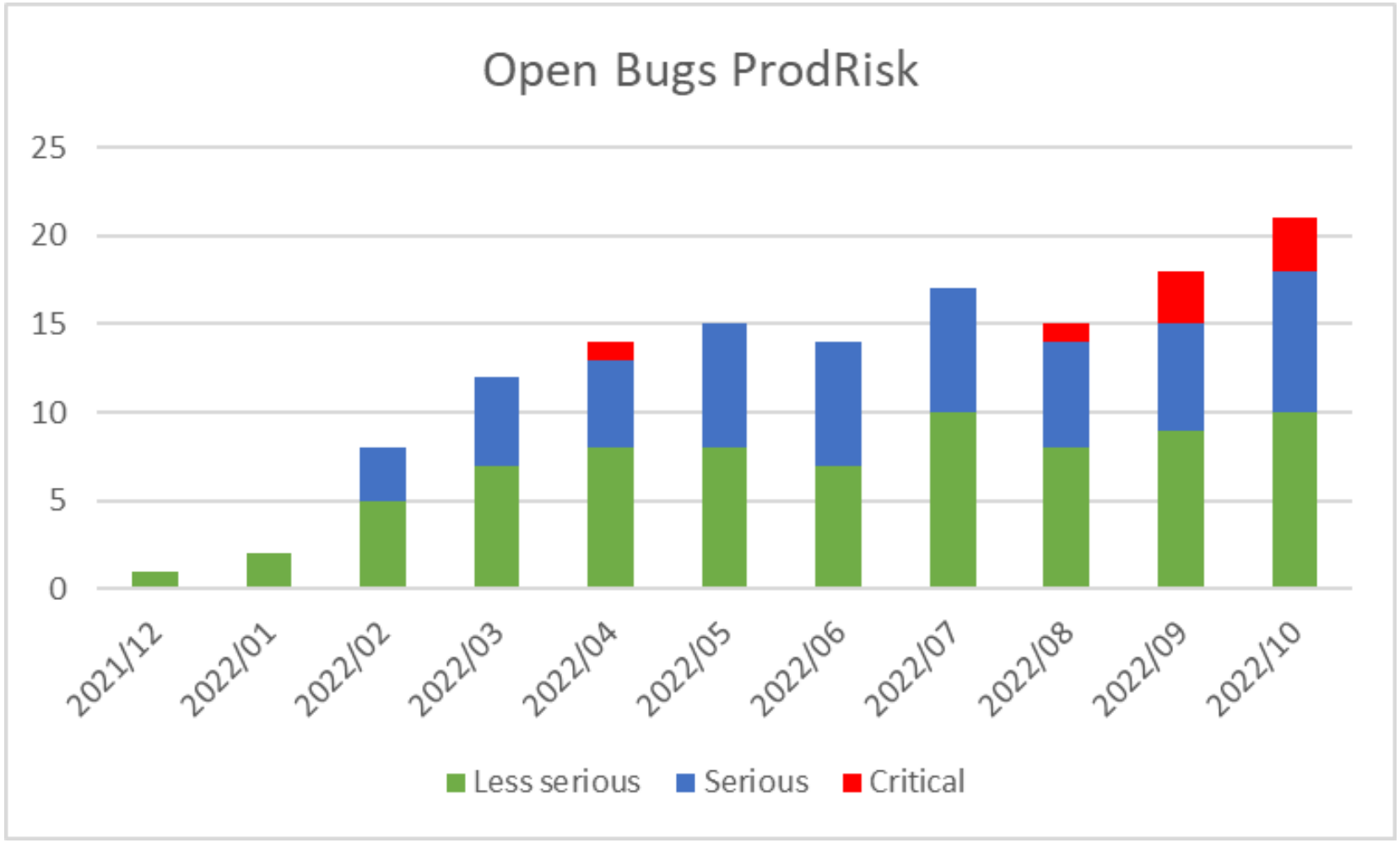
Open bugs ProdRisk



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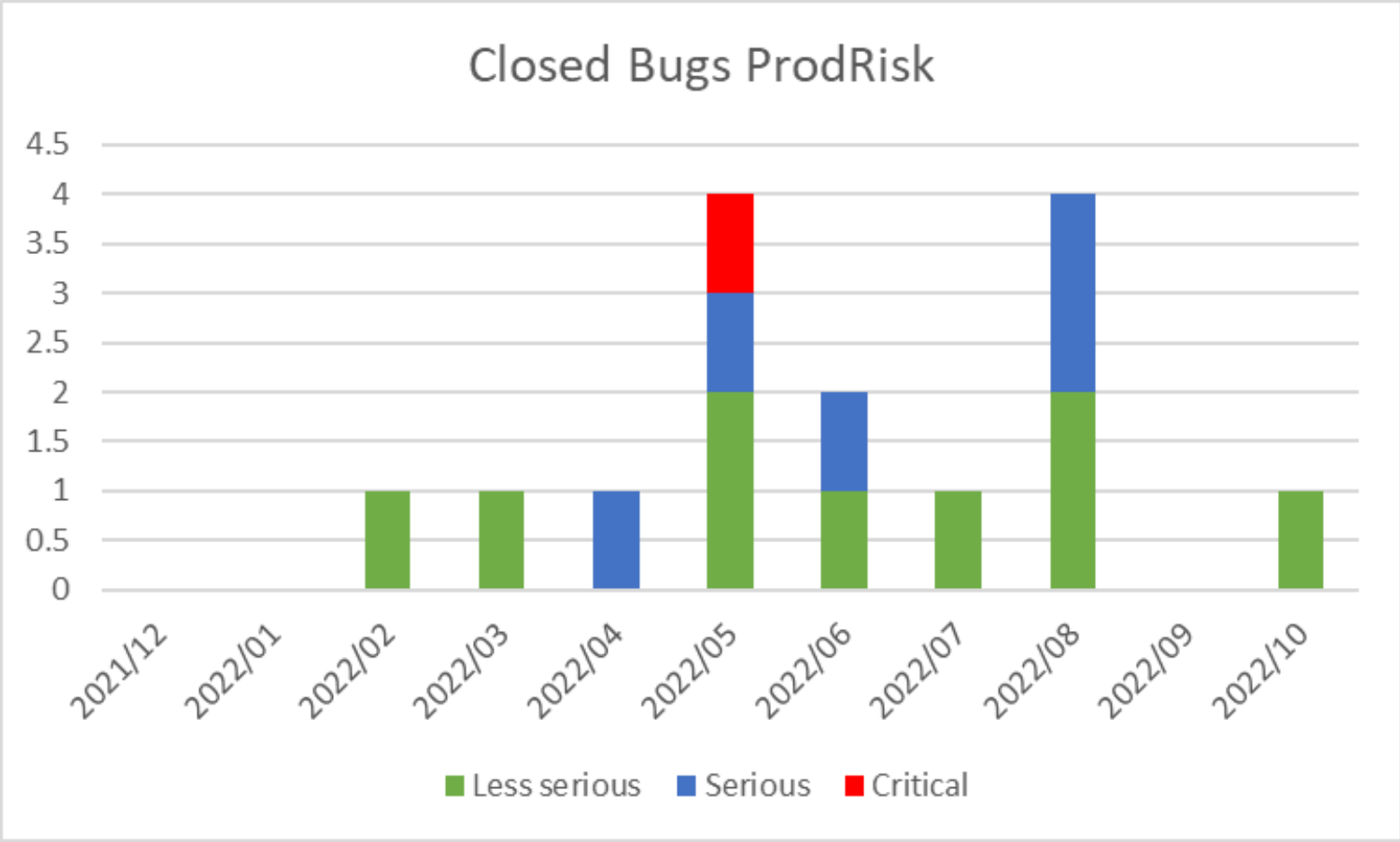
Closed bugs ProdRisk



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ProdRisk activities 2022

Activity type	
Error correction and documentation	E
Functionality	F
Restructuring	R
System adaptations	S

Activity	Planned in release	Activity type
Admin		
Bugfix and support	**All Releases**	E
HydroCen open calls: penalties	**10.3.0**	F
~~HydroCen open calls: cuts.h5~~	~~10.4.0~~	~~F~~
~~Elimination of redundant cuts~~	~~10.4.0~~	~~F~~
~~Message system~~	~~10.4.0~~	~~F~~
(Restructuring)	**10.3.0 /10.4.0**	R
