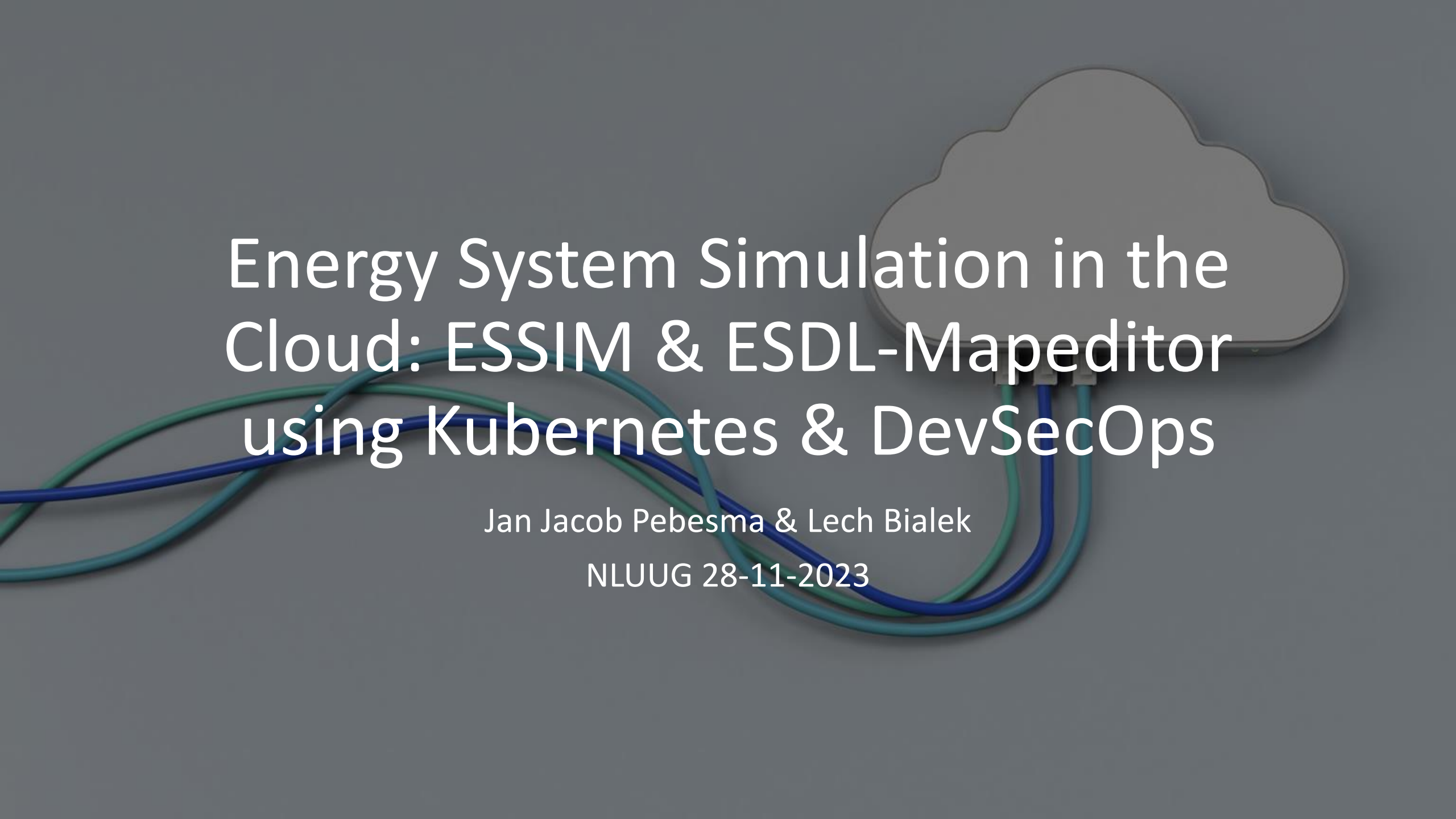

Energy System Simulation in the Cloud: ESSIM & ESDL-Mapeditor using Kubernetes & DevSecOps

Jan Jacob Pebesma & Lech Bialek

NLUUG 28-11-2023

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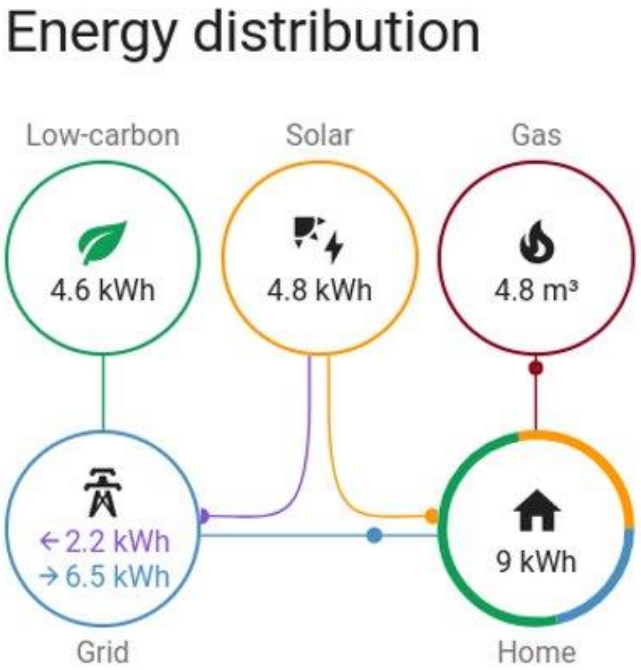
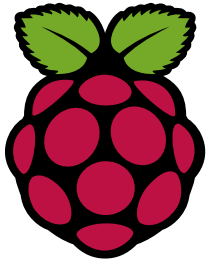
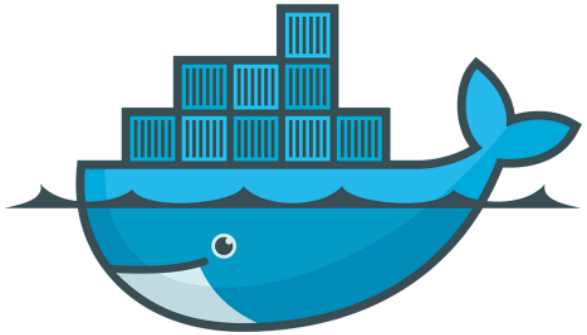
1. Introduction

Jan Jacob Pebesma

- 22 y/o
- Hanze UAS
- 4th-year ICT-student
- Network Security Engineering
- Smart Energy
- Internship at DSO
- Student Assistant







