

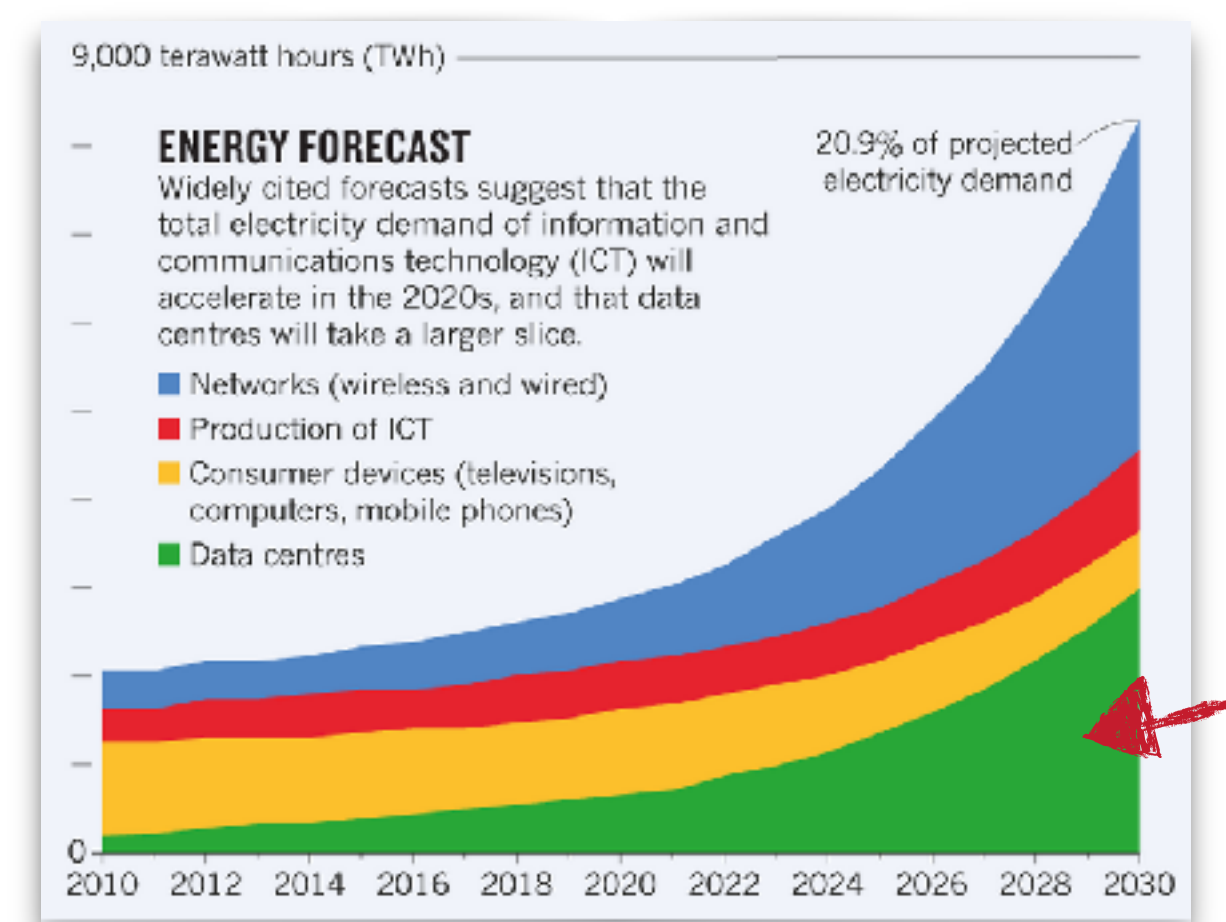
REDUCING THE ELECTRICAL POWER CONSUMPTION OF SCIENTIFIC SOFTWARE

DOMENICO GIORDANO, STEFAN ROISER, ANDREA VALASSI — IT-GOV

20 SEP 2022, HEPSCORE WORKSHOP

WHY

- ▶ Data centres are significant consumers of electricity
- ▶ Power consumption for data centres is expected to rise further
- ▶ Electricity prices are currently going through the roof
- ▶ HEP and other sciences are main consumers of publicly funded distributed computing infrastructures
 - ▶ E.g. LHC data processing on 1.4 million compute cores
 - ▶ For HL-LHC a x10 of data will be collected and processed