Automatic build/test/release	**10.3.0**	S
Portal/lab	10.4.0	S
ProdRisk on linux	**10.3.0**	S

Releases 2022

Release	Date	
10.2.1	February 18th	Bug fixes
10.2.2	May 12th	Bug fixes
10.2.3	June 8th	Minor API features
10.3.0	**June 24th**	**Penalty logging. Linux version.**
10.3.1	September 30th	Bug fixes. Minor API features.
10.3.2	October 27th	Bug fix, API robustness issue.
10.4.0	**November 24th**	

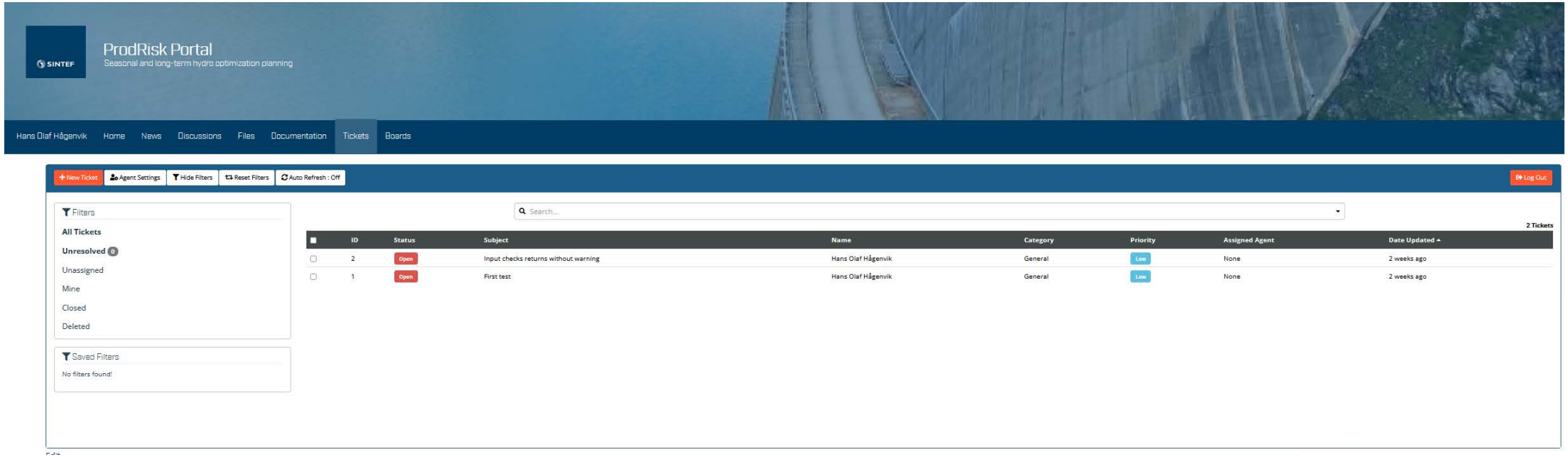
Pyprodrisk

- 1.0.0: Separate release through PYPI.
  - Allows using multiple ProdRisk-versions in the same pythonscript.
  - Don’t have to update whole python package each time a new version is put into use.