PROXMOX

zigbee

Lech Bialek

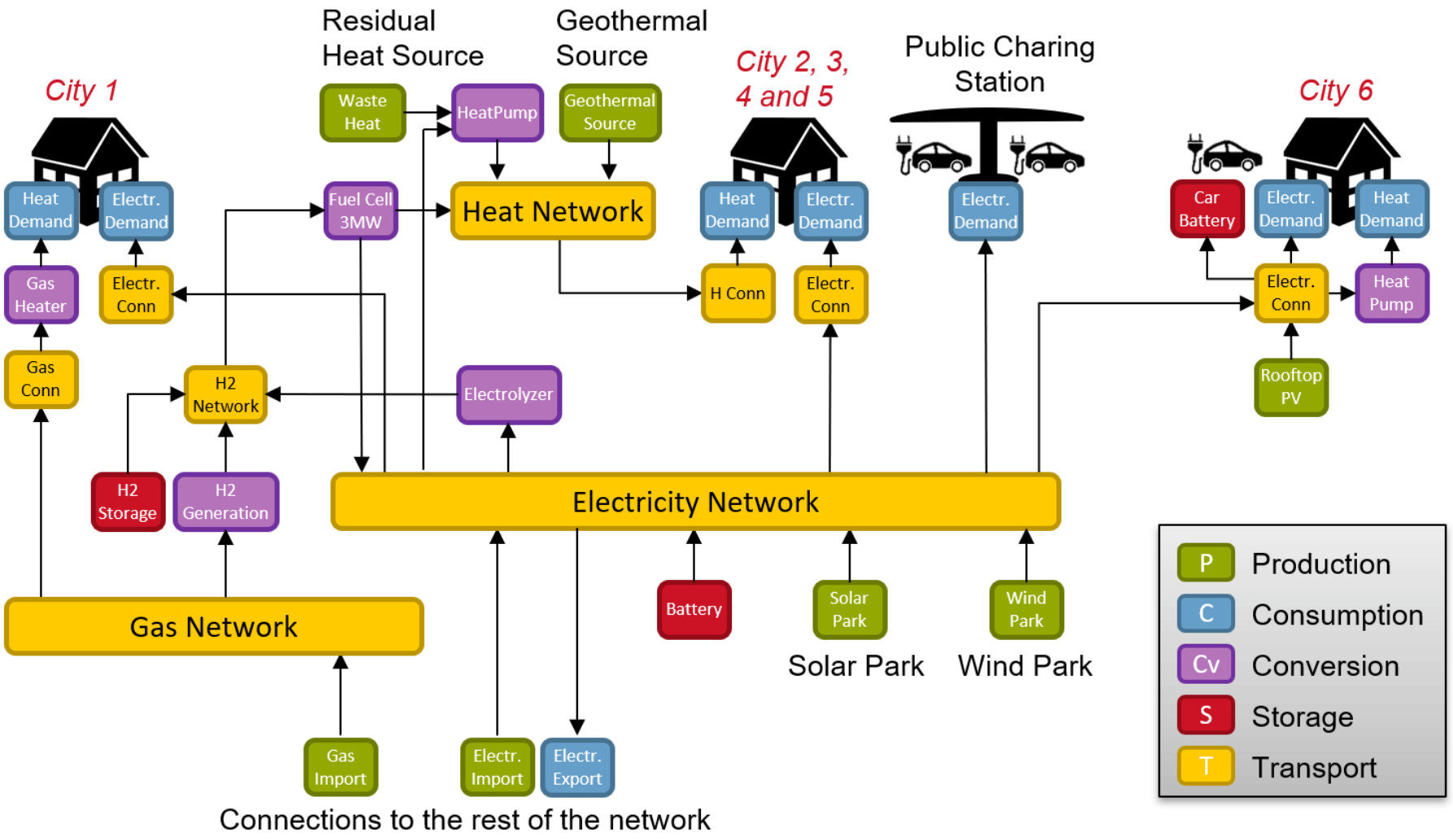
- 43 y/o
- Eternal student (i.e lecturer)
- Energy & Environmental Sciences – Groningen University
- Software Engineering – Hanze UAS
- Researcher at professorship New Business & ICT
- Hobbies: tinkering with software and sim racing

2. Context

Digital Transformation & Energy Transition

What is happening right now?

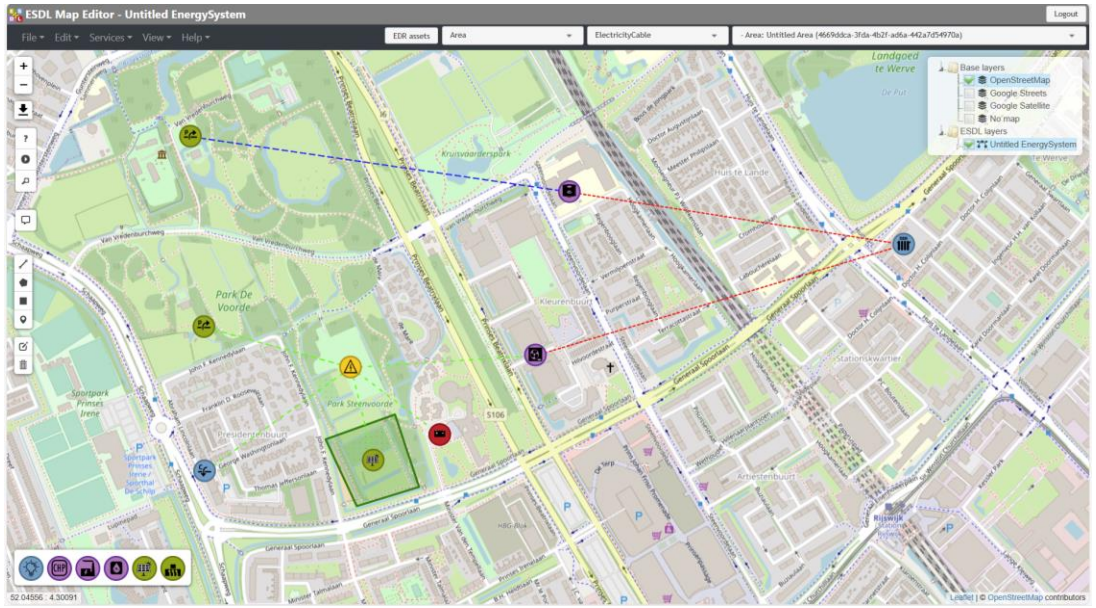
ESDL: Energy Systems Description Language



Source: [ESDL (Energy System Description Language) - Energy.nl]

TNO – ESSIM/ESDL

- Developers and maintainers of the ESSIM/ESDL toolsuite
- Dutch Organization for Applied Scientific Research
- TNO's mission is to generate innovative solutions with demonstrable impact to achieve a safe, healthy, sustainable, and digital society and boost the earning power of the Netherlands