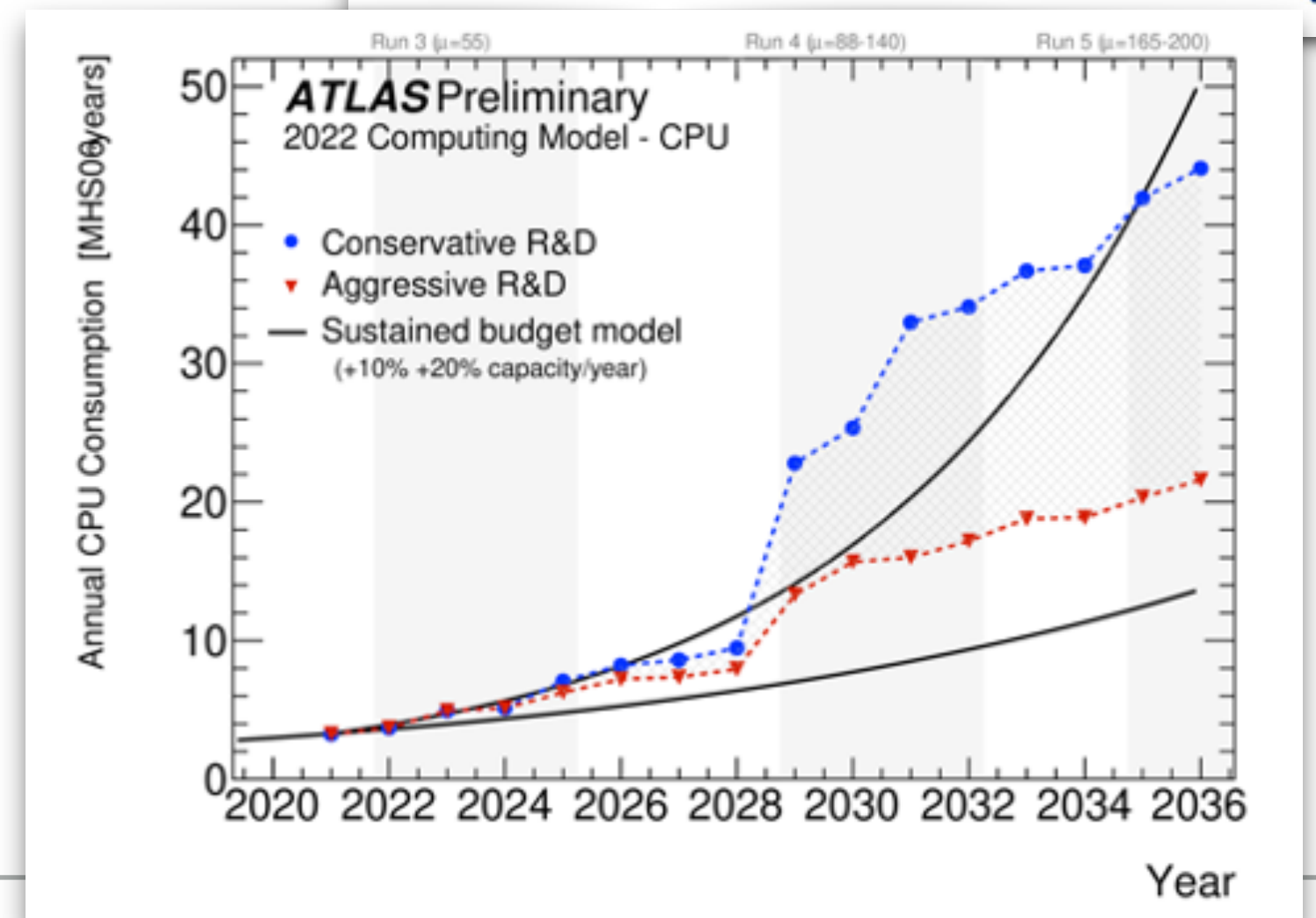
Data centres

Worst case prediction of global electrical ICT power consumption
Nature 561, 163-166 (2018), <https://doi.org/10.1038/d41586-018-06610-y>

