Western Balkans Investment Framework WBIF

ces CLEAN ENERGY SOLUTIONS

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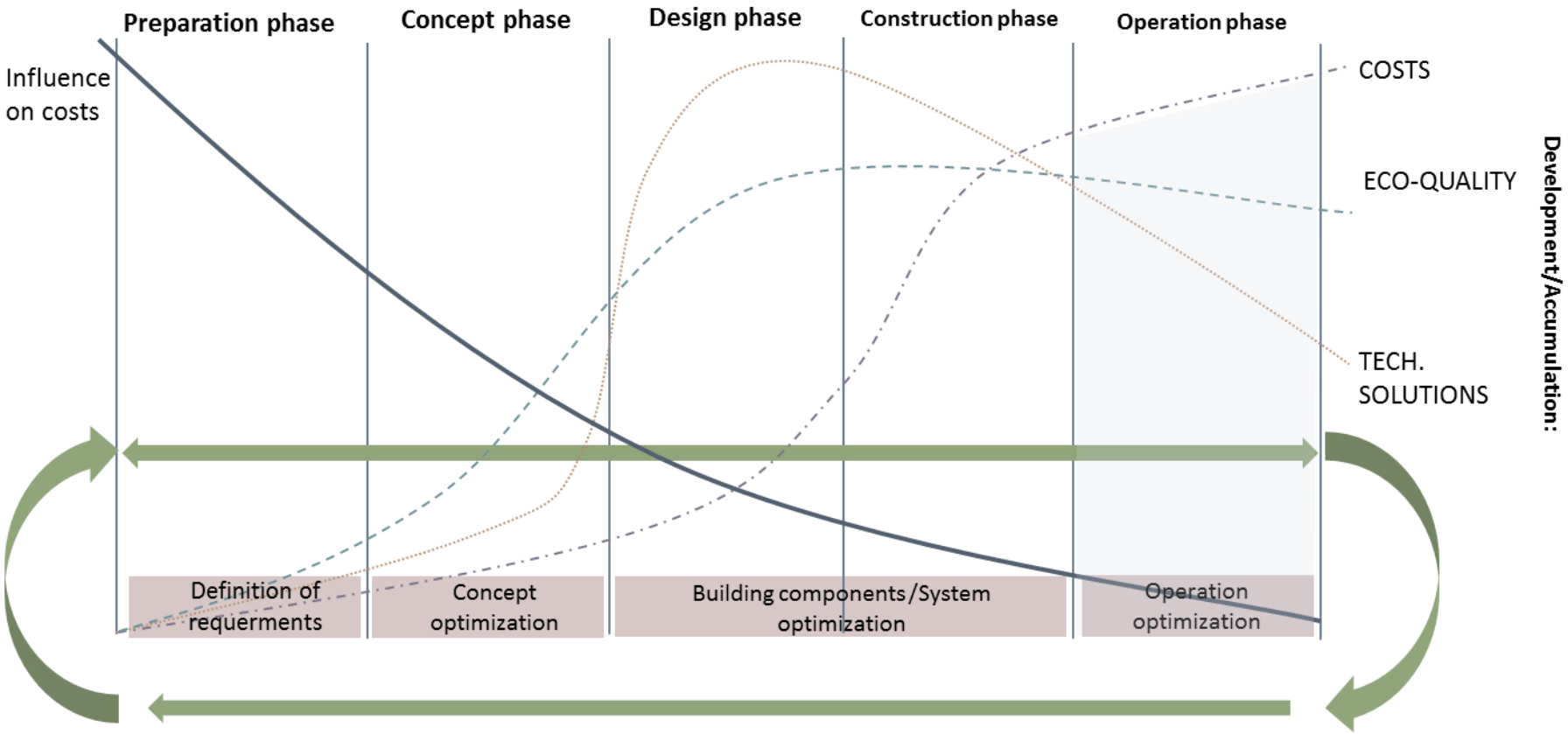
Energy auditing - Trainings Program

Introduciton to energy audits and certification

23/11/2016

Introduction



Note: Sketch graph
Source: CES

*…**buildings have a substantial share in the EU's total energy consumption (40%) and greenhouse gas emissions (36%).***

EU energy efficiency directive 15 June 2012:

"***Making energy audits more available***"

- Large companies must undertake energy audits every 4 years (with their first within 3 years from the Directive coming into force in spring 2014)
- Audits must be promoted to small and medium sized companies. The benefits of energy management system should also be promoted
- Audits must also be promoted to households

What is an energy audit?

- Tool for uncovering operational and equipment improvements that will save energy costs and lead to higher performance
- Aims to identify **where, when, why and how** is energy used in a property in order to identify opportunities to improve efficiency

Who performs an energy audit?

- Energy consultants
- Engineering firm
- Energy services companies (ESCO)

Introduction EA objectives

What are the main objectives of an energy audit?

- Comfort and code issues that can be addresses immediately
- Reduction of energy costs
- Transparency of energy consumption
- Compliance with regulations/guidelines
- Implementation of sustainable processes
- Action plan for energy efficiency capital investments
- Image cultivation

Assesment phases

Phase	Milestones	Activities
Preliminary review	• Facility benchmarking • Base energy load identification	– Collect and analyze utility data – Assess energy efficiency improvement potential
Site assessment	• Site data collection • Immediate energy savings opportunities identified	– Interview building staff – Visual inspection of building key systems – Collect data
Energy & cost analyses	• EEM prioritized according to goals	– Evaluate utility and site data – Analyze energy and cost savings – Develop list of recommended measures
Completiton of audit report	• Action plan developed for next steps	– Summarize findings – Present recommendations

ISO 50001

- ISO is the world largest developer and publisher of International standards

- ISO 50001 is a specification for an energy management system that defines requirements for establishing, implementing, maintaining and improving of energy systems

- Already implemented in over 3000 organizations in 60 countries

"The goal is to create an energy management system within an organization that will lead to a reduction in greenhouse gas emissions and other harmful environmental impacts while controlling energy costs"

Motivation for implementing ISO 50001:

- be a contractual or regulatory requirement
- be necessary to meet customer preferences
- fall within the context of a risk management programme
- help motivate staff by setting a clear goal for the development of its management system

- Rapidly developing standard(332% increase in 2011-12)
- You cannot be certified **by** ISO-> Accredited certification bodies

Definition of terms

- **Energy Management System (EnMS)**

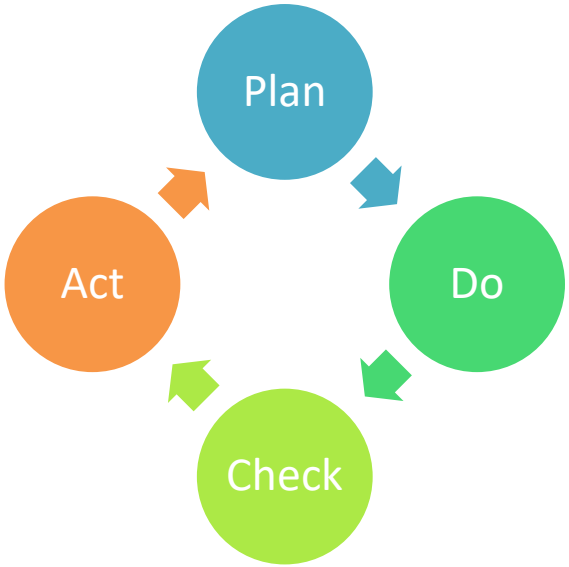
Set of interrelated or interacting elements that comprise an energy policy and energy objectives, as well as the processes and procedures to achieve those objectives.

- **Energy Performance Indicator (EnPI)**

Is a quantitative value of measure of energy performance, as defined by the organization. EnPI´s are utilized to normalize energy data based on factors that may contribute to energy fluctuations