Source: https://www.tno.nl

ENTRANCE – Centre of Expertise Energy

- “Innovatie werkplaats”
- …where research, education and professional practice come together
- Professorship System integration in the energy transition
- Users of ESSIM/ESDL in research and education

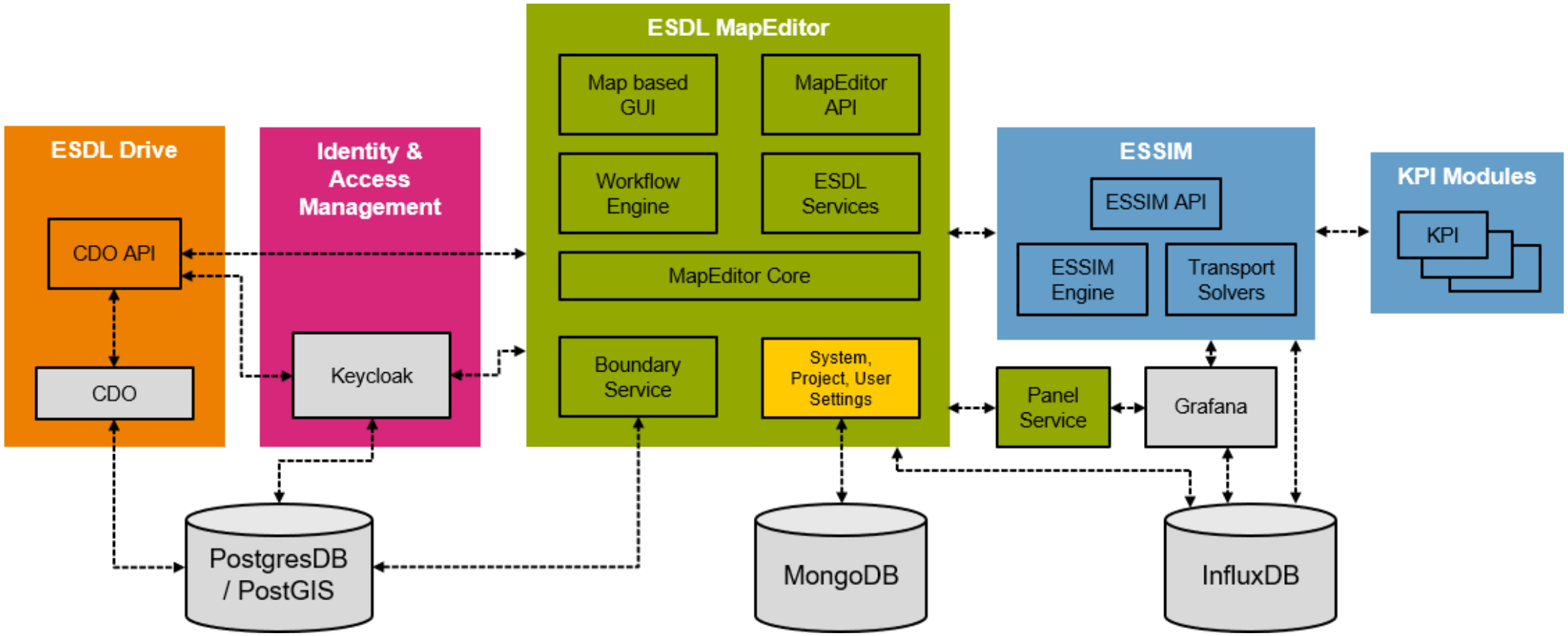
Demonstration

- Load ESDL-file from ESDL-Drive
- Simulate using ESSIM
- Show results in Grafana

3. Challenges

Moving to the Cloud and using DevSecOps

ESSIM/ESDL architecture



Source: https://github.com/ESDLMapEditorESSIM/docker-toolsuite

ESSIM/ESDL @ Hanze

Running ESDL-mapeditor locally:

- Managed employee laptops
- Unable to install Docker desktop
- 3 separate Docker compose files
- Resource usage/battery drain
- Solution

