

# Sustainability at DESY

## Challenges and Opportunities



## DESY – Deutsches Elektronen Synchrotron

- founded 1959 –



Member of Helmholtz Association



Hamburg

**Mission:** Development, construction, operation and scientific exploitation of accelerators

Provide access and services for national and international users



Zeuthen

Internationally used, nationally funded Research Institute

Research Infrastructures: PETRA III, FLASH (II), XFEL, TIER-2, Testbeams

<b>Sites:</b>	Hamburg and Zeuthen
<b>Base-Budget:</b>	180 MEuro
<b>Funding source:</b>	90% federal, 10% state
<b>Staff:</b>	~1900 FTE in Hamburg and Zeuthen
<b>Users:</b>	~3000 (1500 from abroad) from 45 nations



- New High Brilliance X-ray Sources
- Research Labs/ Inhouse
- Application Labs



**PETRA III**

**FLASH**

CFP





# Science is energy intensive

e.g. facilities at DESY have power input **23 MW**

Annual consumption of **160 GWh**

mainly provided by **fossil sources**

Releasing roughly **70 kt CO<sub>2</sub>** per year

~ energy consumption of German city with

**40 000 inhabitants**

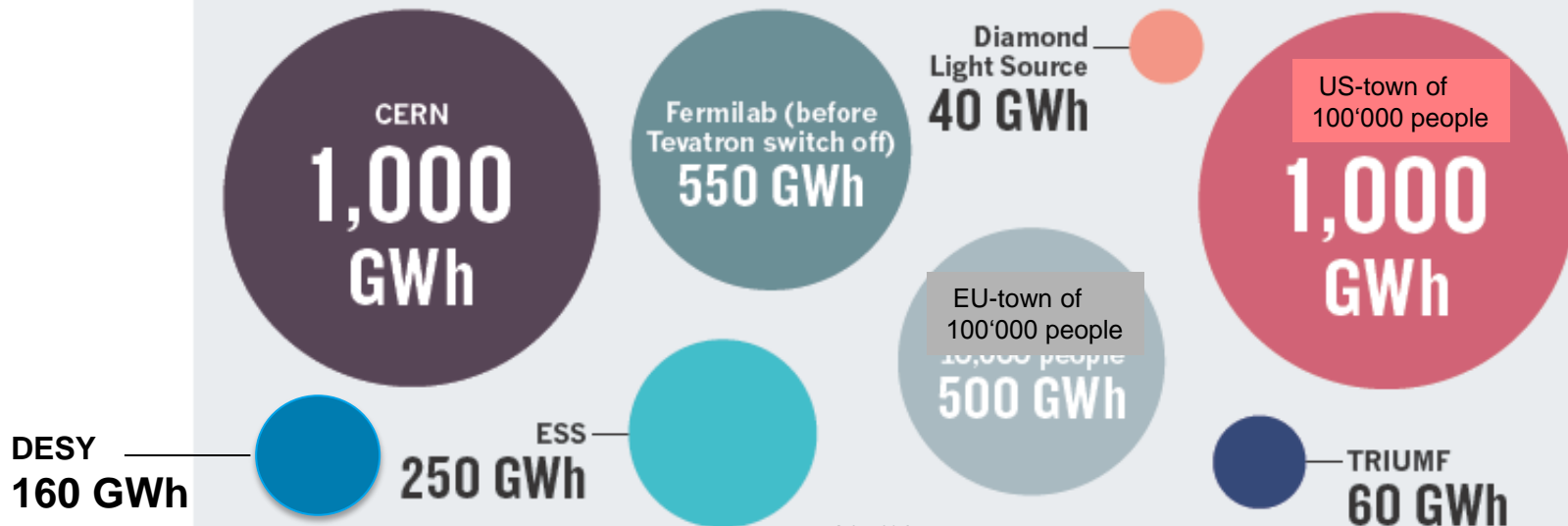
Future developments of energy prices?

How climate neutral/sustainable should research centres be?

=> Strategic question of energy supply/management

## ANNUAL ENERGY EXPENDITURE

Large physics facilities, such as CERN, use as much energy as a small town every year. Smaller ones, such as the European Spallation Source (ESS), also consume lots of electricity. All would benefit from going green.



source:  
T. Parker, Science Mag.



# (Natural) Science is energy intensive



Universities

~150 kWh/(m<sup>2</sup>a)



Laboratories  
(bio/chem/phys)

~300 kWh/(m<sup>2</sup>a)



Residential area

~40 kWh/(m<sup>2</sup>a)



100 German Universities spend ~3 bn € for energy costs



# Pillars of sustainability concept

## > **Improve sustainable management** of facilities & campus

- Focus on sustainable energy management with goal to include mid-term and long-term sustainability aspects as integral elements into all business processes
- Reduce consumption, increase efficiencies, recover waste heat, smarter energy management
- Campus buildings and mobility also play a major role
- develop “sustainability culture for research”

## > **Strategic Research** in Advanced Materials for Renewable Energies

- Interdisciplinary research effort in Helmholtz association: Materials Science
- Joint effort between research fields “Matter”, “Energy” and “Key Technologies”
- DESY: in-situ high precision analysis of materials performance on a molecular level