ISO- continuous energy management improvement/PDCA Plan

PDCA Plan



Source: ISO50001 Recommendation for compliance

- Plan

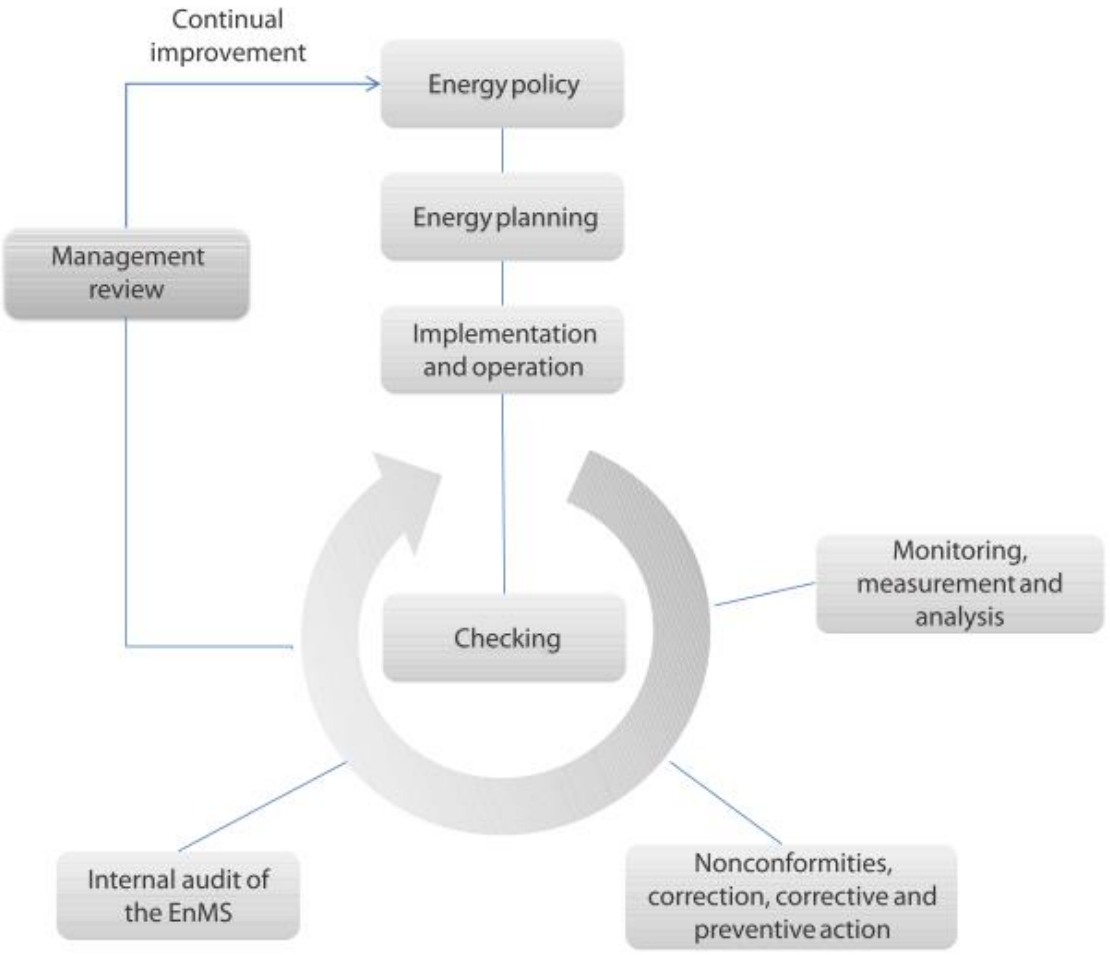
  definition of objectives and processes necessary to deliver results in line with energy policy of the organization
- Do

  Implementation of defined processes
- Check

  Monitor and measure processes against the energy policy and objectives and documentation of results
- Act

  Take actions to continually improve energy performance and EnMS

ISO-continuous energy management improvement /PDCA Plan



Source: ISO50001 Recommendation for compliance

Key to compliance

Key to ISO50001 compliance

Energy aspects Reviews

- ✓ Past and present consumption
- ✓ estimated expected consumption

Awareness training

- ✓ Training for all levels of management

Monitoring and measurement

- ✓ Energy metering plan
- ✓ Consumption and Energy KPI

Operational control

- ✓ Energy considerations in purchasing
- ✓ Design change/restauration

ASHRAE procedures for commercial energy audits

American Society of Heating, Refrigerating, and Air-Conditioning Engineers

Three standard levels of audits

Level 1: Site Assessment or preliminary audits

- ✓ Brief on site survey of the building

Level 2: Energy survey and engineering analyses

- ✓ Breakdown of energy use/savings and cost analysis; O&M changes

Level 3: Detailed analyses of capital-intensive modification audits

- ✓ Cost and savings calculations with a high level of accuracy ; additional measurements, hourly simulations

Preliminary Energy-Use Analysis **(PEA)** represents a prerequisite for any audit. It includes analyses of the historic utility use , benchmarking to similar buildings . It provides background information data for Levels 1,2,3

ASHRAE procedures for commercial energy audits

Level 2 Standard: Energy survey and engineering analyses

- Review mechanical & electrical system design
- Detailed analyses including the following systems:
  - Building envelope
  - Lighting
  - HVAC
  - Domestic hot water
  - Loundry
  - Food preparation
  - Refrigeration
- Review of O&M
- Measurment of key parametars and comparisson to design levels
- Detailed estimation of the proposed measures

Benefits

FINANCIAL BENFITS

- reduced expenditure on energy
- reduced maintenance costs
- improved productivity in working environmer

OPERATIONAL

- optimization of building operation

ENVIRONMENTAL BENEFITS

- reduction of GHG emission
- reduction of environmental impacts related to transmission, delivery or transport of energy

MARKETING BENEFITS

- going green as the new way
- higher recognition in the community

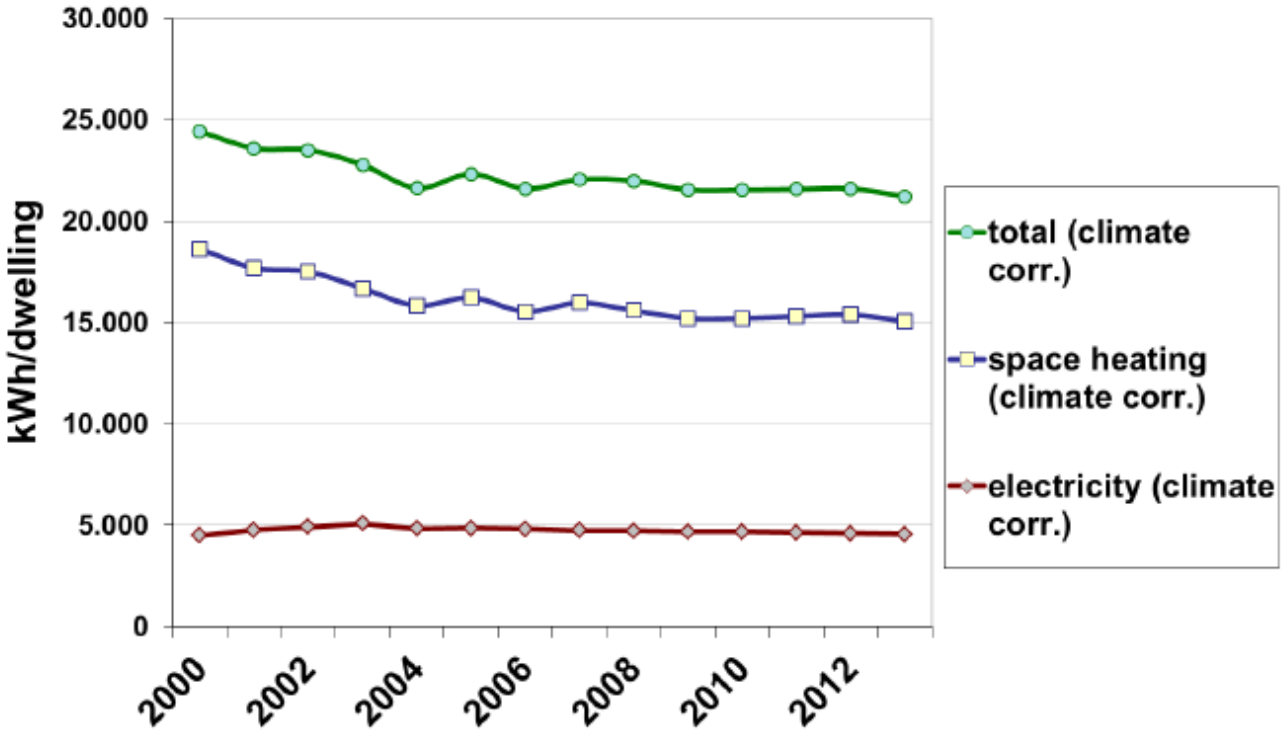
General Barriers/ Weaknesses

- Limited time for assessment
- Inexistent transparency
- Ignorance about legal requirements
- Lack of awareness
- Lack of knowledge
- Negative perception of auditors

- Overestimated savings
- Poor improvement selection
- No-life cycle costing

Energy efficiency policies Austria

Source: ODYSSEE



Development of total energy usage, energy usage for space heating and electricity usage per dwelling (all climate corrected) in the residential sector from 2000 to 2013

Energy efficiency policies Austria

- The building refurbishment programme, implemented in 2009 and ongoing, aims at the thermal refurbishment of residential and commercial buildings that were built more than 20 years ago

A maximum of 30% of the investment cost can be covered by the subsidy; however, a maximum cap is defined for each measure. The budget for 2015 was 80 mio. EUR for households and companies. This sum was used up by August 2015.