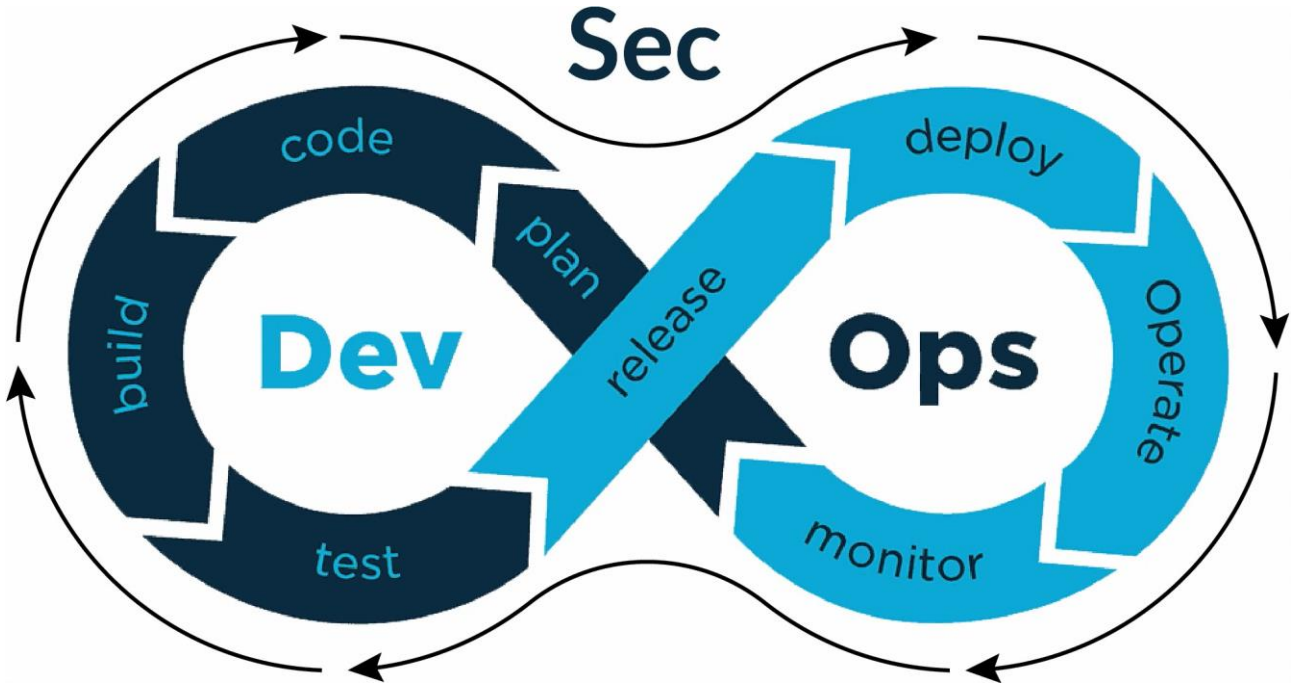
Hanze – DevSecOps learning community

HBO-ICT learning community

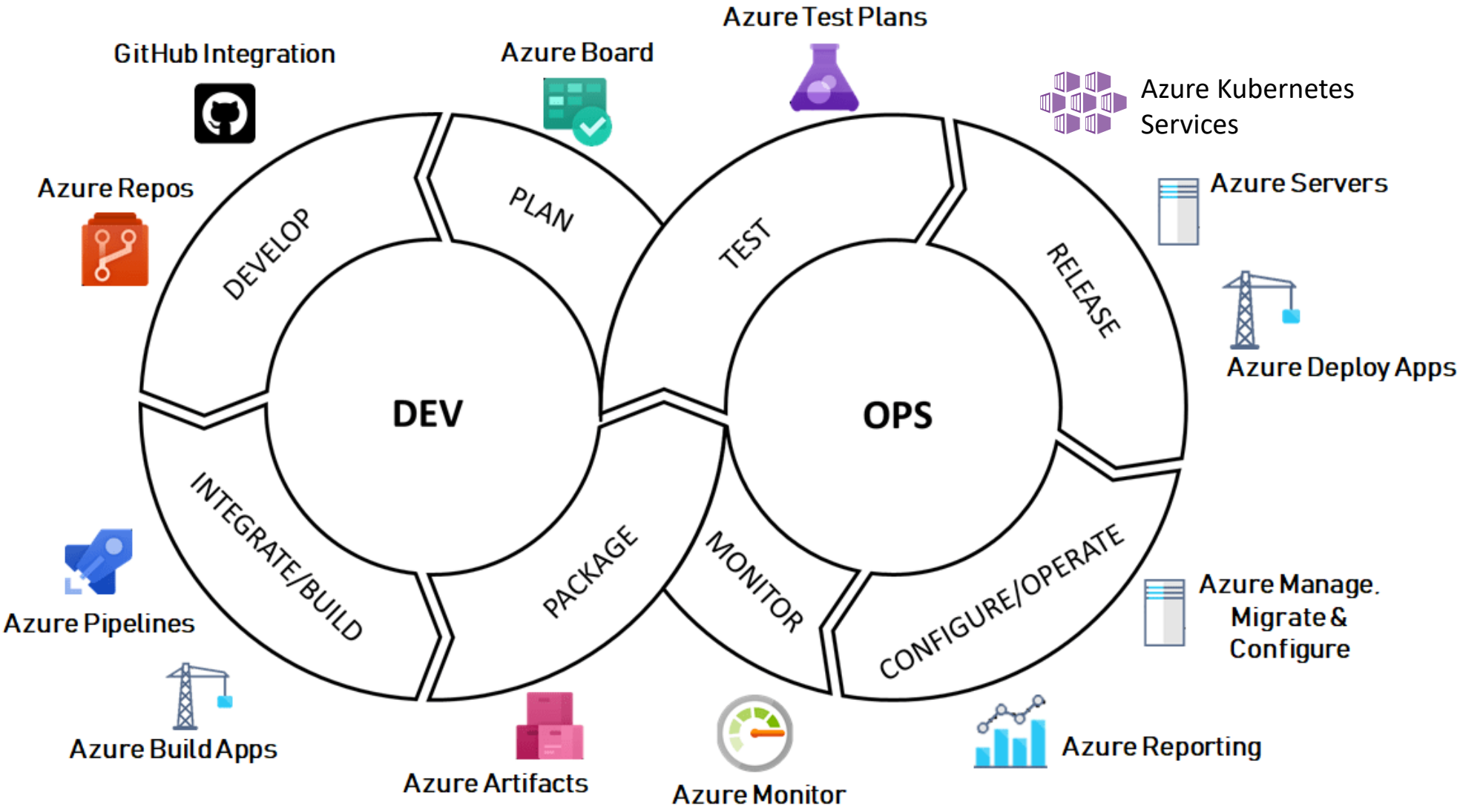
- Development
- Security
- Operations

Digital transformation:

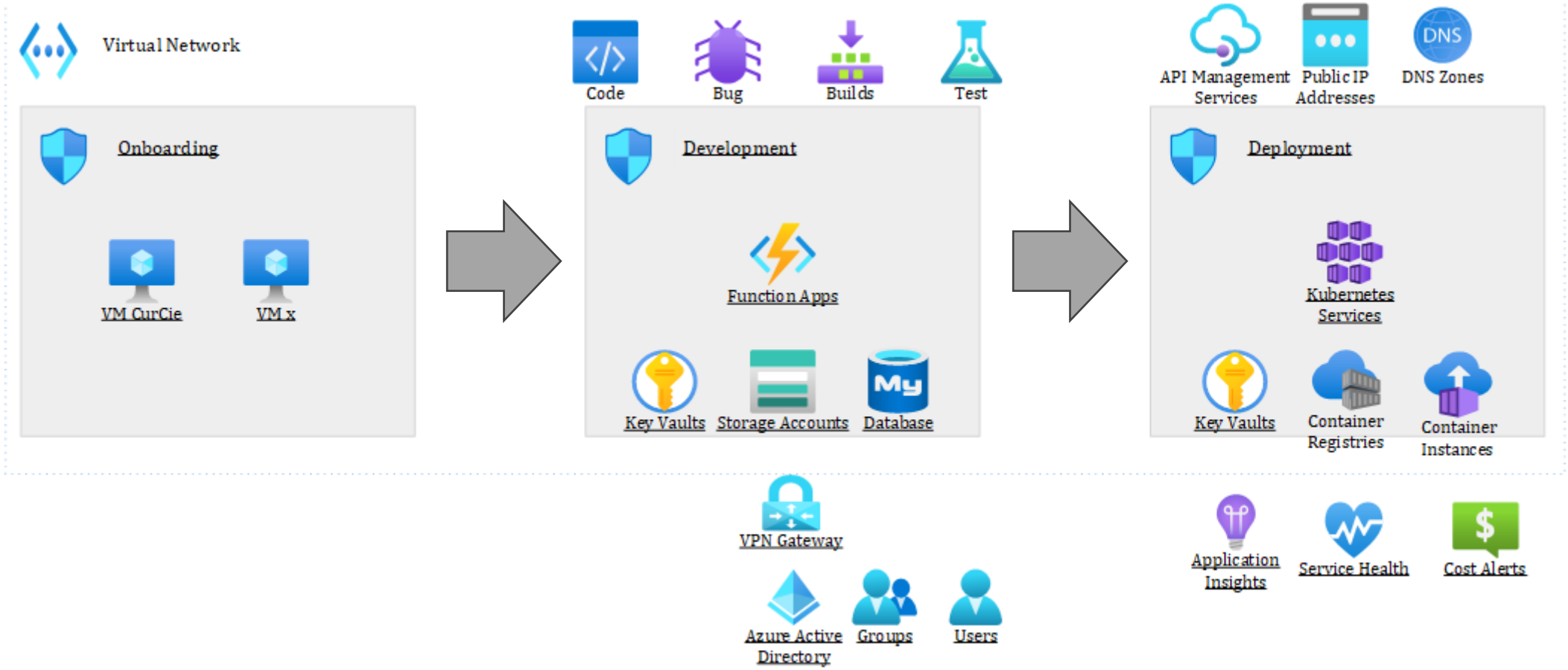
- Smart Mobility
- Energy
- Healthy Aging
- Agriculture