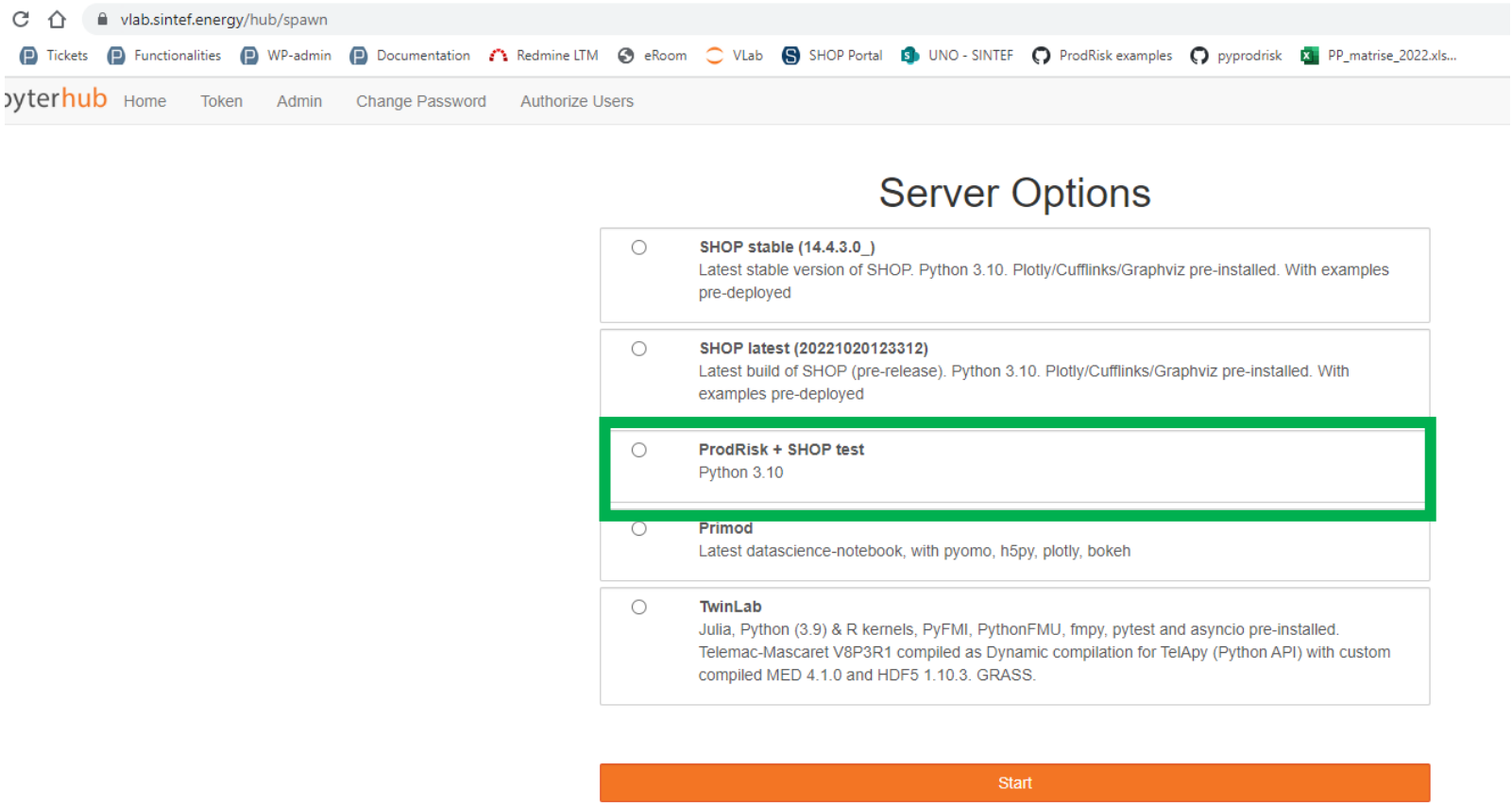
- 1.1.0:
  - Plot topology using prodrisk.model.build_connection_tree()
  - Get-routines returns None instead of «internal flags» for certain unset inputs.

- «pip install pyprodrisk --upgrade»