Development of electricity prices since 2007 (5.000 kWh)



CHECK24



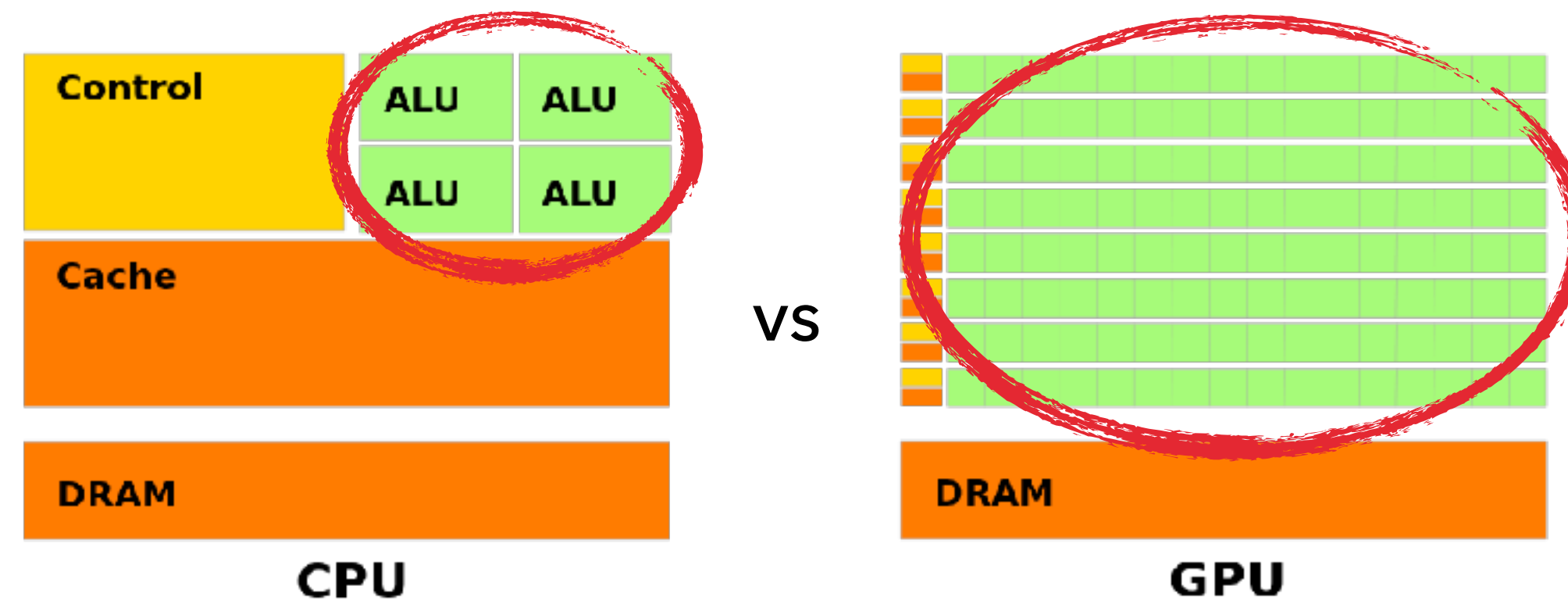
Can we improve the electrical power efficiency of scientific software applications?

WHAT

Investigation example: CPU vs GPU execution

- ▶ To address future computing needs HEP applications are being ported to processing on graphics cards (GPU) in addition to optimisations for "traditional" CPU processing

- ▶ GPU means highly parallel processing on $O(1000)$ compute cores (vs CPU $O(10)$)



- ▶ Depending on application type and complexity can increase the data throughput of the application by factors of 100s