Tooling@Hanze? – Azure DevOps services



Onboarding process…



4. Lessons Learned

Moving to the Cloud and using DevSecOps

Phase 1: Azure VM

- Ubuntu VM with Docker
- Improvements docker-toolsuite
- Researchers start using our implementation…
- But Hanze policy says… NO VMs!

Ubuntu

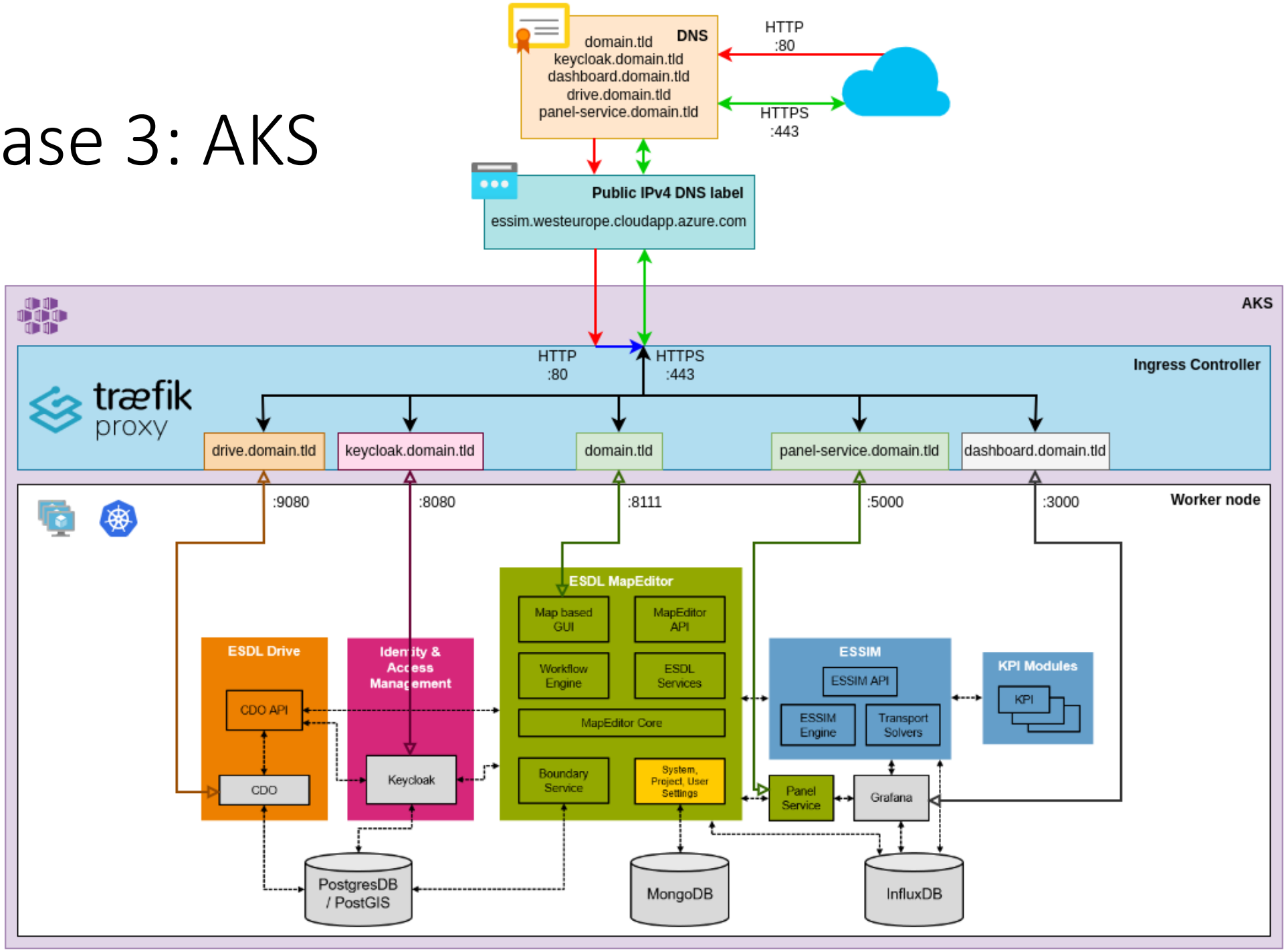
Stress testing with researchers

- Biggest ESDL file
- Unresponsive
- VM down
- No metrics

Phase 2: ACR/ACI

- Serverless
- Logging implementation
- Volume permissions
- Therapy session
- Use AKS instead

Phase 3: AKS


DNS
domain.tld
keycloak.domain.tld
dashboard.domain.tld
drive.domain.tld
panel-service.domain.tld
HTTP
:80
HTTPS
:443
Public IPv4 DNS label
essim.westeurope.cloudapp.azure.com
AKS
Ingress Controller
træfik
proxy
HTTP
:80
HTTPS
:443
drive.domain.tld
keycloak.domain.tld
domain.tld
panel-service.domain.tld
dashboard.domain.tld
Worker node
:9080
:8080
:8111
:5000
:3000
ESDL Drive
CDO API
CDO
Identity & Access Management
Keycloak
ESDL MapEditor
Map based GUI
MapEditor API
Workflow Engine
ESDL Services
MapEditor Core
Boundary Service
System, Project, User Settings
ESSIM
ESSIM API
ESSIM Engine
Transport Solvers
KPI Modules
KPI
Panel Service
Grafana
PostgresDB / PostGIS
MongoDB
InfluxDB

Kompose.io

- Docker compose > Kubernetes
- Not 1:1
- Minikube
- Cloud provider

```
$ kompose convert -f docker-compose.yaml

$ kubectl apply -f .

$ kubectl get po
NAME                              READY     STATUS              RESTARTS   AGE
frontend-591253677-5t038          1/1       Running             0          10s
```