Ticket system on ProdRisk portal

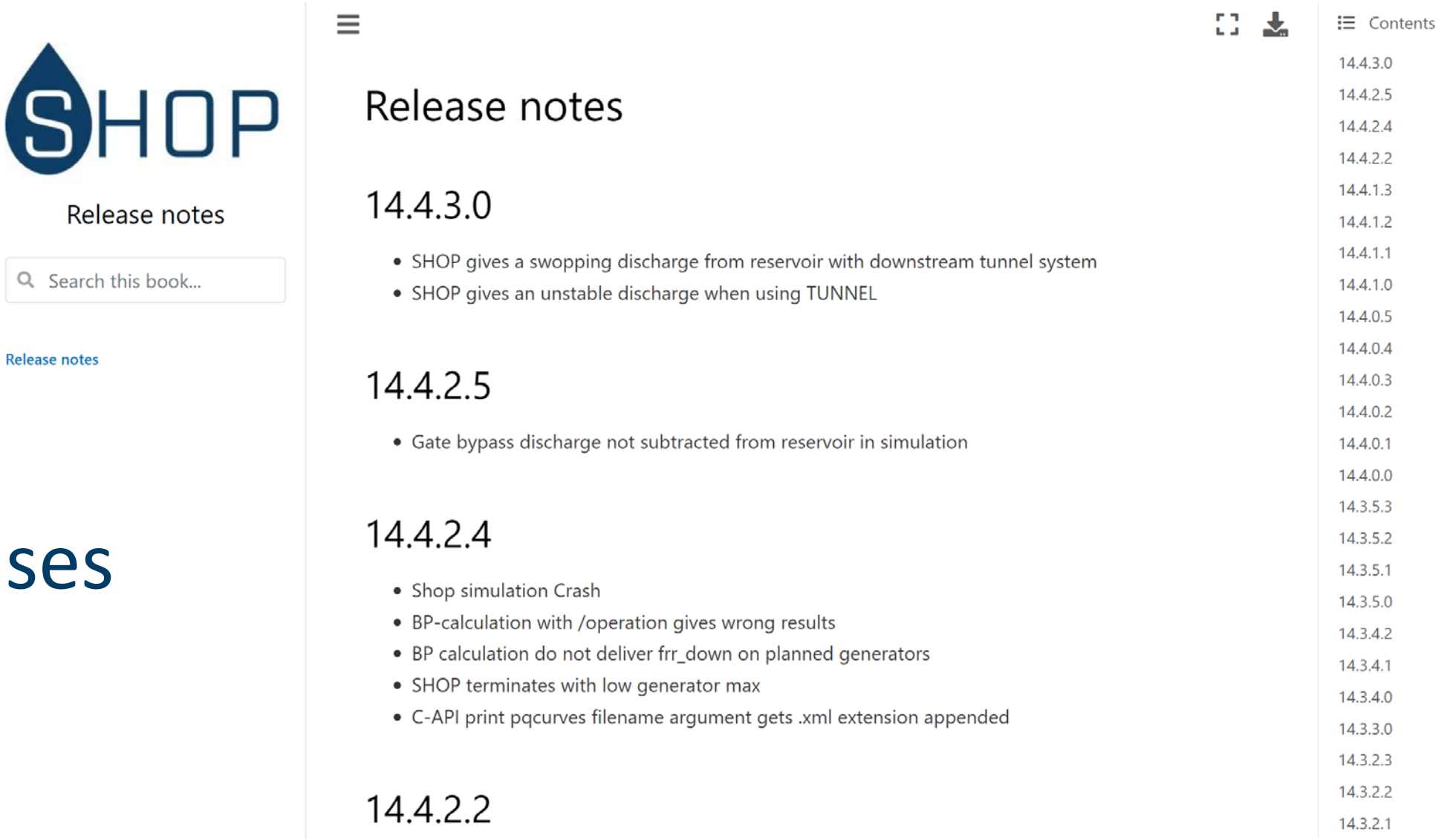


ProdRisk on the SINTEF Virtual lab



SHOP activities in 2022

- New release system
- Online courses
- Common place and format for all documentation
- License generator on SHOP Portal
- Partial conversion to operating ranges for all generators
- Completion of API with Contracts
- Internal restructuring



Releases 2022

- https://shop.sintef.energy/doc/release_notes/html/intro.html

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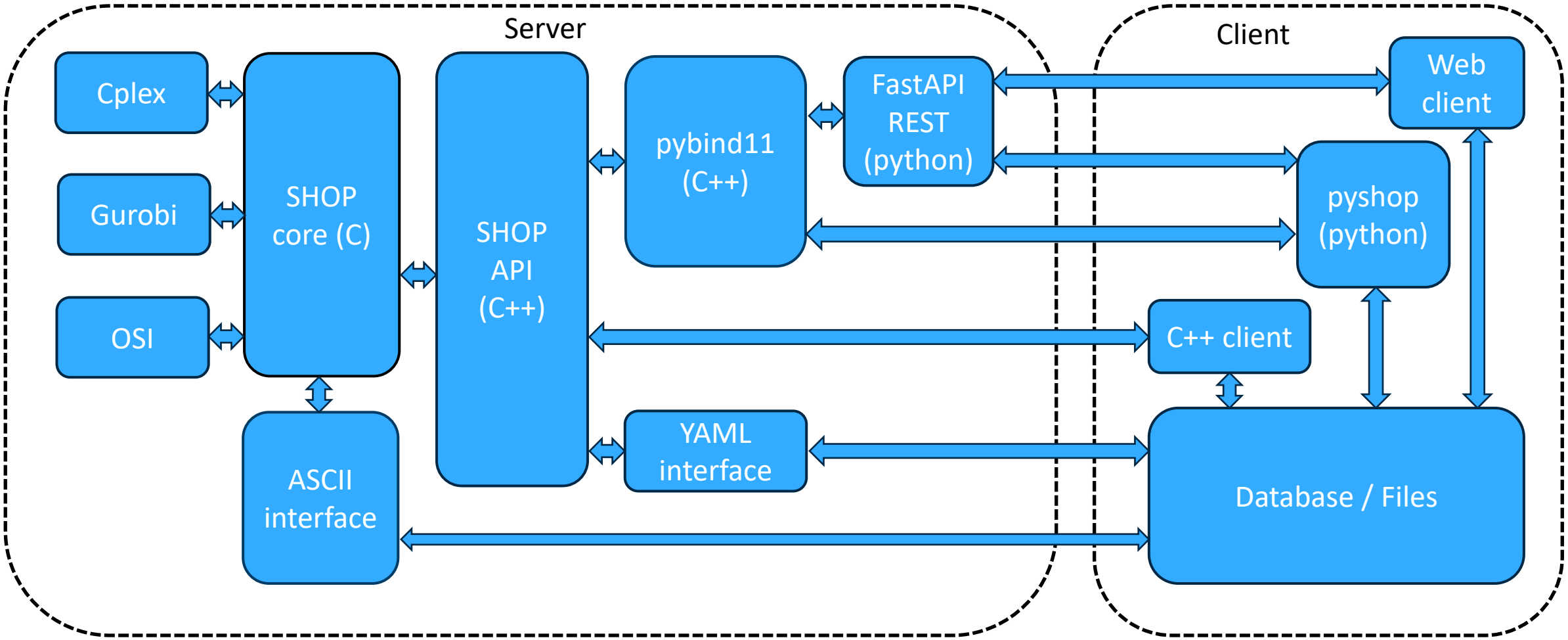
SHOP architecture