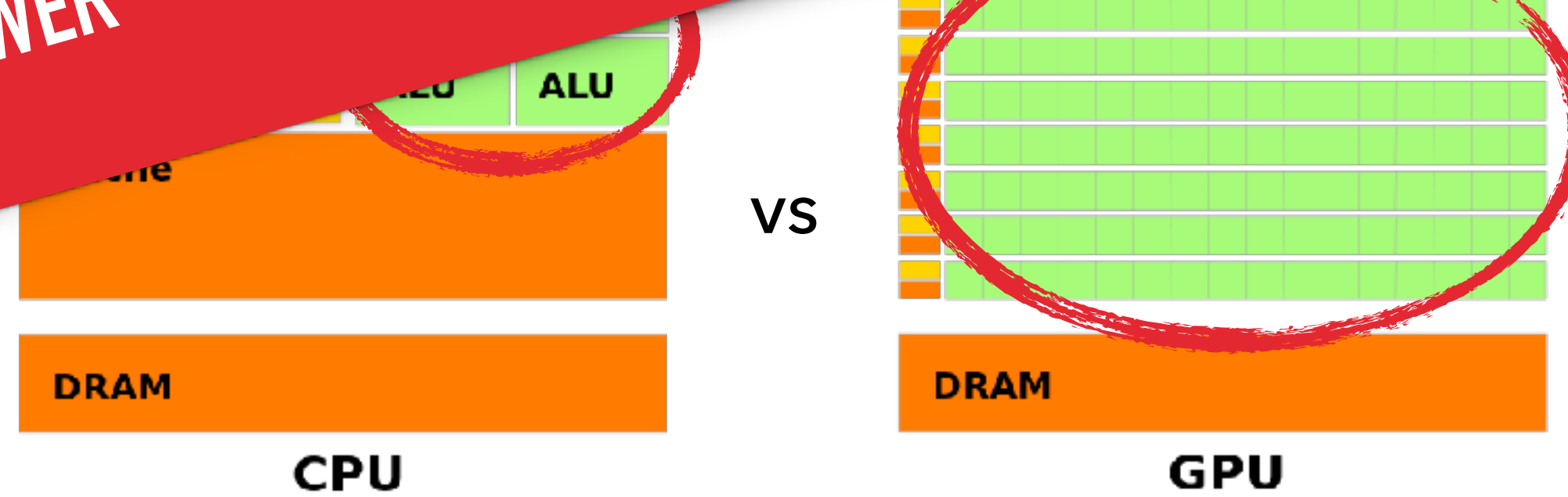
WHAT

Investigation example: CPU vs GPU execution

- ▶ To address future computing needs HEP applications are moving from CPU processing on graphics cards (GPU) in addition to optimizing CPU processing

- ▶ GPU means highly parallel processing
complexity $O(N^2)$

A GPU USES ADDITIONAL ELECTRICAL POWER — IS IT STILL MORE POWER EFFICIENT TO USE?



- ▶ Depending on application type and complexity can increase the data throughput of the application by factors of 100s

HOW

Scientific data processing software applications

The artefacts for the power consumption measurements

- Detector simulation
- Experiment high level trigger
- Machine learning algorithms

Can run on various CPU (Intel, IBM Power, ARM) and GPU (Nvidia, ARM, Intel) hardware platforms