## > **New Strategic Partnership** between European RIs and MENA region

- Building Bridges between Europe and MENA
- Science & Energy Cooperation



**DESY** ■ On the way to a sustainable facility management



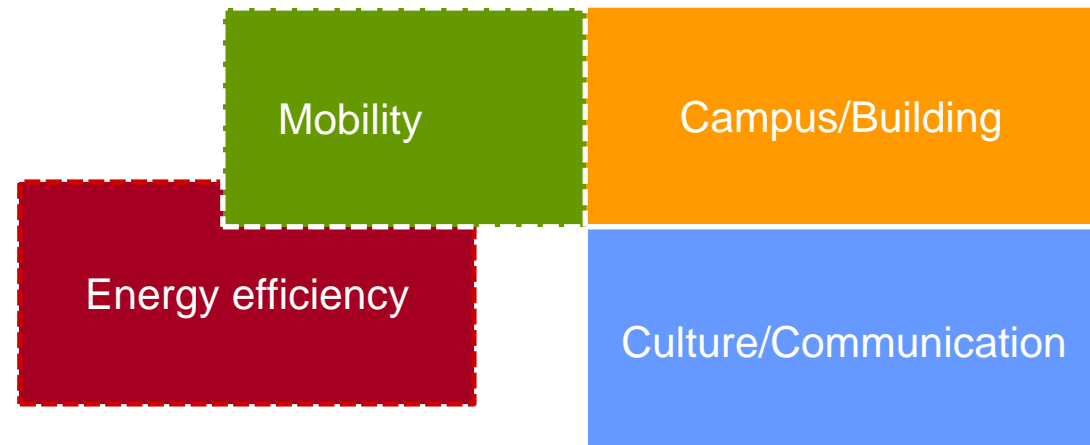
**PILLAR I**  
Improving sustainable management

# Sustainable Management of facilities & campus

- > Impetus/stimulus through one-week workshop with Leuphana University in February 2013
- > ~20 master students of sustainability management
- > Four topics to investigate
  - Concept to create an evaluation instrument for sustainability-oriented construction and conversion of existing buildings
  - Actual condition analysis of the energy management system at DESY and its further development for future requirements
  - Development of a sustainable DESY mobility concept
  - Communication as an instrument to establish a sustainability culture at DESY



*Your Ideas Matter!*

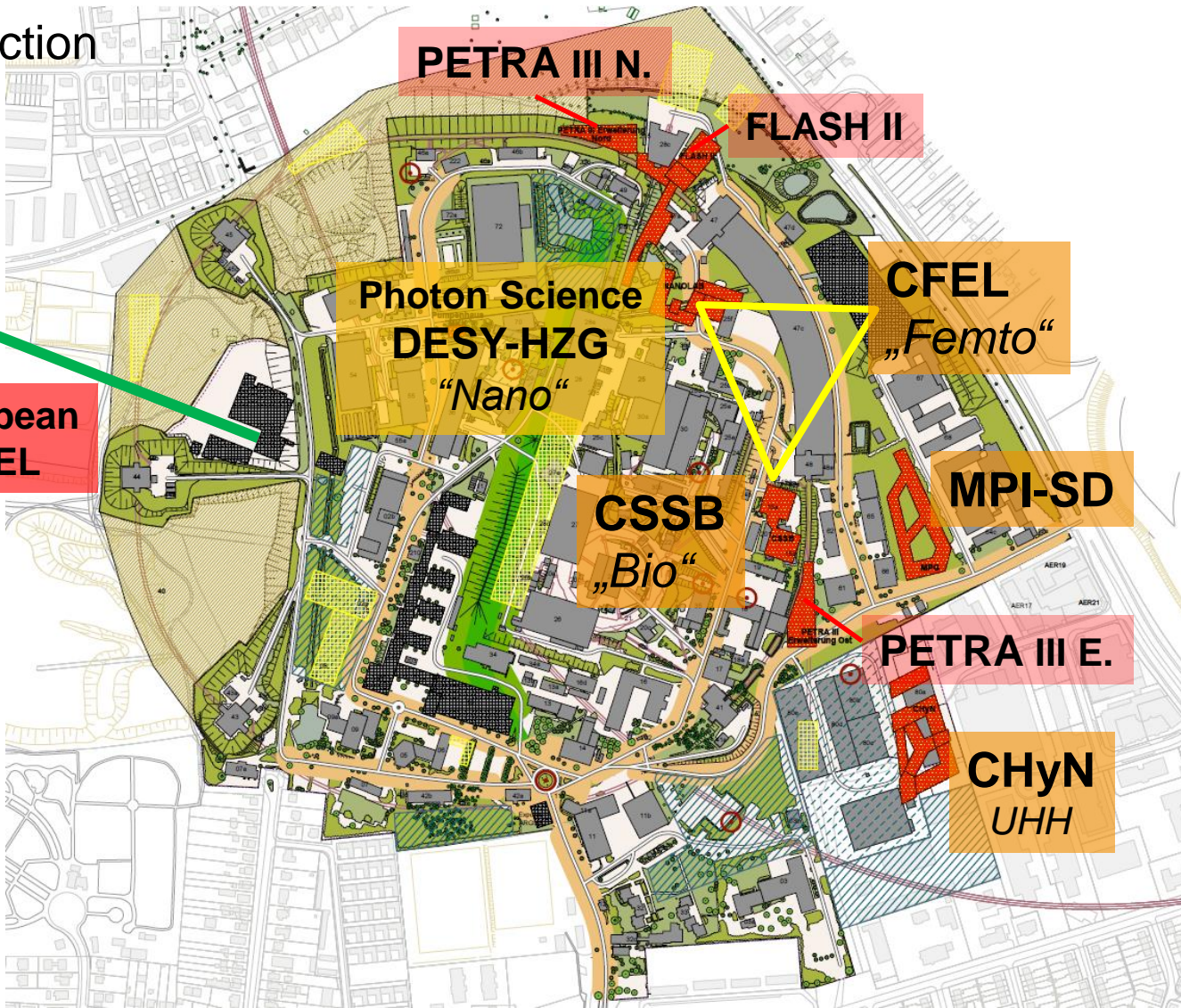




# DESY. New Buildings



 Construction



European  
XFEL



# I. Building/Campus

- > more than 50 buildings on campus, some of them 50 years old
- > started energetic renovation of building structure (through stimulus funds) over last years – four buildings completed
  - ~50% savings in energy, expect 200k€/a savings in energy cost–reduction of 600t/a CO<sub>2</sub>
- > Orientation to sustainable energy standards for new buildings
  - use evaluation instruments BNB
  - Bewertungssystem “Nachhaltiges Bauen”
  - (Evaluation scheme sustainable construction)