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Releases 2022 (LTM v10)

- 10.3 June 2022
  - Error corrections
  - Volue (Powel) database coupling
  - Complete Statkraft input functionality
    - Snow storage in water value calculation

Releases 2022 (LTM v10)

- R10.4 November 2022
  - Thoroughly tested calendar functionality
  - Documentation of new xml-formats
  - Error corrections
  - Prototype of LTM API for Linux (cooperation with Hafslund Eco)

  - New build system (SCons)
  - Improved set up for unit tests
  - Improved numerical consistency between successive EMPS runs

License funded projects in 2022

- Test and code improvements for LTM
- Autonomous Planning
- Efficiency curves in the models
- FANSI upgraded to V10

Test and code improvements for LTM

Toolchain improvements and housekeeping

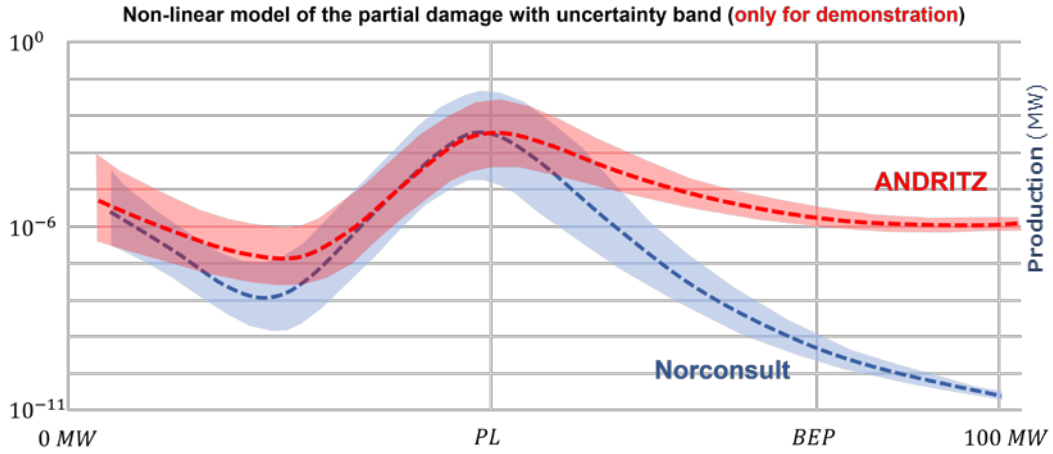
- Stable results
- Reproducible builds
- Robust regression detection (in progress)