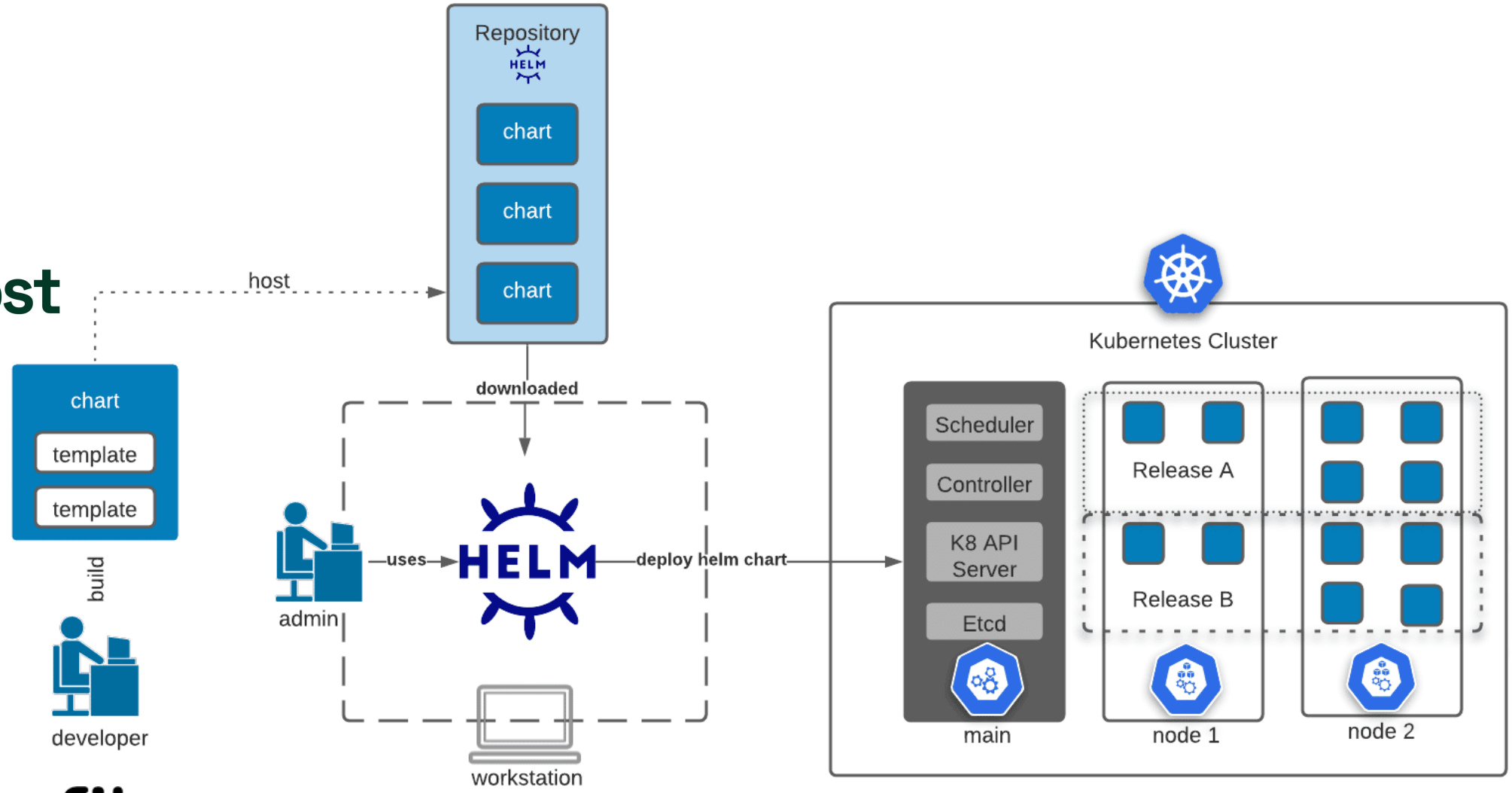
Helm

- K8s made easy
- Timesaver
- Pre-made config
- Difficult troubleshooting

kubecost

aqua trivy

træfik proxy



Helm Workflow

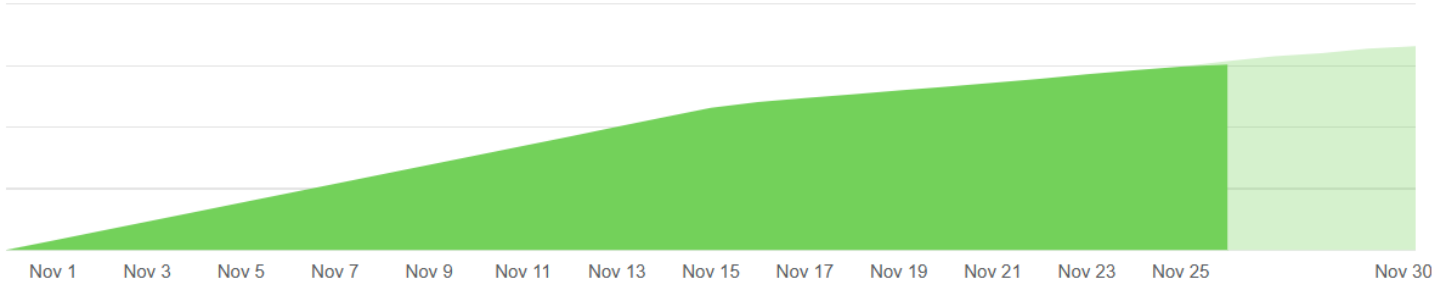
During the summer holiday…

Researchers carry on working during the summer holiday…

- Insufficient RAM
- Oddly familiar...
- ESSIM
- Resource limits!
- Monitor HTTP status

Cost

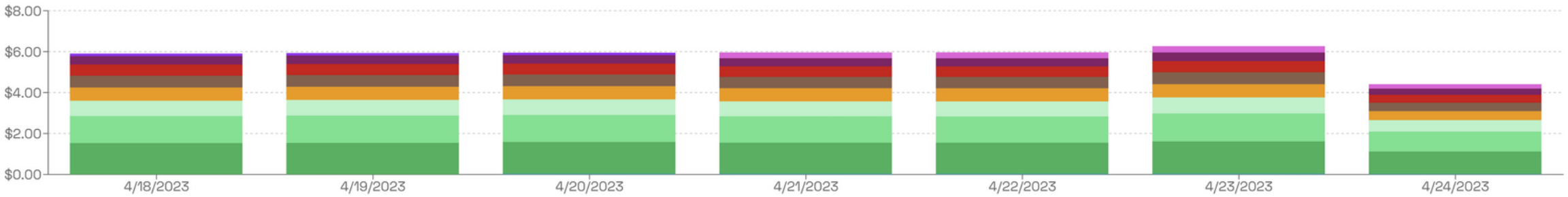
- Azure Cost Analysis
- Cost per project
- Kubecost
- Cost optimizations
- OpenCost (FOSS)