<http://www.nachhaltigesbauen.de>





## II. Energy efficiency

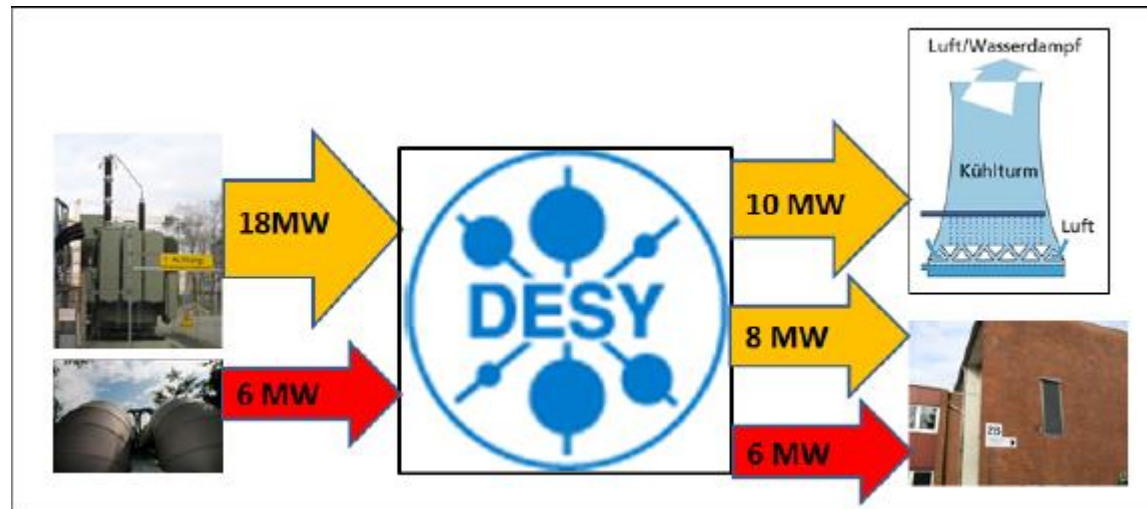
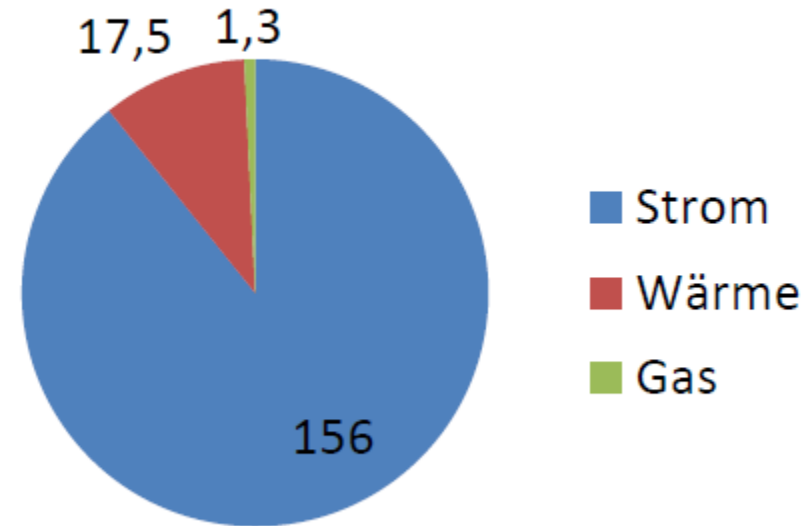
Electrical energy: 156 GWh – dominated by accelerators (difficult to improve)

Existing energy consumption data only on highly aggregated level

set up an energy management system

- What are detailed electrical power / heat consumption levels at various facilities/buildings/labs/offices?
- How do they compare to benchmarks ?
- Are there clear drivers/issues identifiable to improve/optimize efficiencies/gain savings on demand or supply side?
- Setting goals for 2020
- develop action plans

Energy Consumption in GWh (2012)



# Improve waste heat re-usal at DESY

Concrete Project: Cryogenic waste heat utilization for DESY and EU.XFEL

Study shows good potential for using waste heat of a cryogenic plant for heat utilization

	1 cryo street	2 cryo streets
heat extraction (30-35 deg)	4,6 GWh/a	7,0 GWh/a
cost savings <sup>1)</sup>	228.450 €/a	350.600 €/a
payback period <sup>2)</sup>	2,6 a	1,7 a
cash value after 10 years <sup>3)</sup>	807.740 €	1.558.298 €
Reduction of CO <sub>2</sub> -Emission <sup>4)</sup>	1.087 t-CO <sub>2</sub> /a	1.669 t-CO <sub>2</sub> /a

- 1) price for district heating: 0,05 €/kWh
- 2) investment costs: 592.000 €
- 3) adequate target rate: 10 %
- 4) district heating: 238 g-CO<sub>2</sub>/kWh