Source: Austrian Energy Agency, *Energy Efficiency Trends and Policies in Austria*

Energy efficiency policies Austria

The following measures are subsidized

- Insulation of outer walls
- Insulation of the upper ceiling and roof
- Insulation of the lower ceiling and the basement floor
- Refurbishment or replacement of windows and outer doors
- Replacement of heating systems: installation of solar thermal plants, biomass boilers, heat pumps, connection to the district heating grid or local heating grid (residential buildings only)
- Installation of heat recovery systems (commercial buildings only)
- Installation of shading systems (commercial buildings only)

Energy efficiency policies Austria

- Two levels of energy trainings in Austria; A-course (basic training), F-course (advanced training)

- The federal law on energy efficiency, passed in 2014 and in force until end of 2020, implements Directive 2012/27/EU on energy efficiency amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC and the EU 2020 climate and energy package

Source: Austrian Energy Agency, *Energy Efficiency Trends and Policies in Austria*

Energy efficiency policies

Austria

- Energy efficiency obligation system for energy suppliers: energy suppliers selling 25 GWh or more to final customers in Austria have to set energy efficiency measures ->measures have to lead to energy savings of 0.6% of their energy sales in the previous year to final customers in Austria

- Energy management in companies: companies > 249 employees have to (1) implement an energy management system (according to ISO 16001 or ISO 50001) or an environmental management system (according to ISO 14000) or (2) have to carry out an external energy audit every four years

- Renovation of federal buildings: energy efficiency measures have to be implemented between 2014 and 2020 in buildings which are owned and used by the federal state -> refurbishemt rate at 3% per year

Qualified people fulfilling the minimum criteria are listed in the registry for energy service providers

Source: Austrian Energy Agency, *Energy Efficiency Trends and Policies in Austria*

Outlook

Considering the Expertese of Staff and available Simulation Software is possible to:

- Conduct comprehensive, interdiscplinary Analysis
- Maximise Energy and System Efficiency
- Minimise Energy Demands
- Optimize Buildings
- Perform accurate Cost-/Benefit-Analysis
- Analyse the Potential of Renewable Energy Sources
- Reduce CO_2 Emmisions

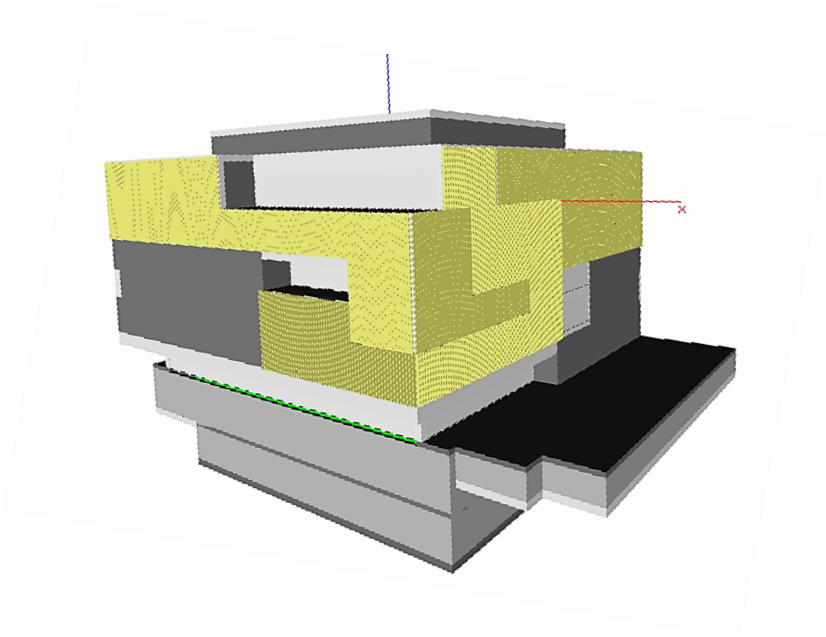
SIMULATION TOOLS

Agenda

- Simulation Activites and Sample Projects
- Used Simulation Tools
- Possibilites Using these Simulation Tools
- Introduction to Simulation Tools
  - TRNSYS
  - Plancal
  - PV*SOL
- Outlook

Simulation Activities

- Dynamic Building Simulation
  - Heating Demand
  - Cooling Demand
  - Humidification and Dehumidifaction
  - Ventilation
  - Etc.

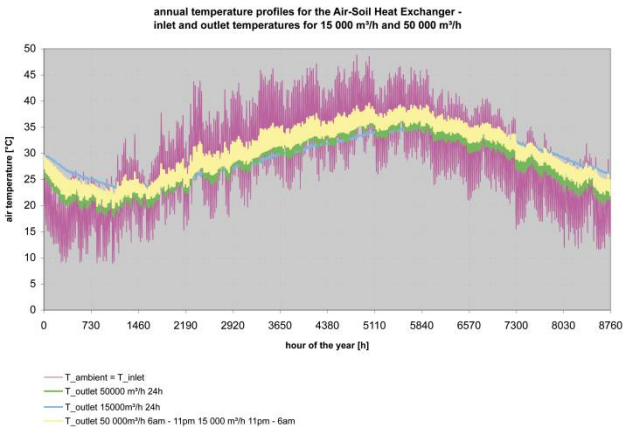


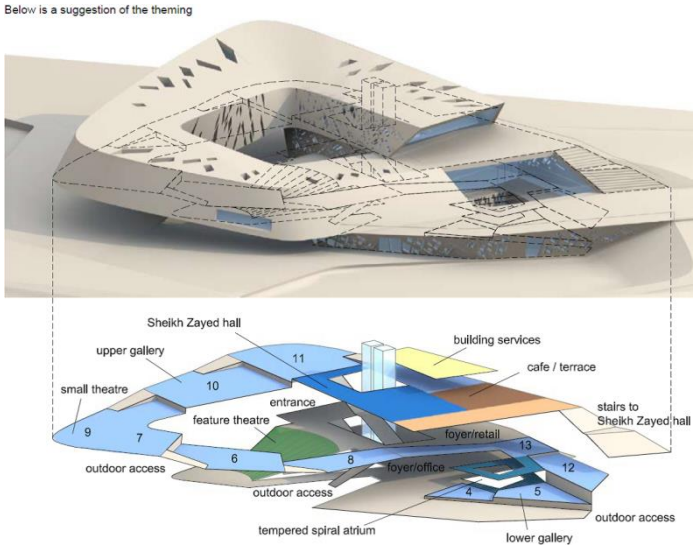
Simulation Activities

- Dynamic Building Services Simulation
  - Hot and Chilled Water Generation and Distribution
  - Renewable Energy Sources
    - Photovoltaic
    - Solar Thermal
  - DEC Dessicant Evaporating Cooling
  - Etc.

Sample Projects

- Sheik Zayed Desert Learning Center
  - Comprehensive Thermal Analysis and Simulation
  - Building Services Engineering
  - Simulation of Photovoltaik Plant
  - Simulation of DEC System





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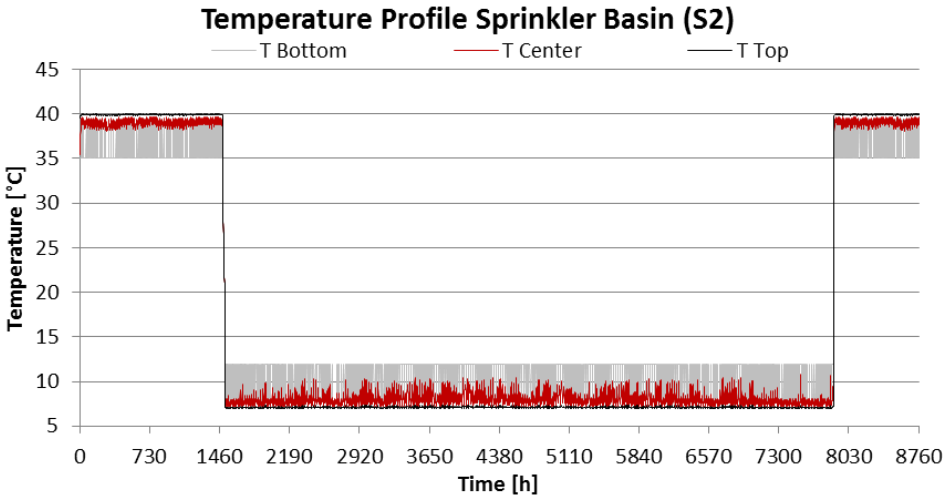
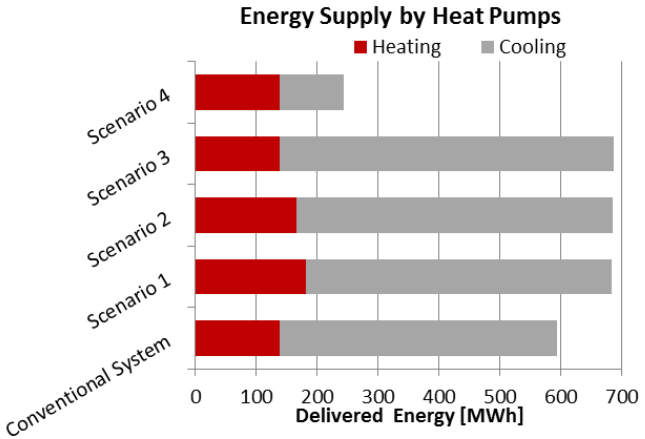
Sample Projects