kubecost

OpenCost

Kubecost by namespace 👍



Name	CPU	GPU	RAM	PV	Network	LB	Shared	Efficiency	Total cost
Totals	$19.88	$0.00	$9.88	$2.11	$1.61	$8.01	$0.00	24.7%	$41.50
kubecost	$3.96	$0.00	$1.39	$0.56	$0.39	$4.00	$0.00	20.4%	$10.31 -10.2%
kube-system	$6.08	$0.00	$1.82	$0.00	$0.98	$0.00	$0.00	12.0%	$8.87 -19.3%
cost-analyzer	$2.85	$0.00	$2.00	$0.09	$0.16	$0.00	$0.00	19.3%	$5.10 -7.5%
ingress-nginx	$0.15	$0.00	$0.15	$0.00	$0.00	$4.00	$0.00	34.7%	$4.31 -6%
dev	$1.93	$0.00	$1.24	$0.56	$0.08	$0.00	$0.00	23.5%	$3.82 -16.3%

Container security scanner

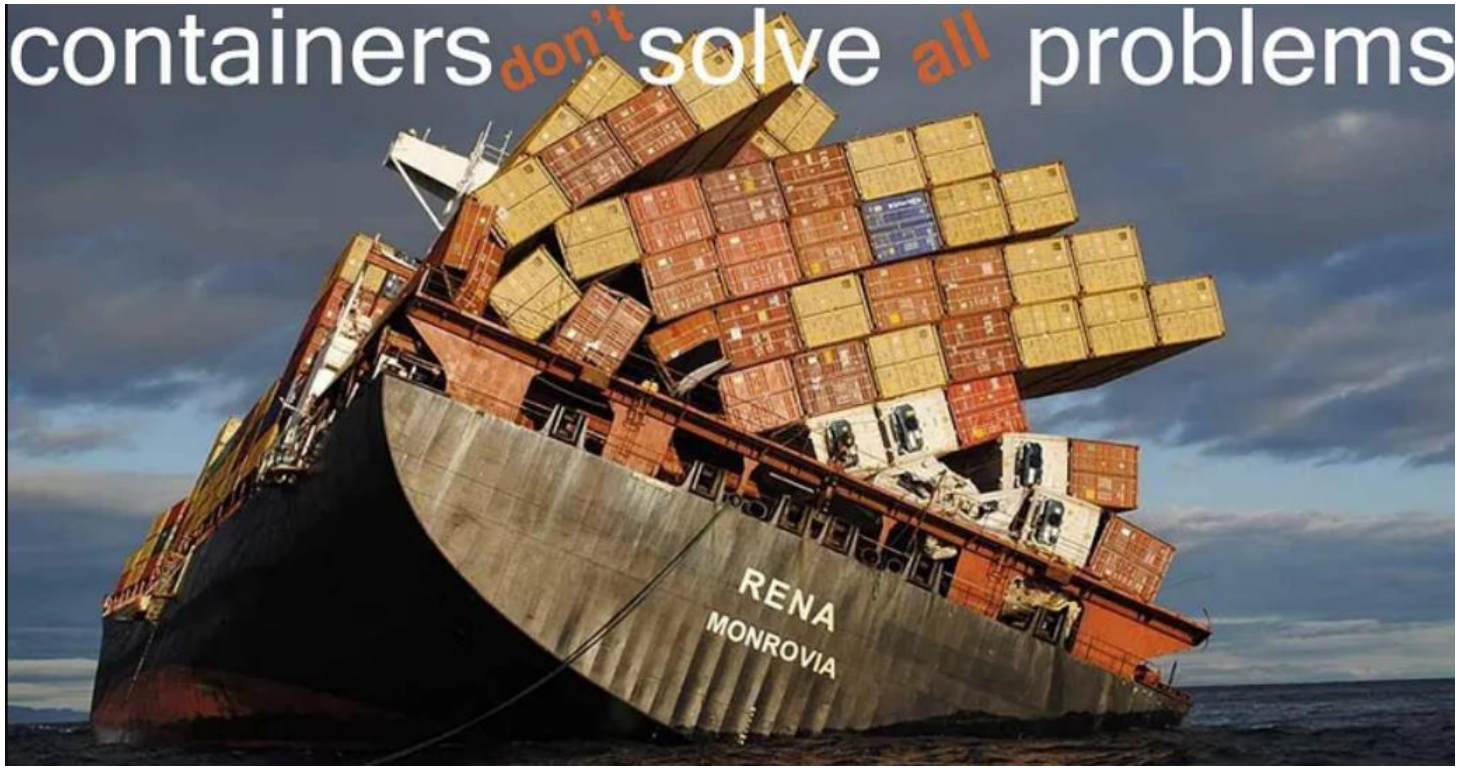
- What is Trivy?
- Scans config
- Scans images for CVEs
- Results...


```
- fixedVersion: ""
  installedVersion: 5.3.28+dfsg1-0.8
  lastModifiedDate: "2021-07-31T08:15:00Z"
  links: []
  primaryLink: https://avd.aquasec.com/nvd/cve-2019-8457
  publishedDate: "2019-05-30T16:29:00Z"
  resource: libdb5.3
  score: 9.8
  severity: CRITICAL
  target: ""
  title: heap out-of-bound read in function rtreenode()
```