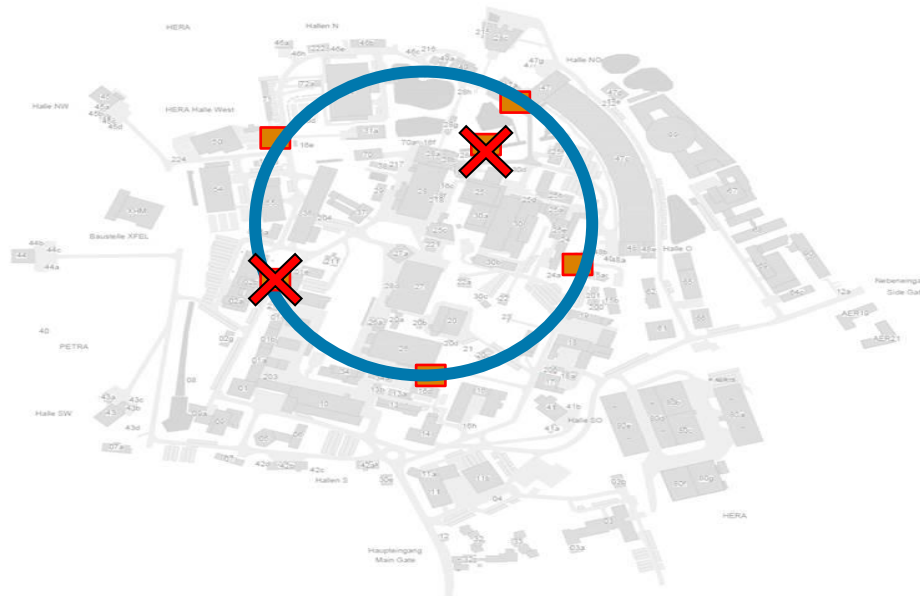
See talk by J.-P. Jensen  
Thu, 24 October  
Parallel B2





# Cold water ring

- Concrete project: improve cold water ring ( $T=8\text{C}$ ) at DESY (“Fernkältering”)
  - ~4 MW refrigeration power for cooling building, IT, power supplies, ...
  - Ring connect nearly all refrigerator plants on campus, improve efficiencies, eliminate decentralized, isolated solutions
- Reduce installed power from 13.6MW to 9.6MW, increase average efficiencies from 50% to 60%



# III. Sustainable Mobility Concept

> Carbon-footprint: Mobility at DESY (~2000 employees) causes 11,5 kt CO<sub>2</sub>/year

- 2,5 ktCO<sub>2</sub>/a Commuting
- 8 ktCO<sub>2</sub>/a Travel (99% flights)
- 1 ktCO<sub>2</sub>/a on-campus mobility



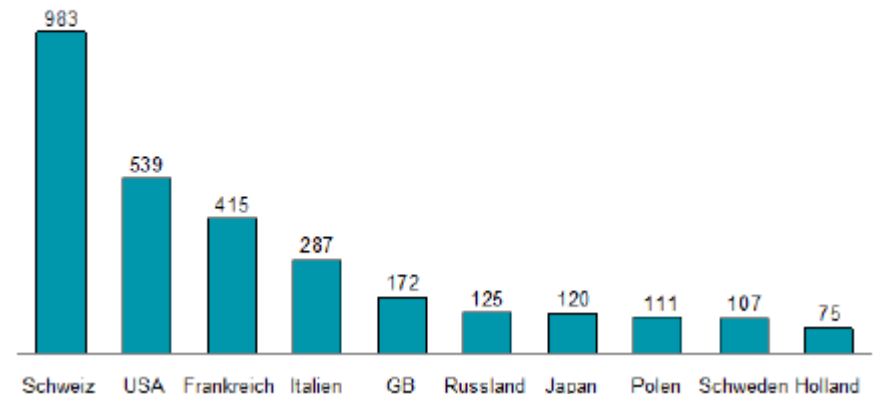
> Develop environmentally and socially responsible management of mobility of people and goods, taking into account economic factors

> Goals

- contribute to the reduction of mobility-related CO<sub>2</sub> emissions
- image building / legitimacy
- employee acceptance



Anzahl der Auslands-Dienstreisen

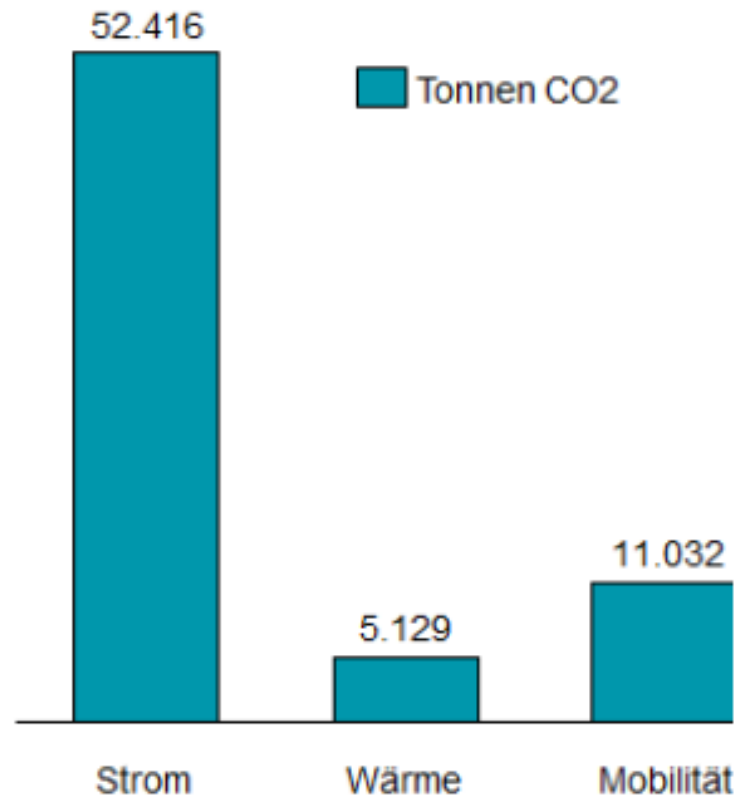


# CO<sub>2</sub> Footprint DESY

- In total ~70 kt CO<sub>2</sub>/a
- Self commitment by DESY (in cooperation with city of Hamburg)  
Goal: Annual reduction by 3-5 kt CO<sub>2</sub>
- New lighthouse projects under discussions:
  - Green IT
  - Block heat and power plant
  - ...