- Haus der Musik
  - Heating and Cooling Demand
  - Heat Pump Energy Generation
  - Thermally Activated Fire Sprikler Basins





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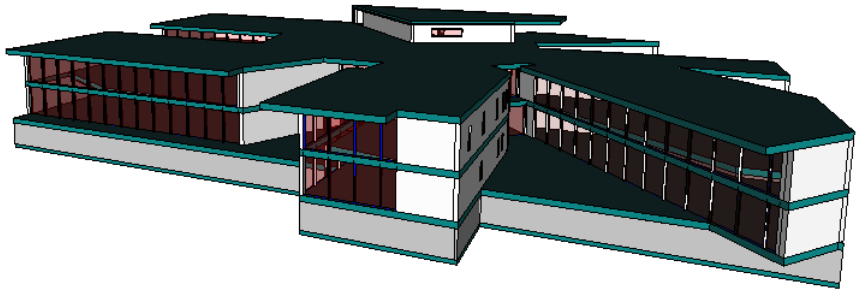
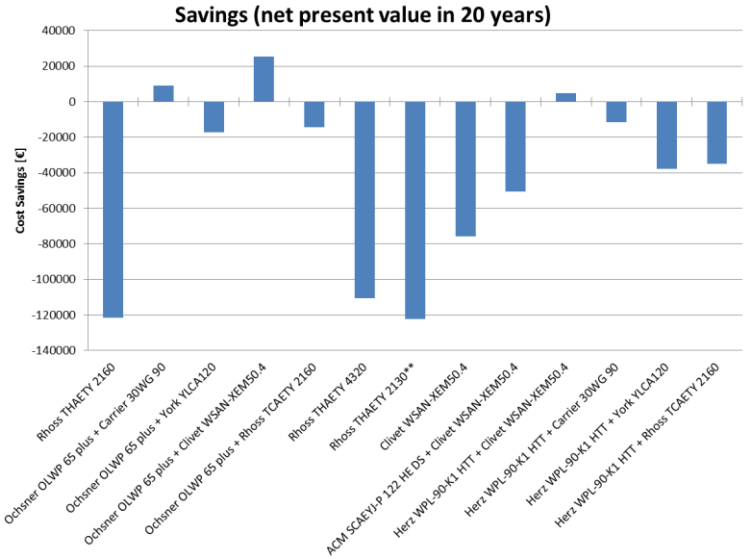
Sample Projects

- Office Building Austria
  - Heating and Cooling Demand
  - Heat Pump Energy Generation
  - Economic Analysis and LCC of Heat Pumps





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Common Used Simulation Tools

- TRNSYS17 (Transient Simulation of thermal and electric energy of buildings with weather impact)
- PLANCAL (Software for Cooling Load VDI and Heating Load ÖNORM)
- PV*SOL premium (Photovoltaic systems simulation)
- T*SOL expert (Solar thermal systems simulation)
- EnergyPlus 8.1 (Energy Analysis)
- REVIT MEP (BIM design and 3D geometry for further processing)

Possibilities

- Detailled Analysis of…
  - Renewable Energies
    - Photovoltaic Energy
    - Solar-Thermal Energy
    - Heat Pumps
    - Solar-Cooling
  - Energy Distribution within the Building
  - Energy Demands and Saving Potentials
  - Dynamic Behaviour of Buildings (e.g. Thermal Mass)
  - Innovativ Building Services Engineering

Introduction to…

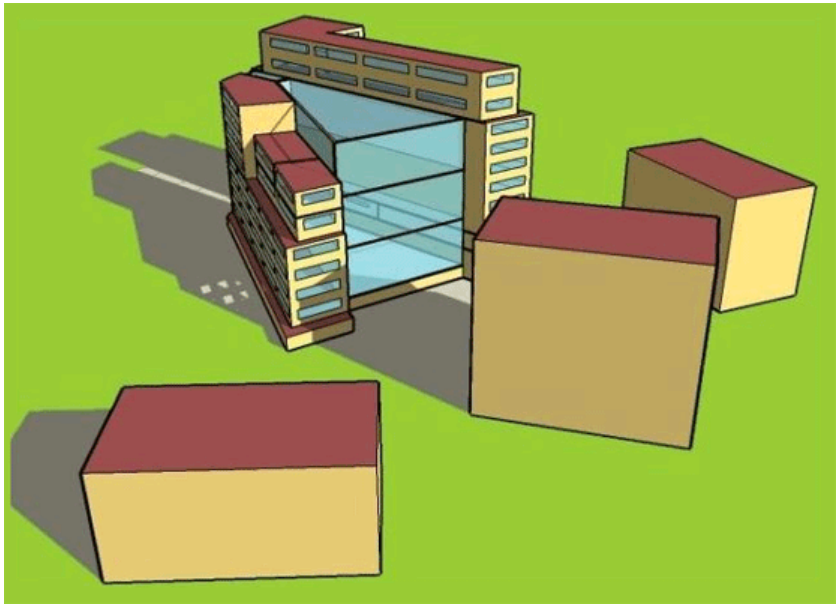
- TRNSYS

  - Abbr. for **TR**a**N**sient **SY**stems **S**imulation
  - Graphically Based Simulation Tool
  - Plug-Ins for Google Sketch-Up and Design Builder
  - Drag- and Drop Library Elements
  - ExtendedMathematical Library (TESS)

- TRNSYS

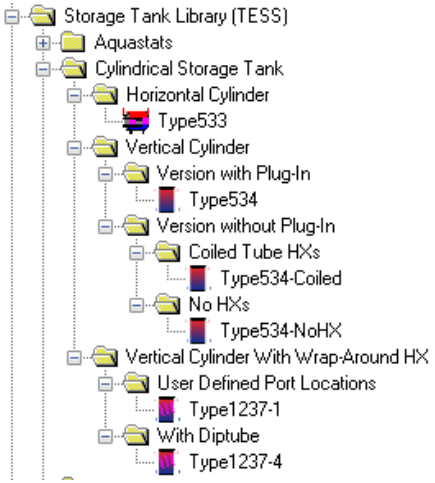
  – Typical Progress:

    - Simplified 3D Geometry drawn in Google Sketch-Up and transferred into IFD-format and further processed in TRNSYS as a Block (Type Type 56)



Introduction to…

- TRNSYS
  - Typical Progress:
    - Step by Step Implementation of System Components, Adjustment of e.g. U-Values, Occupancy Schedules, etc.
    - Different Mathematical Library Types for all components: In depth research in advance, which types suite best to the upcoming simulation?
    - Import of EXCEL possible
    - Evaluation of required time steps
    - Dynamic Simulation not only Buildings!



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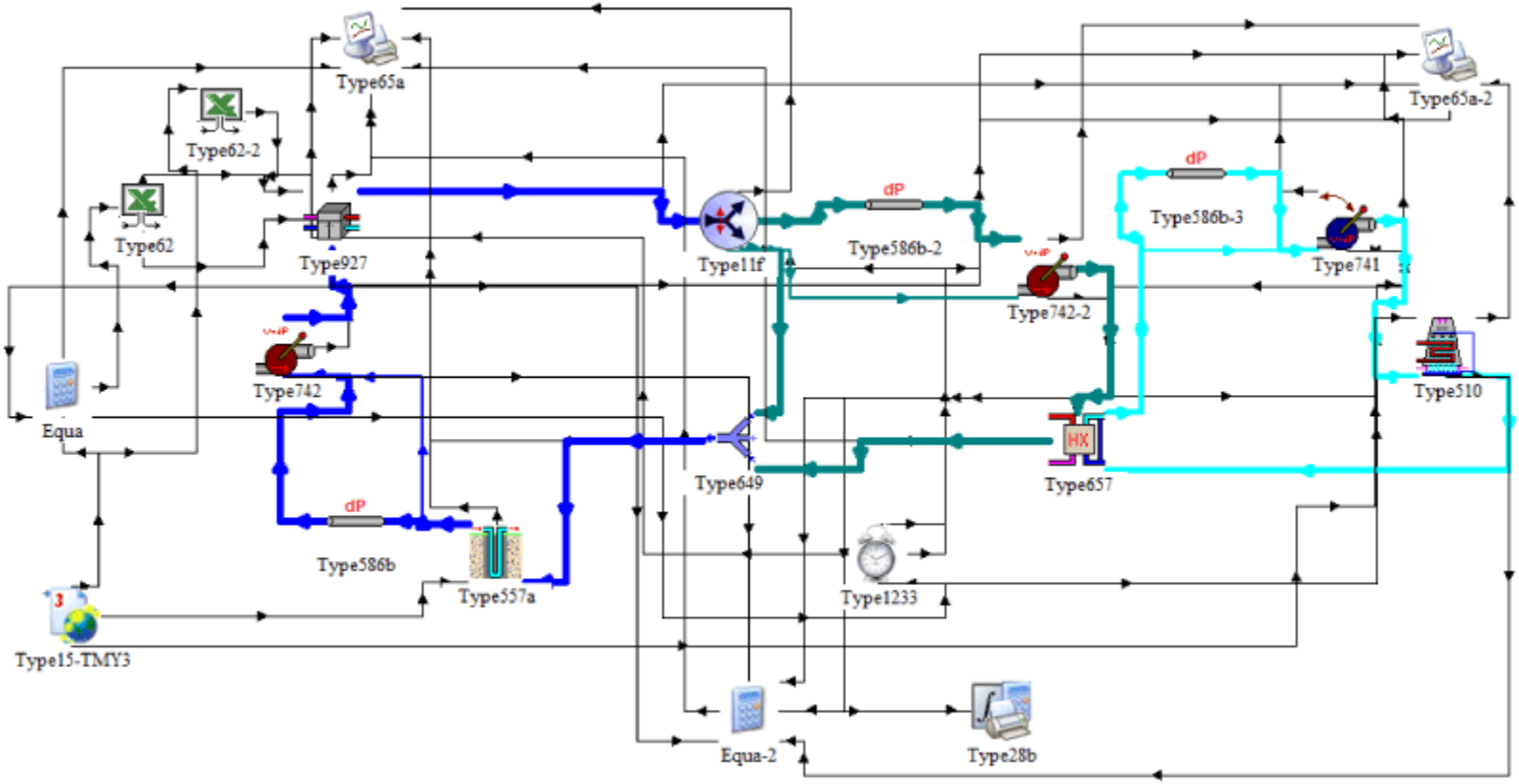
Introduction to…