Hardware infrastructure

Computing infrastructure to perform the measurements on

- CERN computer center
- HPC sites (Jülich/GE, Cineca/IT, ...)
- CERN Openlab

Provide all necessary hardware platforms we want to use



Software infrastructure

Software tools to perform, store and analyse the measured data

- Measure power consumption
- Store results centrally
- Plot and compare data

Available via HEPIX benchmarking working group and IT-FA



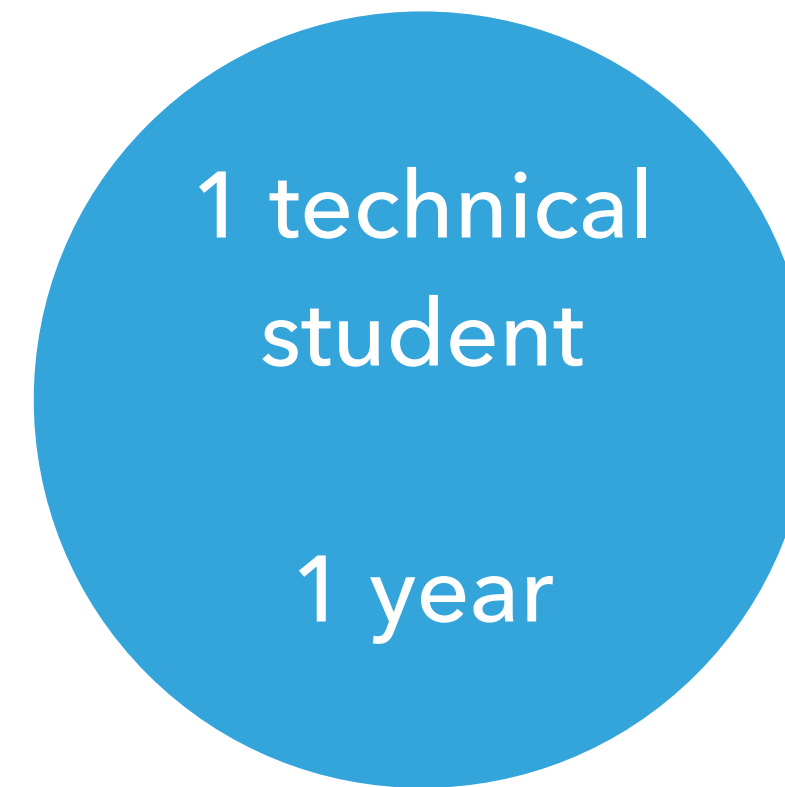
Project plan:

1. Connect the scientific software applications, the software infrastructure and the hardware infrastructure
2. Execute and collect the electrical power measurements of the applications on different hardware platforms
3. Analyse the data and publish general guidelines for power efficient execution of scientific software applications

WHO

Embedded in:

- ▶ Madgraph software development team (IT-GOV)
- ▶ HEPIX benchmarking team (IT-GOV)



Collaborates with:

- ▶ CERN Openlab
- ▶ IT computer center infrastructure team (IT-FA)
- ▶ AdePT / Geant4 development team (EP-SFT)
- ▶ HPC centres (Juelich/Germany, CINECA/Italy, ...)

The INDEPENDENT

THURSDAY 16 JULY 2022

Lionesses England to play Germany at Wembley for first time

Kim Sengupta We're entering a dangerous new age
Sophora Smith How far seas have risen since 1990s
Holly Bancroft Activist says born: hoax is Chinese false

Driest July for more than a century

Parched grass in London's Greenwich Park yesterday as the Met Office warned dry weather will continue

DER SPIEGEL

No. 33 13.7.2022

COM EN AMBON: Wie weit hat die Welt schon? | SPANISCHER: Die letzten Jahre | KÖRPER: Das will der Körper tun

Wie die Bundesregierung ihr wichtigstes Projekt beerdigt

Households face energy bills of £500 per month

'Almighty hit' to living standards as Russia squeezes gas supply

ANNA ISAAC ECONOMICS EDITOR

Energy bills are set to triple as households face a £500 cost in January 2023, with a £3,850 prediction for the annual price cap. The bleak forecast comes as Russia further tightens gas supplies to Europe. In the next two years, inflation will reduce living standards at a rate not seen since the 1970s, said Paul Dales, the chief UK economist at Capital Economics. "There's an almighty hit for households' spending power coming down the line," he warned.

Le Monde

CAMPUS - SUPPLÉMENT RÊVES ET DÉREALISATIONS DES JEUNES CHÊRES

Nucléaire: la moitié des réacteurs français

Alors qu'il est prévu que la moitié des réacteurs nucléaires français sera fermée d'ici 2035, le gouvernement a annoncé qu'il allait construire de nouveaux réacteurs. Cette décision a suscité de vives réactions de la part des écologistes et des citoyens.

Süddeutsche Zeitung

MÜNCHENER NEUESTE NACHRICHTEN AUS POLITIK, KULTUR, WIRTSCHAFT UND SPORT

Auf ins All

Die Raumfahrt wird immer wichtiger. Die ESA plant, im Jahr 2028 einen ersten Marsflug zu starten. Die NASA hat ebenfalls Pläne für eine bemannte Mission im Jahr 2033.