## Auszug CO<sub>2</sub>-Footprint bei DESY

Quelle: DESY und eigene Berechnungen (CO<sub>2</sub>)



**DESY** ■ On the way to a sustainable facility management

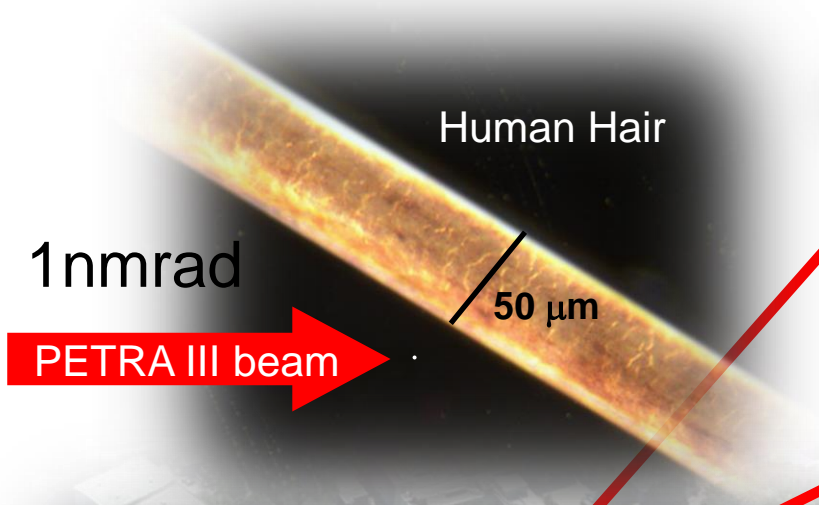


**PILLAR II**  
Research in sustainable technologies

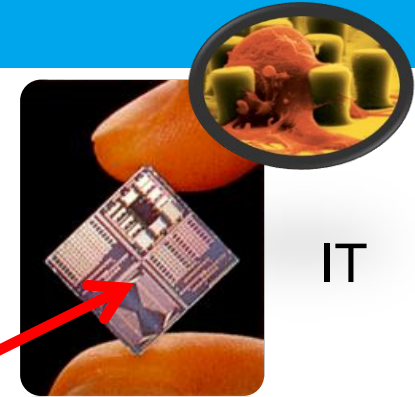


# PETRA III.

Advanced Materials for ...

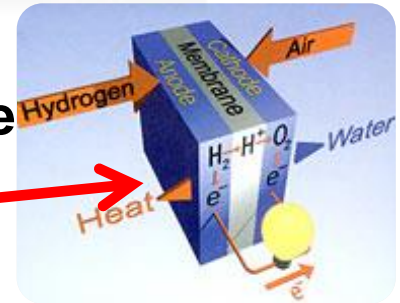


Health

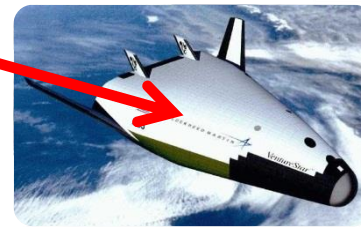


IT

Renewable Energy

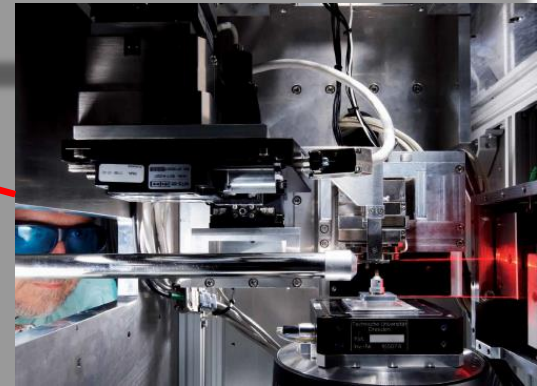
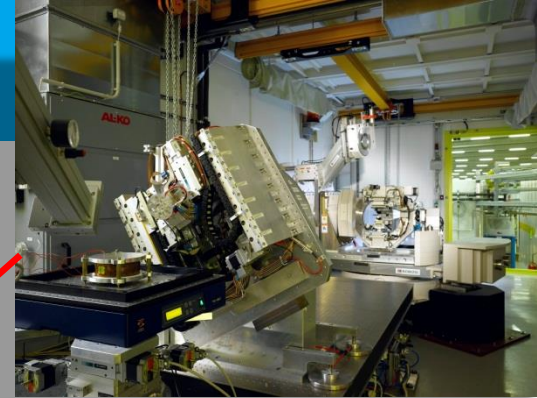