- TRNSYS

TRNSYS 17

  - Typical Progress



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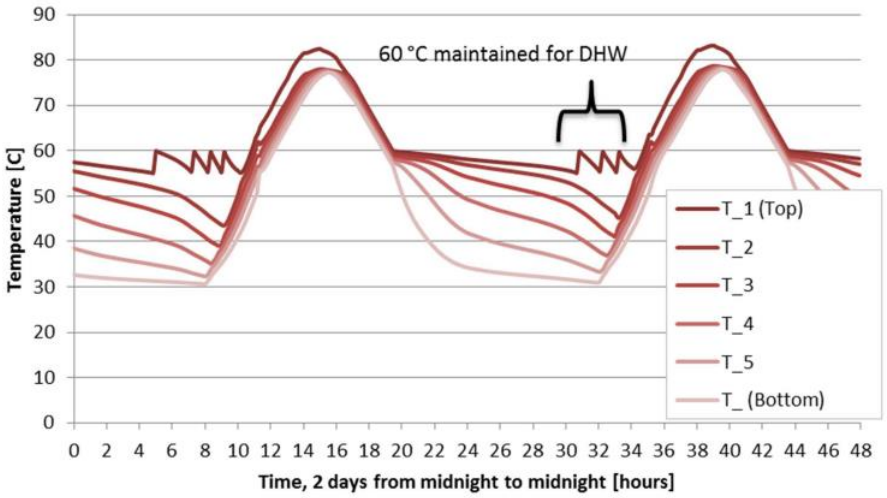
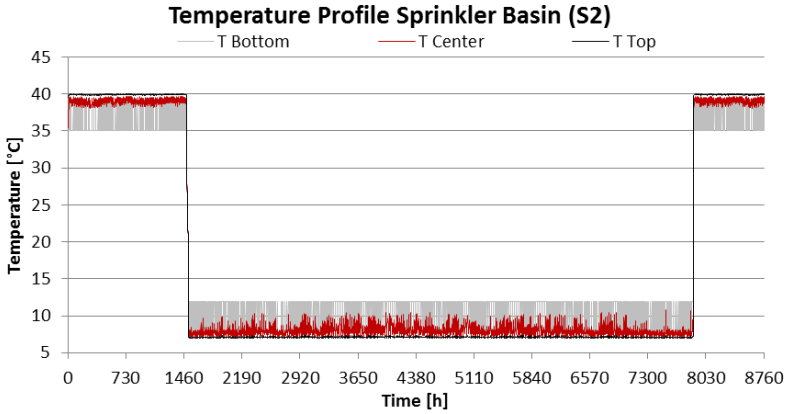
Introduction to…

- TRNSYS
  - Typical Progress: Results processed in Excel





Introduction to…

- PV*SOL 

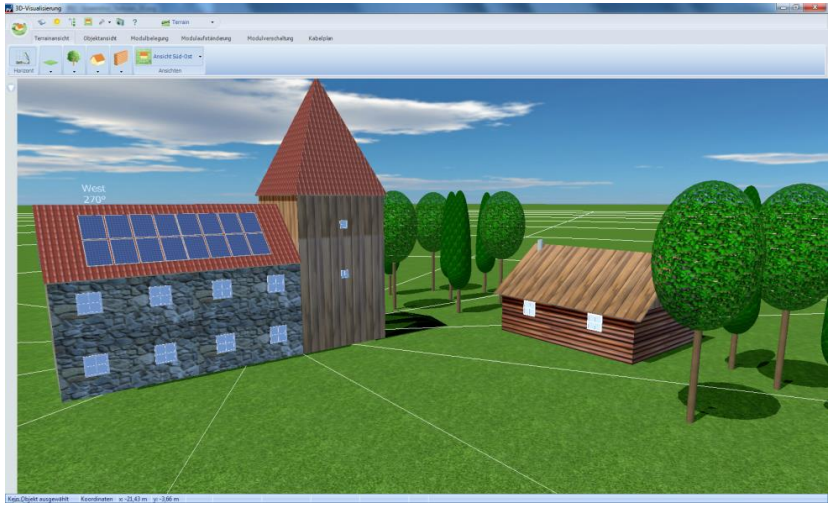
  - PV Simulation Tool
  - Underlaying Library of all common Photovoltaic Modul and Inverter Manufactures and their Products, including all specific Product Data
    - Efficiencies
    - Degrading Ratio
    - Open-Circuit Voltages
    - Short-Circuit Currents

Introduction to…

- PV*SOL

  – Typical Progress:

    - Simplified 3D Geometry can be drawn, including sourrounding objects to anaylse shading
    - Modules need be chosen
    - Modules can be arranged on the Roof or on a tilted mounting system (auto-
      matically or manually)



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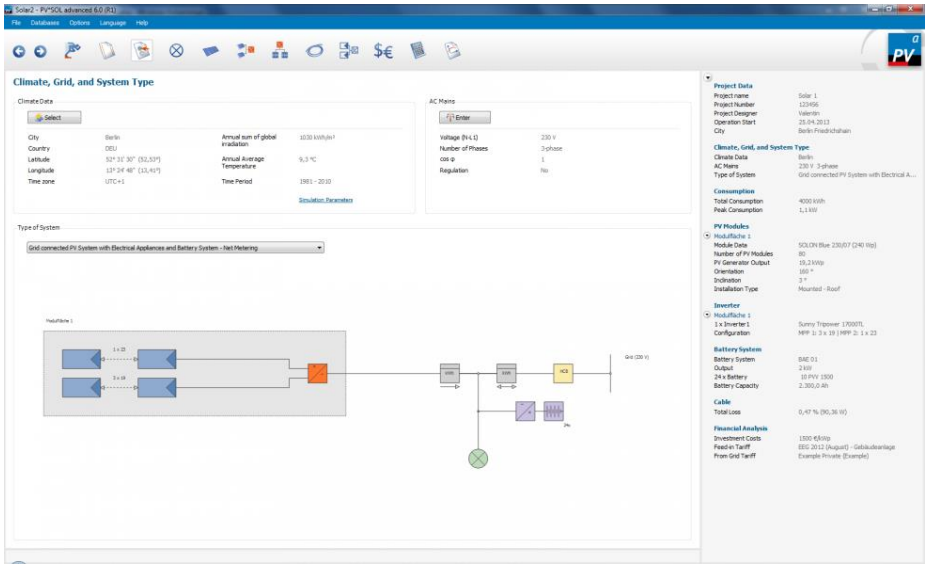
Introduction to…

- PV*SOL

  – Typical Progress:

    - Suiting Inverters need to be chosen, accoding to defined PV-Strings and resulting OC-Voltage and SC-Current.
    - Definition of system type: consumtion, feed in, excess energy feed in, etc.