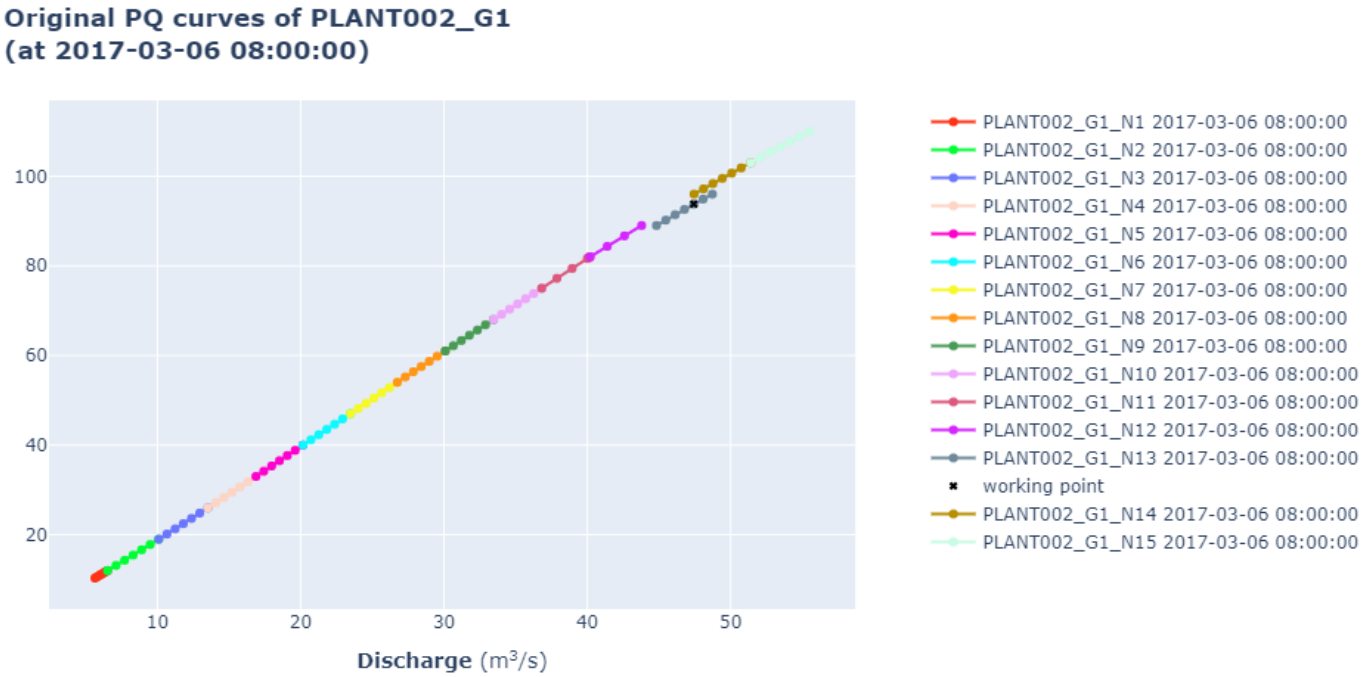
Build automation components

- Conan – Package manager
- Scons – Build system
- GitLab – CI/CD

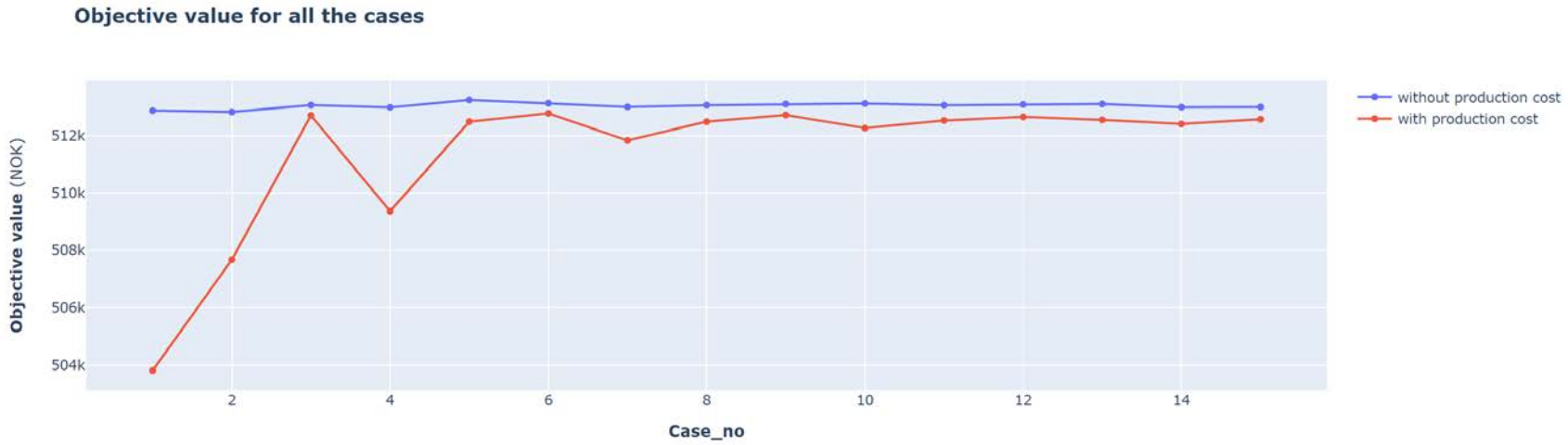
Efficiency curves in the models

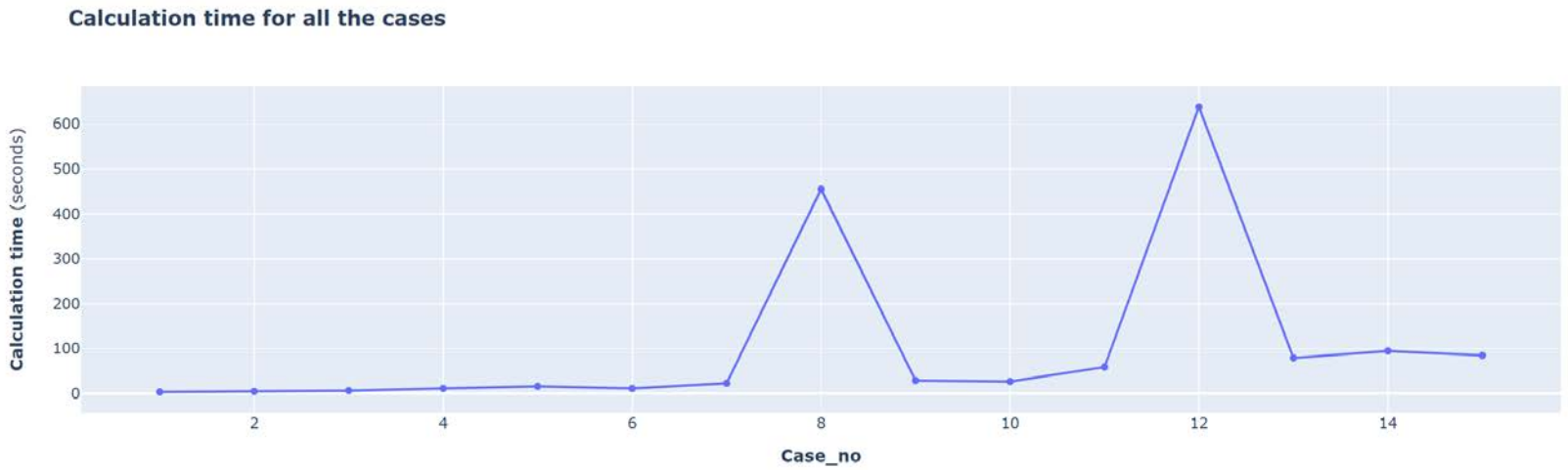
```
static
TYPE_META_INFO reserve_gen_ramping_var_meta =
{
  VAR_OBJECT,
  SHOP_RESERVE_GEN_RAMPING_VAR,
  "Reserve generator ramping", "Rgrp",
  7, 7,
  { TIME_INDEX, SCENARIO_INDEX, PLANT_INDEX, GENERATOR_INDEX, NEEDLE_COMB_INDEX, RESERVE_TYPE_INDEX, UP_DOWN_INDEX, 0, 0, 0 },
  dynamic_var_row_all_used_functions_array,
  all_used_var_row_index_functions_array,
  0,
  POWER_UNIT,
};
```