Transport



# PETRA III.

## Novel Instrumentation ...



# DESY User Operation 2012

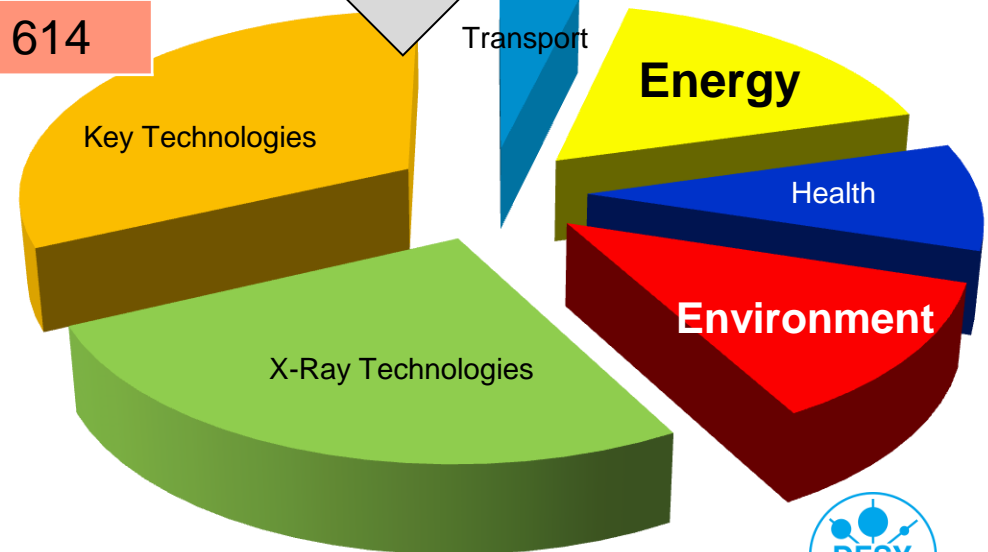
80% Open Access, Peer Review

20% Inhouse Research, Industrial Use, Maintenance

Facility	Proposed Hours	Accepted Hours	Superscription Factor
DORIS III	89048	67000	1,3
PETRA III	83000	32880	2,5 (rising)
FLASH	8640	2196	3,9