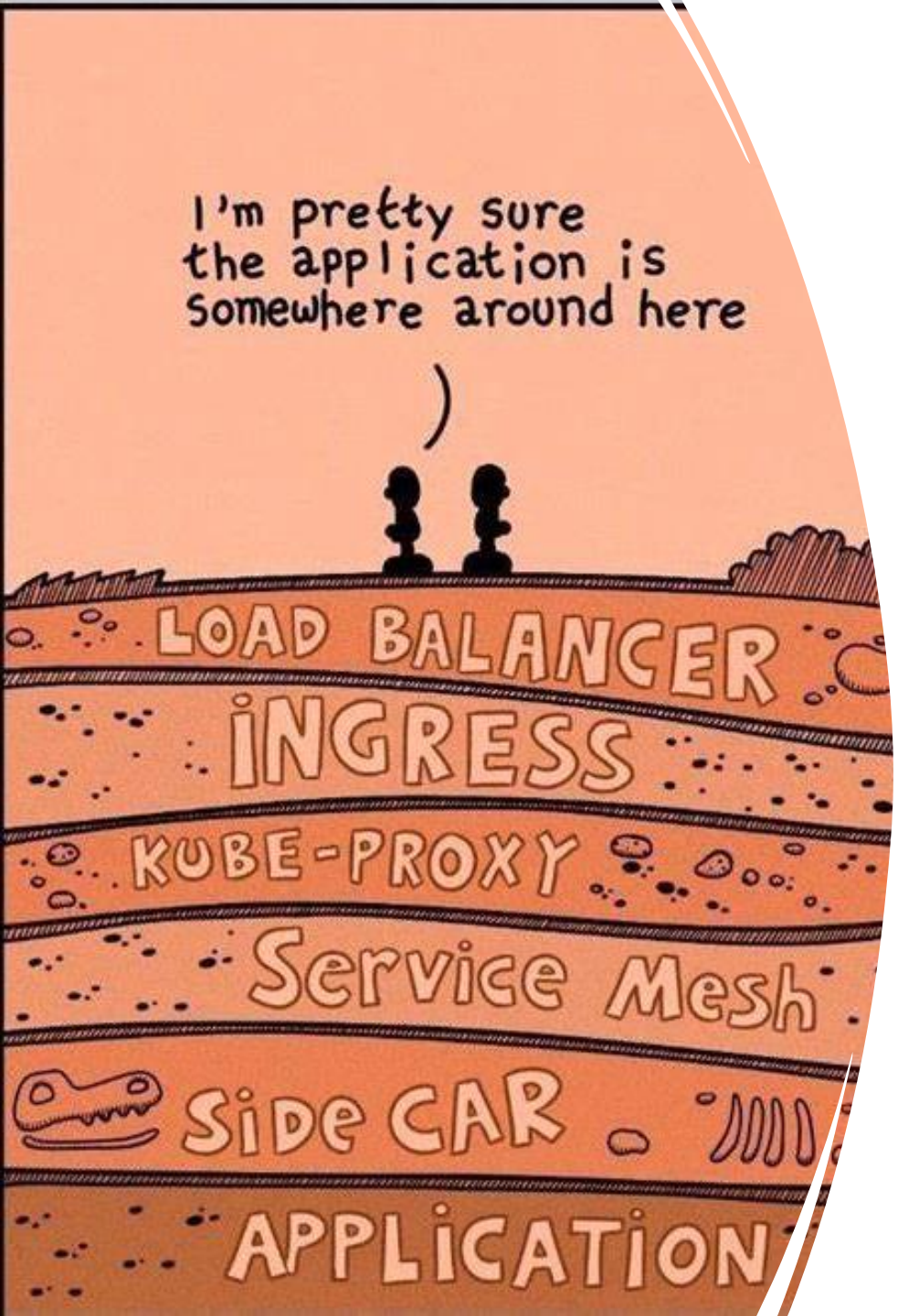
Autumn holiday!

Student assistants can break things too…

- Performance issues
- Undetected until update
- 2 days downtime
- Cause?
- Dev/Prod!



5. Final words



Results

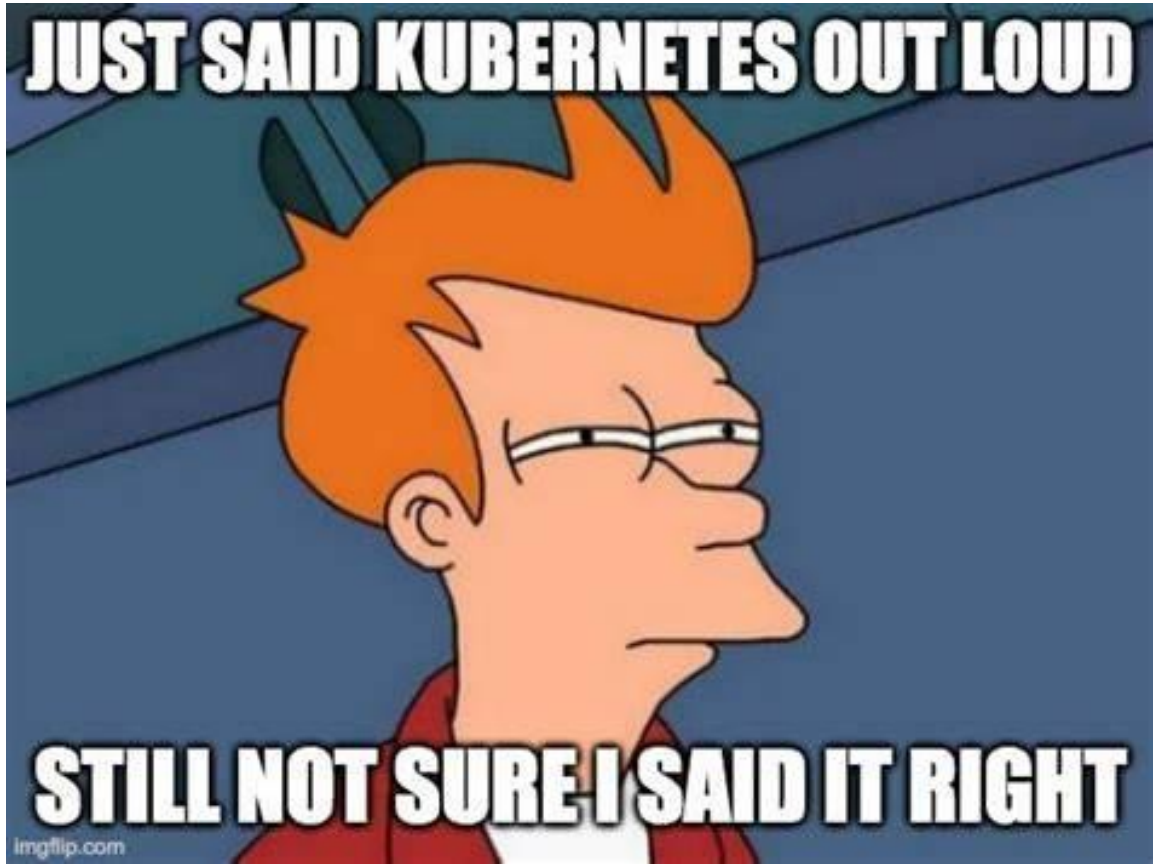
- Docker local > Kubernetes cloud
- Fully functional
- In use
- Continuous improvement
- Cost management
- Security scanning
- Plenty to-do

DevSecOps

- Requires a relatively high organizational maturity level
- There is much more to it than tooling
- Difficult to do with small teams that work part-time
- We did more SecOps than Dev…
- Azure is convenient, fast and costly
- Azure DevOps Services can be convoluted

Kubernetes

- Helm makes k8s easy and fast to deploy
- Tools like Kubecost can improve costs and – insight within your cluster
- Monitor your setup closely to properly setup limits and requests
- A dev and prod environment are essential to develop and test
- Easy insight in security by deploying tools like Trivy



6. Questions?

And discussion…