Consistency- and performance valuation for autonomous planning





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FANSI upgraded to V10

- Original budget 700 kNOK used
- Status:
  - Upgraded input and output files
  - Adapted data structures and subroutines to v10
  - Tested on HydroCen 2030 dataset:
    - Runs, but some minor problems remain
    - Testing and error corrections not finished
- Further budget needs (~200 kNOK) must be resolved

ngLTM

- Presented by Stefan Jaehnert

LTM Release plans 2023

- 10.5 June 2023
  - Fix errors reported by customers
  - Thoroughly tested calendar functionality
  - Auto tests: Loop over lists of functionality, contract types, time resolution etc
  - Doc: Finalize existing description of new v10 apps (Ltm, Upgrade_10, …) and calendar/timeseries.
  - Doc: Tables with data flow (apps and files)
  - Ltm-application (create and delete new EMPS-areas)
  - Portal: New ticket system, distribute releases, upload data sets and forum.

LTM Release plans 2023

- 10.6 November 2023
  - Fix errors reported by customers
  - "LTM-core-API": Read/write ENMD, DETD, MASKENETT.DATA, PRISAVSNITT.DATA…
  - Autotests: Loop over flex user input (based on work of summer student 2021)
  - LTM Portal: First version of documentation
  - New functionalities: To be decided. Suggestions are welcome!

Release plans –inputAPI version

- After agreement

Long-term development

- Believe LTM will be the main tool 5-10 years ahead even if implementation of next generation tool goes as planned.
  - Supplemented with EMPSW/FanSi/PriMod for special analysis.
  - These models are using the same input, output and internal data structures.
- Important to build and maintain competence and make needed improvements.
- New large research projects, proposed by SINTEF, will be connected to, FanSi and/or PriMod type models/algorithms

LTM Roadmap drafts

- Development based on customer feedback
  - Foresee a lot of new wishes when version 10 is operational and integrated into your own systems
- Scenario (uncertainty) type functionality for all contract types
- Complete API
  - All input through API
  - Error messages
  - Initiate a model setup from scratch through the API
- Documentation
- Implementation of more automatic testing
- Customer portal
- LTM on Linux?

ProdRisk Roadmap drafts for 2023 ->

- Stefan R.

Release plan 2023 (Follow LTM releases)

Release	Date	
10.5.0	June	??
10.6.0	November	??

- Minor releases as needed

Fra kontrakter

Tabell 2: Spesifikasjon av ytelsene

Nr.	Ytelse	Kommentar
2.1	1. linje support - brukerstøtte	Faktureres
2.2	2. og 3. linje support – håndtering av feil	Inkludert
2.3	Leveranse av nye forbedrede versjoner	Inkludert
2.4	Generelle systemtilpasninger av modellene	Inkludert
2.5	Restrukturering og levetidstiltak	Inkludert
2.6	Engangsordre – utbedring av avdekte svakheter i modell	Faktureres

Leverandøren vil tilstrebe at ressursene som benyttes til de inkluderte ytelsene for hver enkelt modell over tid skal ha følgende fordeling:

- Feilretting 30 %
- Restrukturering 30 %
- Systemoppgradering 20 %
- Ny funksjonalitet 20 %

Differansen mellom tilgjengelige og benyttede midler overføres til det påfølgende året.

Kvalitetssikring av ytelsene baseres på SINTEF konsernets kvalitetssikringssystem som beskrevet i SINTEF konsernets styringssystem. Prosedyrer som er relevante for å sikre en forsvarlig gjennomføring vil bli benyttet.

Leverandøren skal en gang i året presentere gjennomførte tiltak og deres konsekvens for programvarens kvalitet og levetid. Dette gjøre felles for alle kunder i forbindelse med Brukerforum og/eller Brukermøter.

Release notes, for alle modellene, inneholder følgende elementer:

- Forskjellen mellom den nye og forgående release.
- Kjente feil og svakheter.
- Varsel om fremtidige endringer i grensesnitt og funksjonalitet.
- I tillegg har Leverandøren og Kunden intensjon om å utvikle innhold og format for testdokumentasjon som viser hva som er testet og gir måltall for endring i ytelse og regnetid sammenliknet med tidligere releaser.

System upgrades

Automized workflows
- Set up automatic release-process
- expand the test system

Robustness in the API
- Improved logging
- Further consistency checks of input (in the C++ API implementation)

Reduced data transfer through files
- More lucid run directory
- less read/write disk operations

Portal, lab, and open repositories

- Continue to improve documentation on the portal
- Possible to extend functionality on the portal/lab based on requests from the users
- Facilitate getting started with pyProdRisk, e.g. expand "prodrisk_examples" on github

Restructuring the core

- Data structures
- Improved modularization
- MPI Communication
- Streamline code for weekly LP problems

Ideas for development / operationalization

- Elimination of redundant cuts for SHOP

- Operationalization: HydroCen Open calls
  - Cuts.h5, with the states the cuts are made for (reservoir volumes, weekly inflows)