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Introduction to…

- PV*SOL

  – Typical Progress:

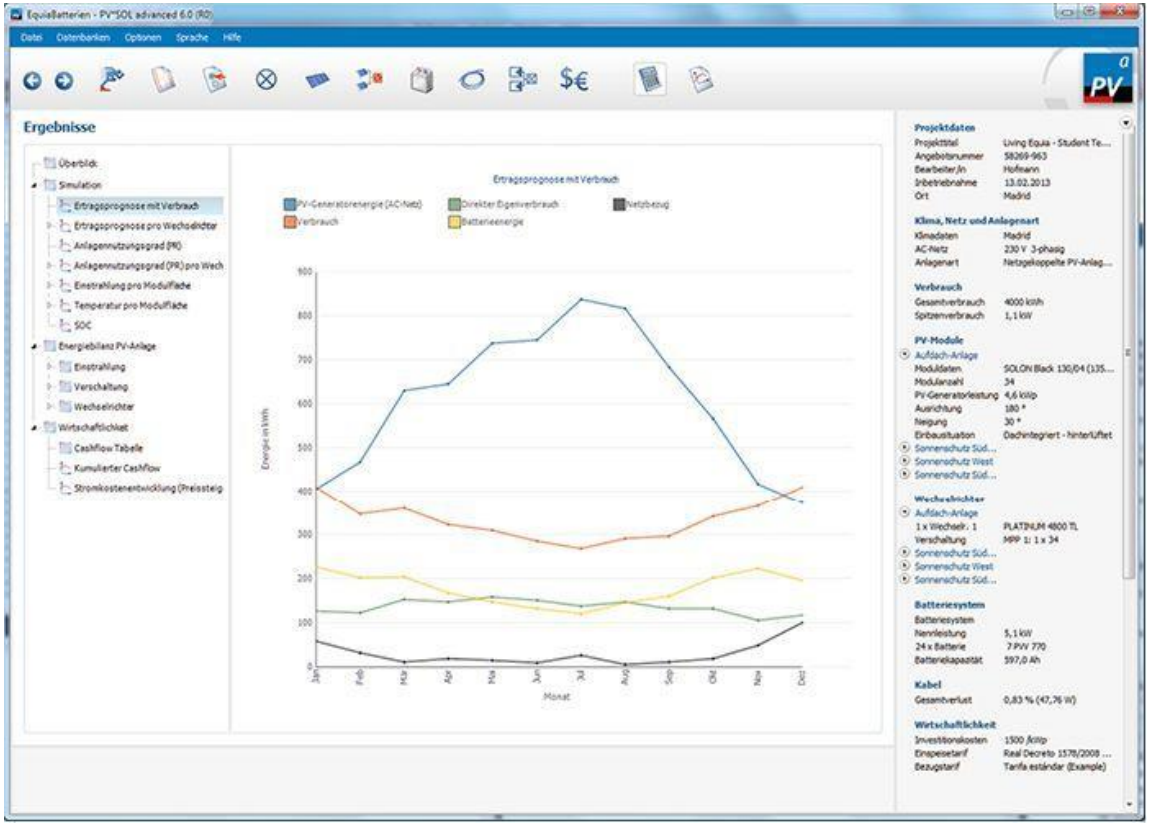
    - Desired Load profiles, if self consumption is required, can be loaded into the project. Definition of feed in tarrifs, etc.
    - Back-Up energy system can be defined.
    - The simulation results in a yearly profile, considering all factors (tempature, shading, degradation, consumtion, cable losses, etc.) – which could also be imported to e.g. TRNSYS for further analysis

Introduction to…

- PV*SOL

  PV*SOL premium

  – Typical Progress: Results



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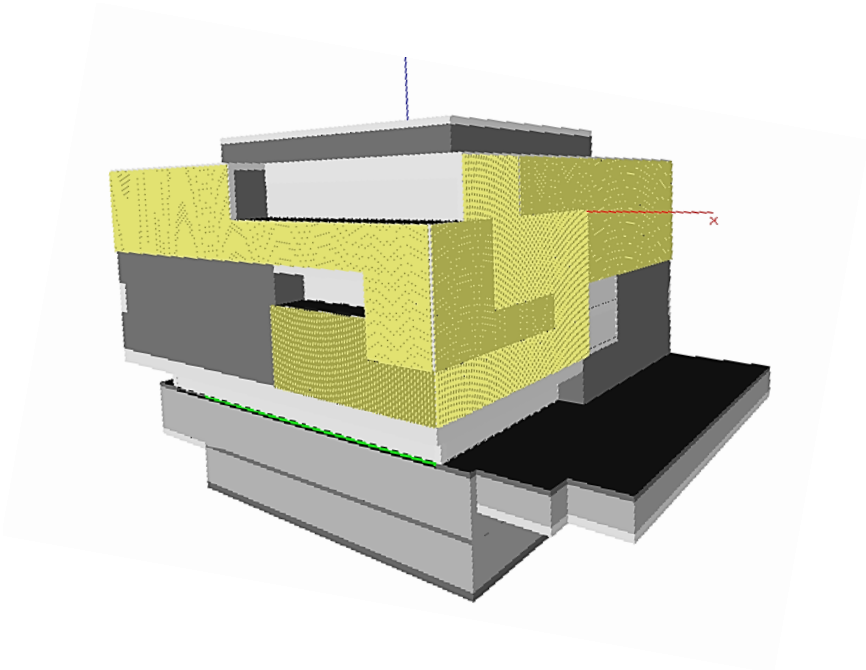
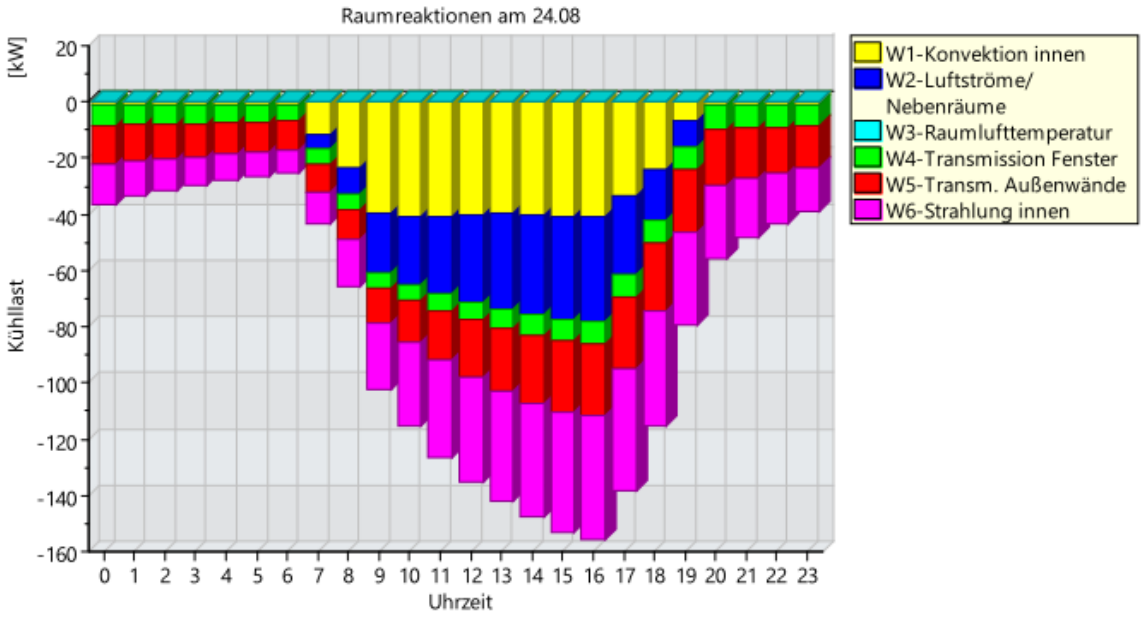
Introduction to…

- Plancal
  - Static and Dynamic Simulations, according to Law
  - Detailled Cooling Load Analysis of Buildings
  - Unterlying Calculation for most Design Purposes
  - Typical Progress:
    - Definition of Building Geometry and the detailled Thermal Building Shell and Properties



Introduction to…

- Plancal
  - Typical Progress:
    - Defintion of Occupancy Schedules
    - Shading Devices and Shading Behaviour
  - Results:



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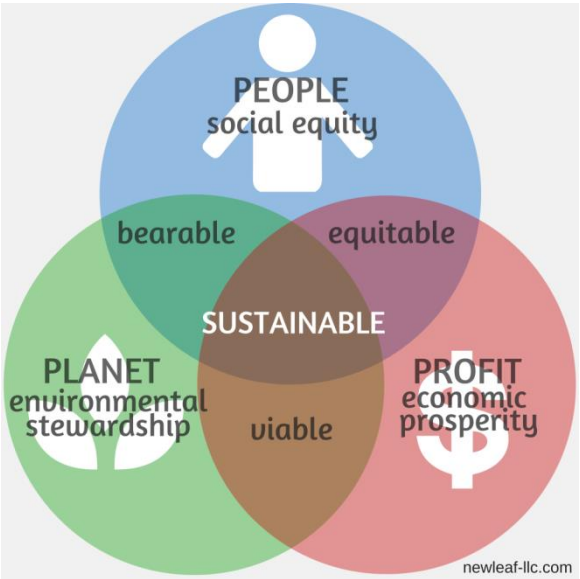
Outlook

- Considering the Expertese of Staff and available Simulation Software is possible to:
  - Conduct comprehensive, interdiscplinary Analysis
  - Maximise Energy and System Efficiency
  - Minimise Energy Demands
  - Optimize Buildings
  - Perform accurate Cost-/Benefit-Analysis
  - Analyse the Potential of Renewable Energy Sources
  - Reduce CO_2 Emmisions