PETRA III	2010	2011	2012
Proposals	77	433	614

- creating awareness among our users
- promoting strategic research



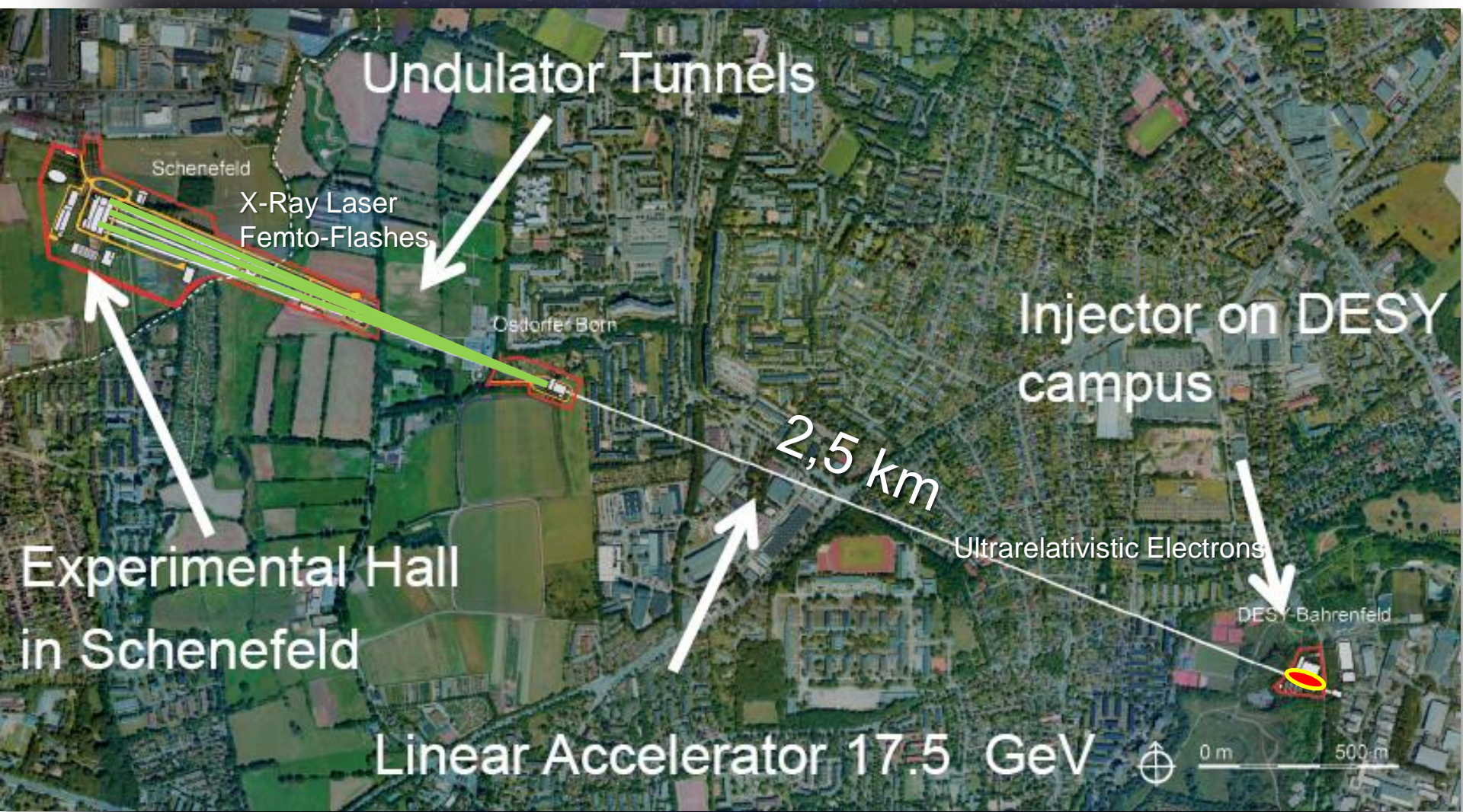




# European XFEL



Eine Hochgeschwindigkeitskamera für die Nanowelt

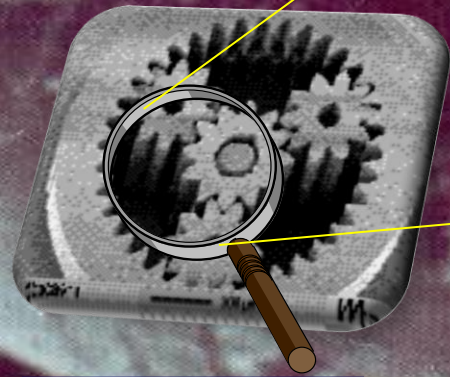
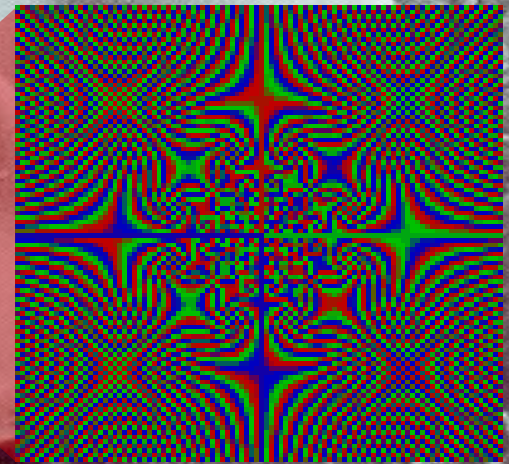




# Friction and Lubrication in Nanospace

## What is a liquid in a Nanoslit ?

Science Friction: „Supralubrication“



Micro gear

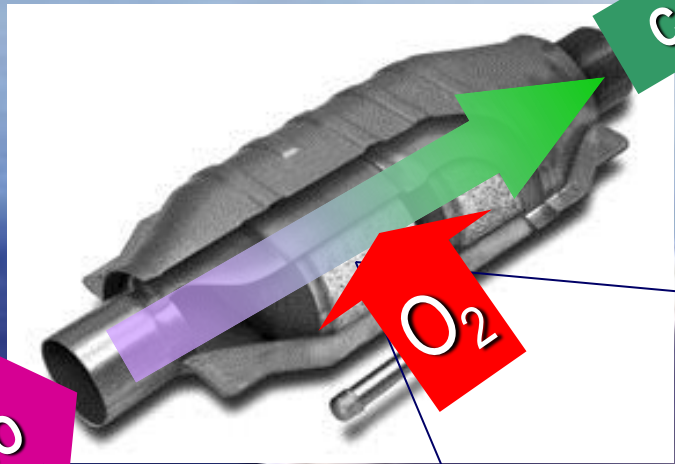
severe ecological/economic issue  
annual loss by friction/wear: 2-7% GNP  
Germany: 40 Bio €/y