ProdRisk Forum

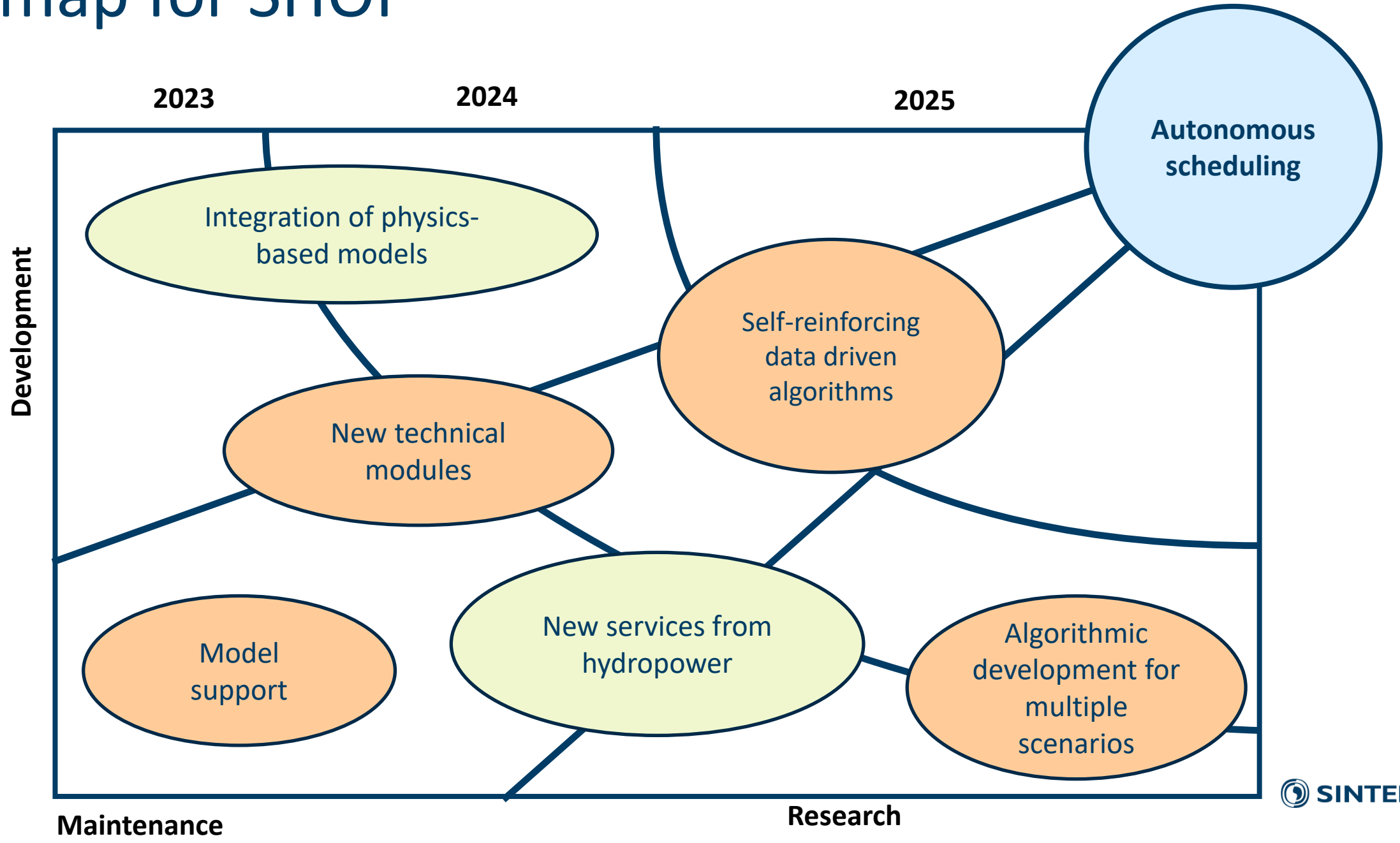
- February?
- Preferences regarding digital/physical?
- possible content:
  - work plan 2023
  - update on other ProdRisk related projects:
    e.g. HydroCen, IMPRO, test system
  - user experiences, ideas for development and maintenance project

Planer – roadmaps SHOP

Roadmap and future SHOP-releases

- SHOP 14.3 was released on 18/02-22
  - First version of River module
  - Fix for time-dependent reserve group membership in ASCII files 13/05-22
- SHOP 14.4 was released on 01/06-22
  - Prioritized reserve functionality
  - Preliminary reserve capabilities
- SHOP 14.5 to be released on 17/11-22
  - Operational version of River module
  - Contracts in API
- SHOP 15 to be released on 31/01-23
  - Operating areas for all turbines
  - pyshop logging

Roadmap for SHOP



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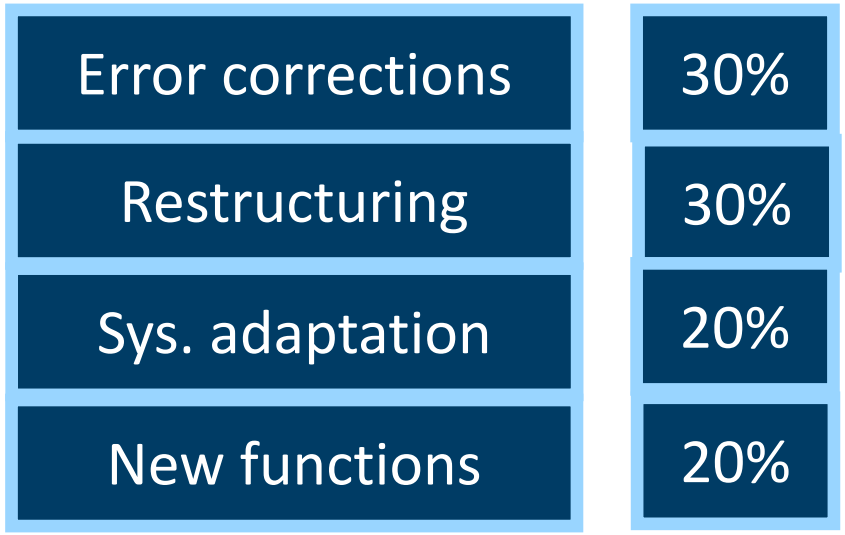
Questions for the break-out sessions

- What you would like to see included in the short- and long-term roadmaps for the SINTEF models?

- Suggestion
  - Within each delivery areas?



- If time: What are your recommendations for next user-forum?

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