Mehr Energie-Kooperation mit Kanada

Die beiden Länder haben sich auf eine verstärkte Zusammenarbeit im Bereich der erneuerbaren Energien geeinigt. Dies soll die Energieversorgung beider Länder verbessern.

Gib mir das Paradies

Die Suche nach dem Paradies führt zu neuen Entdeckungen. Forscher haben in der Antarktis neue Ölfelder entdeckt.

À KIEV, UN PREMIER PROCÈS POUR LES CRIMES DE GUERRE RUSSES

Le tribunal ukrainien a commencé les audiences pour le premier procès de guerre contre un officier russe. L'accusé est accusé de crimes de guerre commis pendant l'invasion de l'Ukraine.

Transport

Le législateur a adopté une loi pour améliorer le transport public en France. Cela inclut des mesures pour réduire les coûts et améliorer la qualité du service.

Festival de Cannes

Le festival de Cannes a ouvert ses portes avec une programmation riche. Parmi les films en compétition, on trouve 'Les Passagers de la nuit' de Céline Sciamma.

Tribune de Genève

Le quotidien genevois. Depuis 1879 | www.tdg.ch | LEADER EUROPEAN - NEWSPAPER ALLIANCE

Pénurie d'électricité: Genève se prépare

Christian Brunier, directeur des Services industriels de Genève, espère des mesures de Berne. La ville de Genève se prépare à une éventuelle pénurie d'électricité en raison de la situation en Suisse.

La Bâtie, festival en osmose avec son temps

Le festival de La Bâtie a été un succès. Les artistes ont créé des œuvres qui reflètent les préoccupations actuelles de la société.

Libération

200€ Pour l'abonnement | VENDREDI 2 SEPTEMBRE 2022 | www.libération.fr

Outgroups L'ONU reconnaît les crimes de la Chine

Femicides L'hécatombe continue

Arts de la table La classe sociale met le couvert

CRISE ÉNERGÉTIQUE PASSERA-T-ON L'HIVER AU CHAUD ?

Emmanuel Macron réunit aujourd'hui un Conseil de défense consacré à l'énergie, sur fond de coupures de gaz russes. Fragilisée par la défaillance de ses centrales nucléaires, la France est à la merci de la météo.

FINANCIAL TIMES

NATIONAL NEWSPAPER OF THE UK

Brussels to unveil crisis action in bid to curb soaring energy costs

Push to avert electricity and gas price spikes | Utilities seek aid | Crisis might last years, says Shell

Kyiv's forces launch counter strike to reverse Russian gains around Kherson

Ukrainian forces have launched a counter-offensive to recapture territory around the city of Kherson.

Hot over 50

The most stylish older women

Energy bill rebates to help against rising costs

Loans scheme means £200 for every household

Frankfurter Allgemeine

ZEITUNG FÜR DEUTSCHLAND

Zwei Atomkraftwerke bleiben bis April 2023 in Bereitschaft

Die Bundesregierung hat angekündigt, zwei Atomkraftwerke bis April 2023 in Bereitschaft zu halten.

Liz Truss wird britische Premierministerin

Liz Truss wird die neue Premierministerin des Vereinigten Königreichs.

Die Presse

Die Presse hat eine neue Ausgabe mit aktuellen Nachrichten und Analysen.

THE TIMES

Wednesday February 2, 2022 | thetimes.co.uk | No. 73098

Hot over 50

The most stylish older women

Macron blames 'hypocritical' Britain for migrant drownings

Emmanuel Macron has accused Britain of being hypocritical in blaming migrant drownings on the UK.

Energy bill rebates to help against rising costs

The government has announced a new scheme to provide rebates to households to help with rising energy costs.

Police joked about rape and hitting their wives

Police officers have been accused of making inappropriate jokes about rape and domestic violence.

Strom soll noch teurer werden

Die Energiepreise werden weiter ansteigen. Verbraucher müssen sich auf noch höhere Kosten einstellen.

Police joked about rape and hitting their wives

Police officers have been accused of making inappropriate jokes about rape and domestic violence.