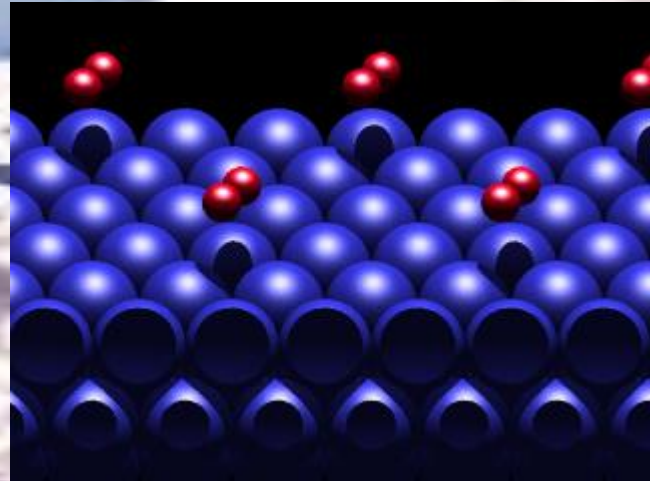
# Catalytic Reactions



MAX-PLANCK-GESellschaft

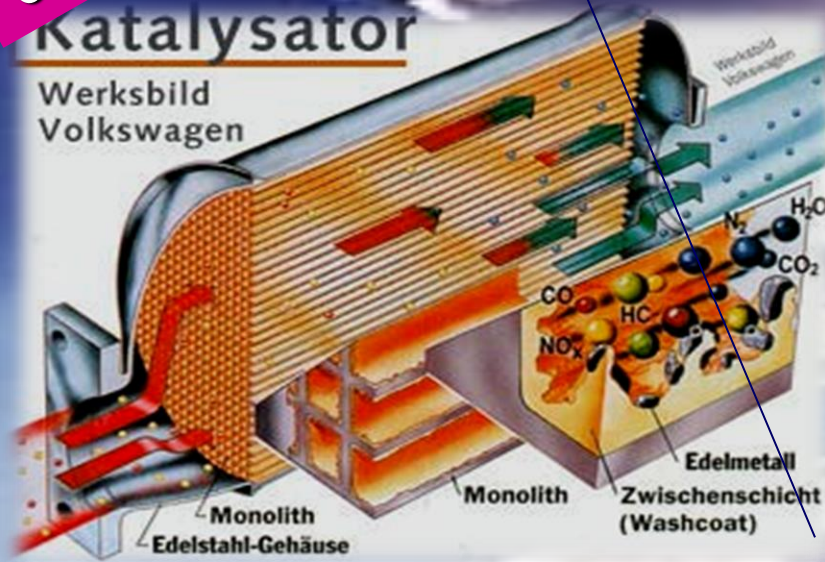


Dissociation of  $O_2$  induces strong molecular Motions



## Katalysator

Werkbild Volkswagen



Fritz Haber Institut der MPG, Berlin



Gerhard Ertl, Nobel Chemistry 2007



**DESY** ■ On the way to a sustainable facility management



**PILLAR III**  
**Strategic Cooperations**



# Energy from the desert

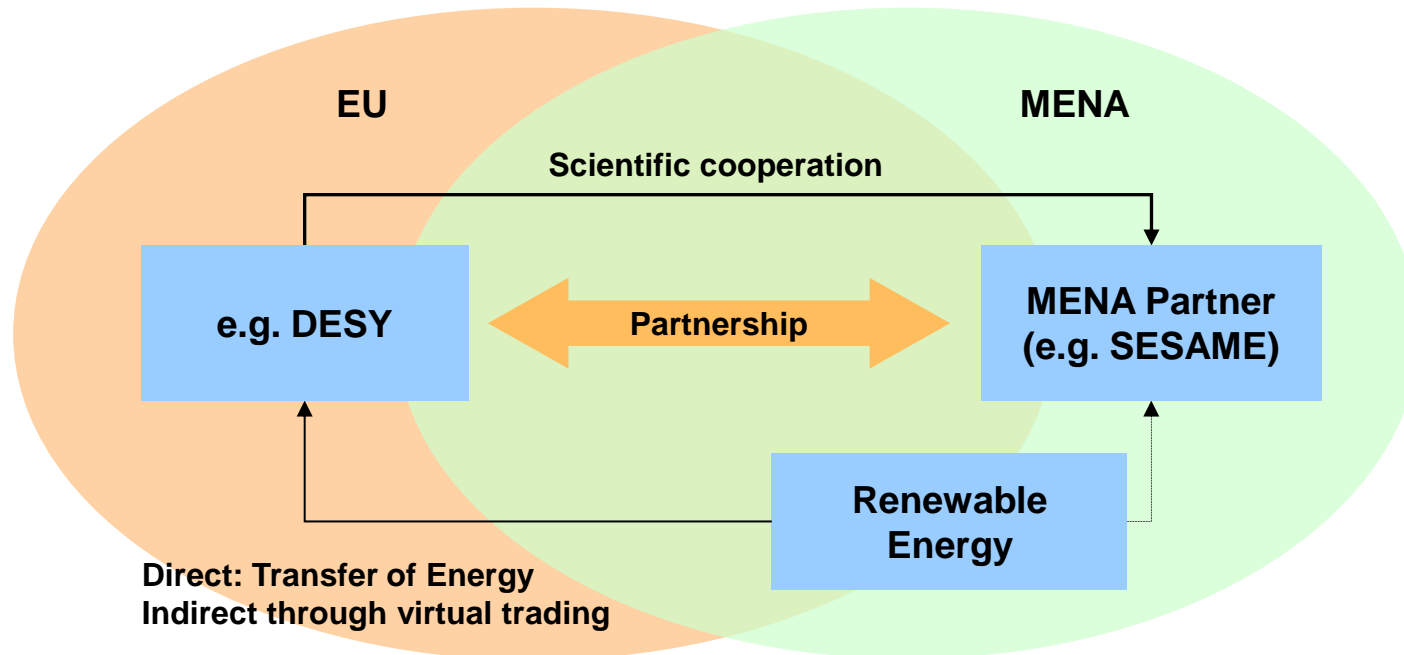


- Promising conditions
- Energy demand is increasing for population
- EU committed to support (Mediterranean Solar Plan)

***Fundamental transformation of the MENA region to a green economy and implementation of the gigantic DESERTEC-concept would require substantial technological and innovative capacities***



# A new EU-MENA Partnership on Energy & Science



- > Enhance S&T cooperation with MENA partners as stimulus for governments to promote renewable energies in MENA
- > Prospect/Vision for EU-MENA: direct physical transfer of solar energy (via high voltage DC transmission lines) – swap knowledge, education and S&T versus energy (“in-kind contribution)
- > European research infrastructures could be “first movers” to receive solar energy from desert
- > Promote “Energy sustainability for European research” & Intellectual sustainability in MENA



# Symposium „Building Bridges“ – 19/20 May 2011

## DESY - Hamburg

- > Organizers:
  - DESY, DLR, Egypt ASRT, SESAME-Jordan
- > Scientific cooperation creates trust and acceptance and brings to bear peace-making and stabilizing effects in societies
- > Topics
  - Climate Change, Renewable Energy and Societal and Developmental Challenges
  - Science, Sustainability and Responsibility
  - Solar Energy Projects in MENA and around the world
  - Bridging Solar Energy from MENA to Europe
  - Scientific & Educational Projects in MENA as Anchor Points for Collaboration and Capacity Building
  - Towards a Science / Energy Partnership



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## BUILDING BRIDGES



**SYMPOSIUM**  
**19/20 MAY 2011**  
**DESY HAMBURG**  
**GERMANY**

[www.solar4science.de](http://www.solar4science.de)



With the support of  
**Natural Sciences**  
**Sector**





250 participants from 30 countries

Representatives from science, Politics, industry, NGOs

~50 participants from MENA



# Follow-Up Conference EWACC2012/Building Bridges in Cyprus 10-12 December 2012



**Establish new conference EU-MENA**

**EWACC2014/Building Bridges  
Nicosia, Cyprus  
10- 12 November 2014**





# Conclusions