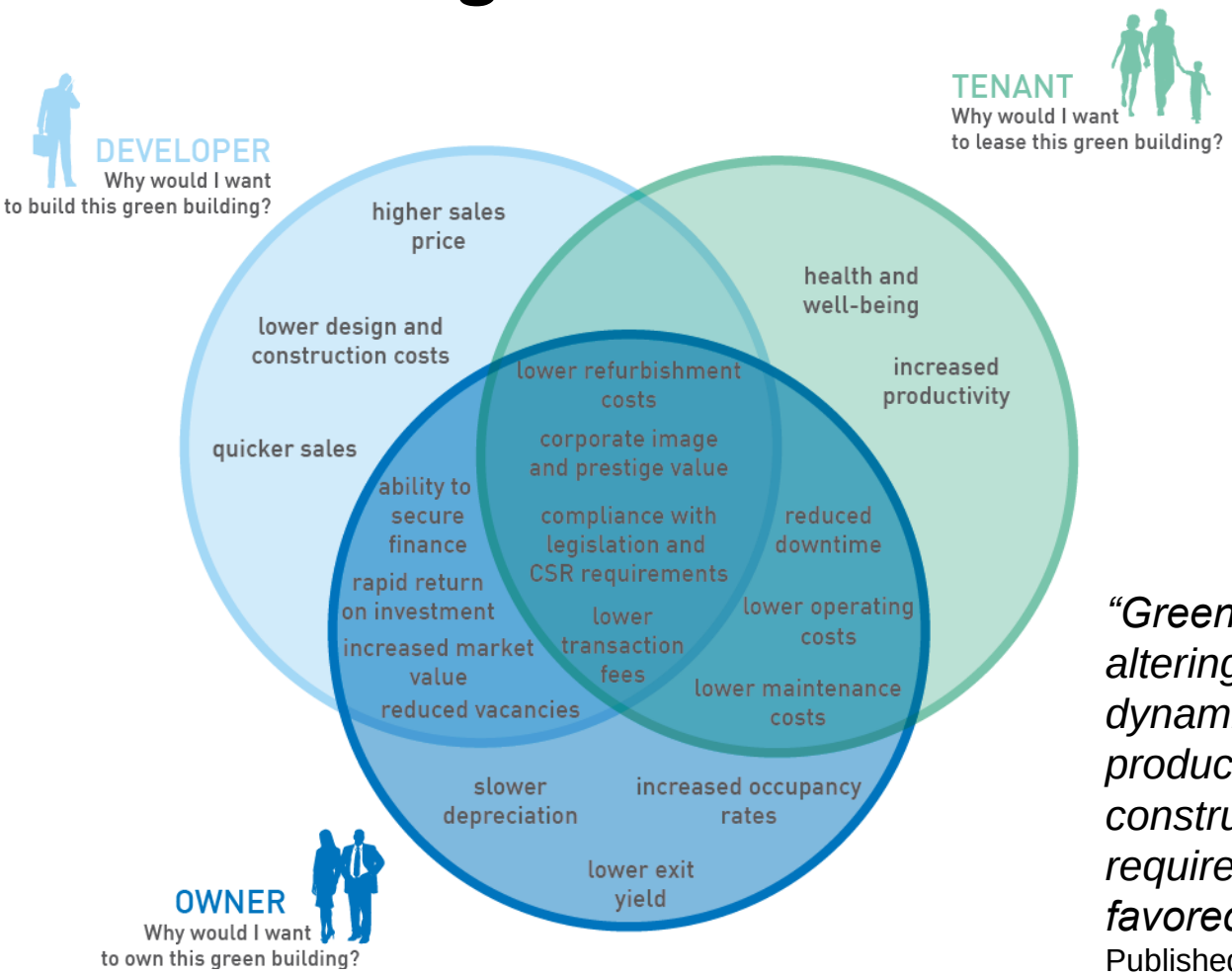
Sustainability

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

(World Commission on Environment and Development 1987



Green Building



"Green building is fundamentally altering real estate market dynamics – the nature of the product demanded by tenants, constructed by developers, required by governments and favored by capital providers,"
Published in Forbes magazine and according to RREEF Research

Source: World Green Building Council, 2013

Green Building Certification Systems

LEED (Leadership in Energy & Environmental Design)

BREEAM (Building Research Establishment Environmental Assessment Methodology)

ÖGNI (Österreichische Gesellschaft für Nachhaltige Immobilienwirtschaft)

DGNB (Deutsches Gütesiegel Nachhaltiges Bauen)

Other e.g.; HQE (France), CASBEE (Japan), ESTIDAMA (UAE), Green Star (Australia)

Benefits of green building

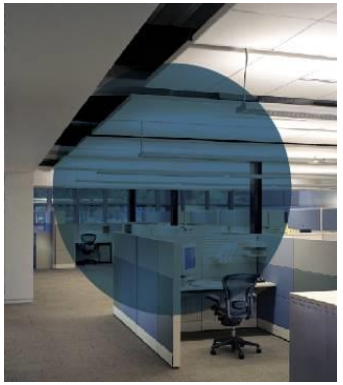
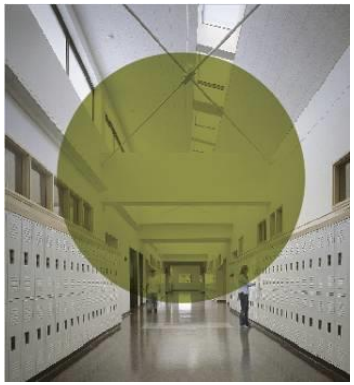
- Enhance resource efficiency
- Reduce the environmental impact of buildings
- Increase the well-being of occupants in a healthy and resource optimized environment
- Improved indoor comfort
  - Hygro-thermal comfort
  - Air quality
  - Visual comfort
  - Acoustic comfort
- Transparent comparison of buildings based on their environmental performance
- Enhancing the demand for sustainable and green buildings
- Goes beyond the national codes and building practices

Benefits of green building

Examples of additional value for various building types:

- RETAIL: INCREASE IN SALES PER AREA
- FACTORY: INCREASED PRODUCTION OFFICES: 2-16% PRODUCTIVITY INCREASE
- SCHOOLS: 20% BETTER TEST PERFORMANCE
- HOSPITALS: EARLIER DISCHARGE
- OFFICES: 2-16% PRODUCTIVITY INCREASE

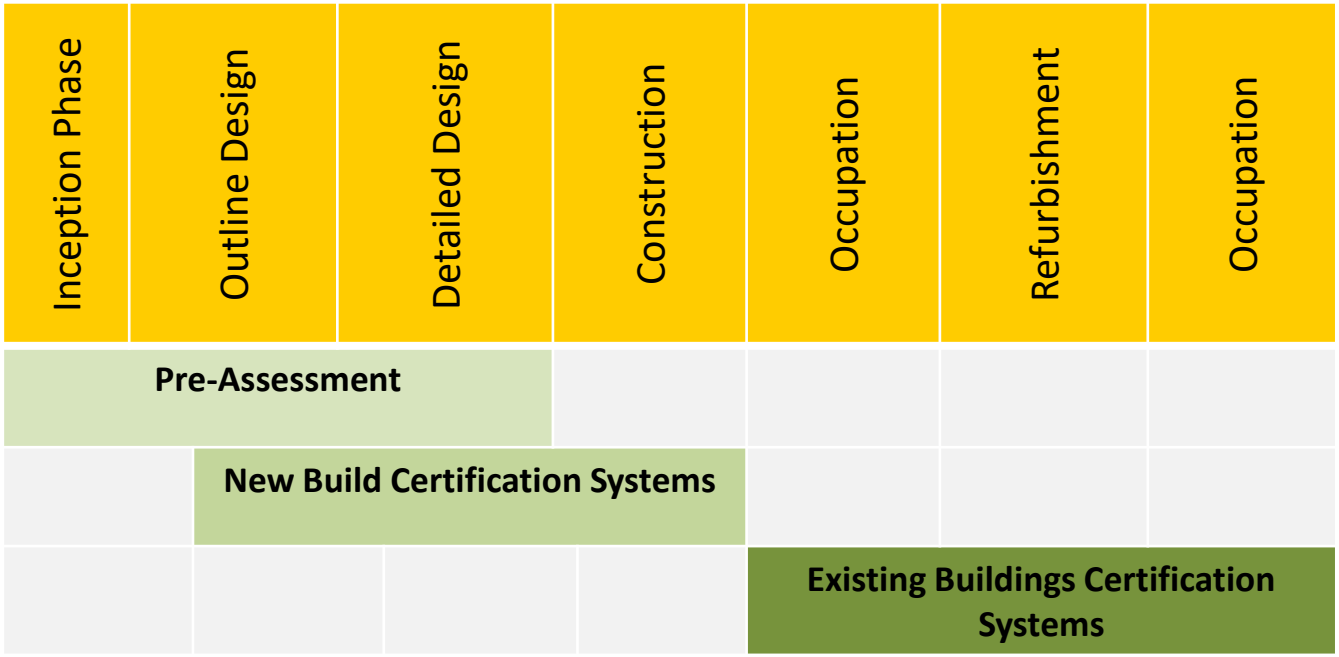


Green Building Certification

Project Phases & Life Stages

- Green building certification systems are applicable for both new and existing buildings



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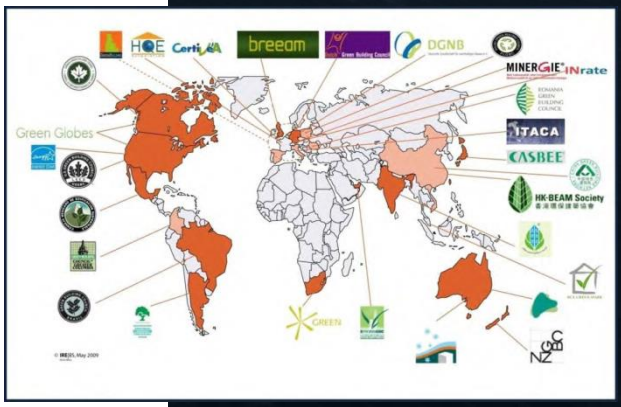
Others e.g.; HQE (France), CASBEE (Japan), ESTIDAMA (UAE), Green Star (Australia)

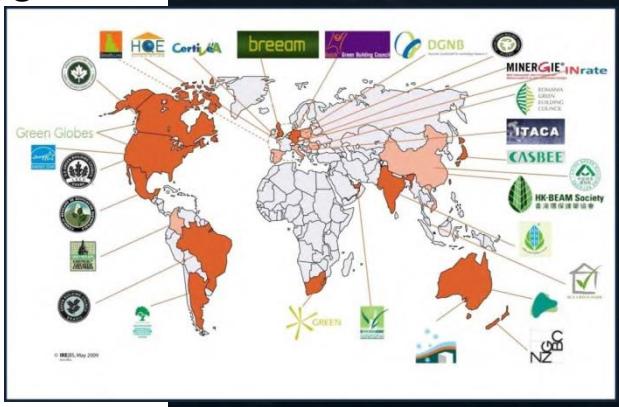
LEED and BREEAM are currently two most widely spread systems in Europe



Green Building Certification Systems

Current situation Europe & Slovenia

- According to the official project databases in Slovenia there is **one LEED** certified project (Core&Shell) and **one BREEAM** certified project.
- On European level BREEAM has the highest share but due to the fact that is has become almost a standard in the UK. Leaving out the UK market, LEED has thee highest share also in Europe
- On a global level LEED still holds the highest share



LEED

- BUILDING DESIGN AND CONSTRUCTION
- BUILDING OPERATION AND MAINTENANCE
- INTERIOR DESIGN AND CONSTRUCTION
- NEIGHBOURHOOD DEVELOPMENT

BREEAM

- NEW CONSTRUCTION
- IN-USE
- REFURBISHMENT AND FIT-OUT
- COMMUNITIES – MASTERPLANNING
- INFRASTRUCTURE – CIVIL ENGINEERING & PUBLIC REALM

LEED

BREEAM

- NEIGHBOURHOOD DEVELOPMENT
  - Plan
  - Built Project
- HOMES
- COMMUNITIES
  - No subcategories, large scale masterplanning and regeneration projects eligible
- INFRASTRUCTURE
  - Energy (Power plants, renewables)
  - Structures (Bridges, tunnels…)
  - Transport (Roads, rails…)
  - Other (Aviation, marine and coastal, water, data and communication and others)

LEED	BREEAM
Location & Transportation	Transport
Sustainable Sites	Land Use and Ecology
Water Efficiency	Water
Energy & Atmosphere	Energy
	Pollution
Material & Resources	Materials
	Waste
Indoor Environmental quality	Health and Wellbeing
Innovation	Innovation
Regional Priority	Management

LEED

BREEAM

CLEAN ENERGY SOLUTIONS

CERTIFIED
40 - 49 POINTS

SILVER
50 - 59 POINTS

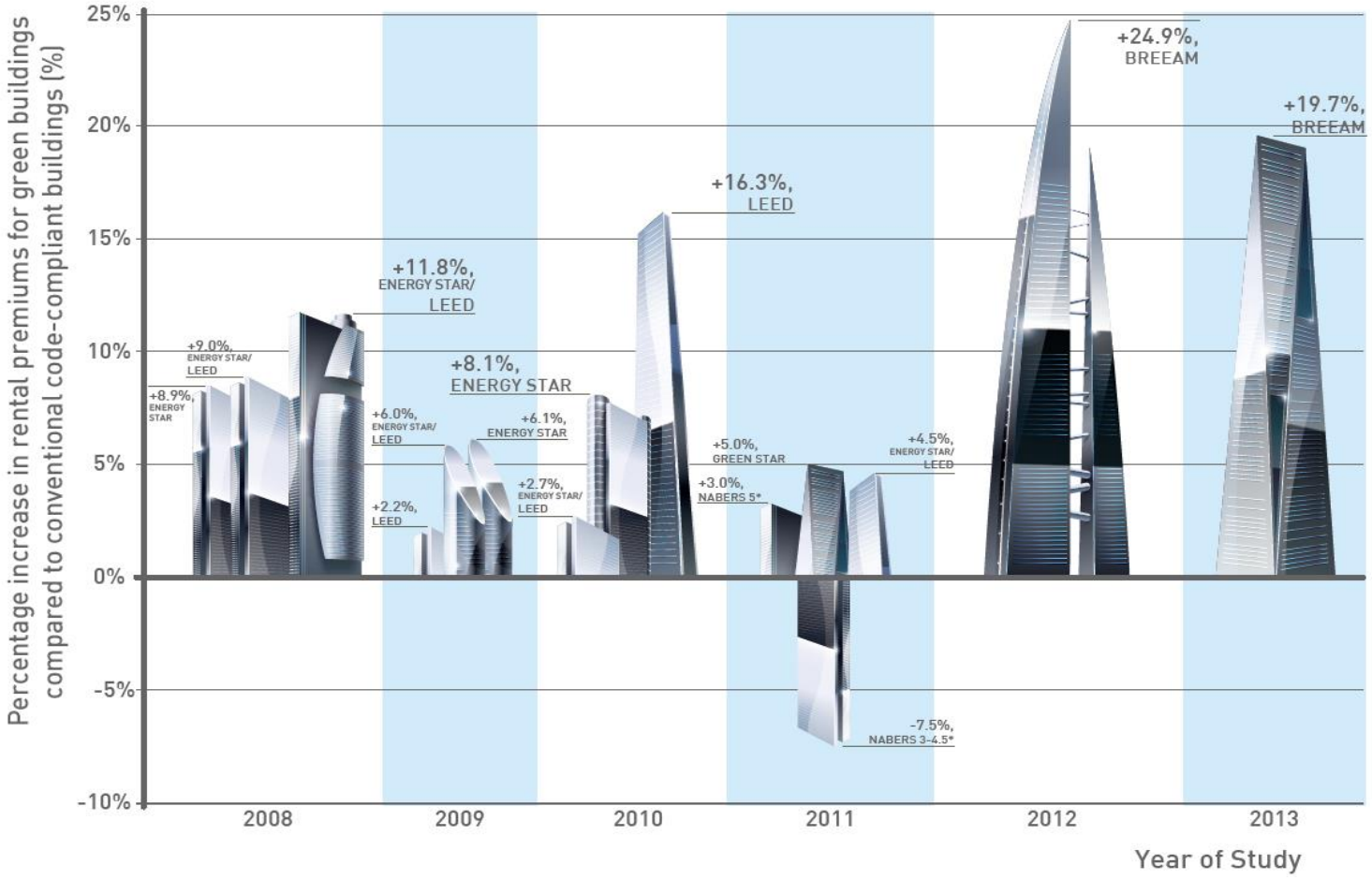
GOLD
60 - 79 POINTS

PLATINIUM
80+ POINTS

- <10% Unclassified
- >10% Acceptable
- >25% Pass
- >40% Good
- >55% Very Good
- >70% Excellent
- >85% Outstanding

Economic benefits

Higher rent yields compered to conventional buildings



Source: World Green Building Council, 2013

Economic benefits

Analyses of certified buildings shows that green certified buildings can achieve a higher value compared to similar building that are not certified.

- Estimated 3% higher rent on average
- Estimated 6% higher revenue (due to higher occupancy)
- Up to 16% higher sale price

Source: Eichholtz P. et al., (2009), Doing Well by Doing Good? An Analysis of the Financial Performance of the Green Office Buildings in the USA, Maastricht University and California University

Profile

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Ivan Krofak

- Experience in international team management and project coordination in energy efficiency, renewable energy and new technologies implementation
- Team leader in sustainable design and construction and international green building development
- Experience in capacity building in developing countries
- Experience in multidisciplinary and international project engineering and management
- Expertise in sustainability analysis and evaluation of energy & ecological performance of buildings and building components, elements and structures
- Project experience across CEE

Visit us on the internet …

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We are looking forward
to the future.
Wherever!
Whenever!
With you.

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