

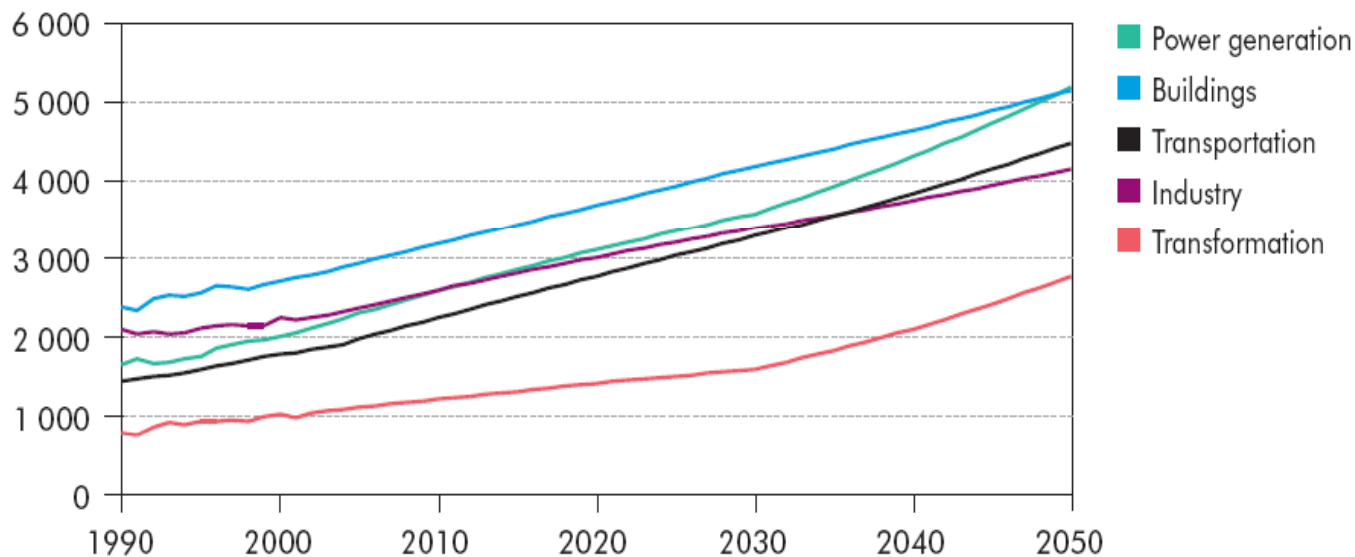
WHP

First draft to be discussed at the next ILC

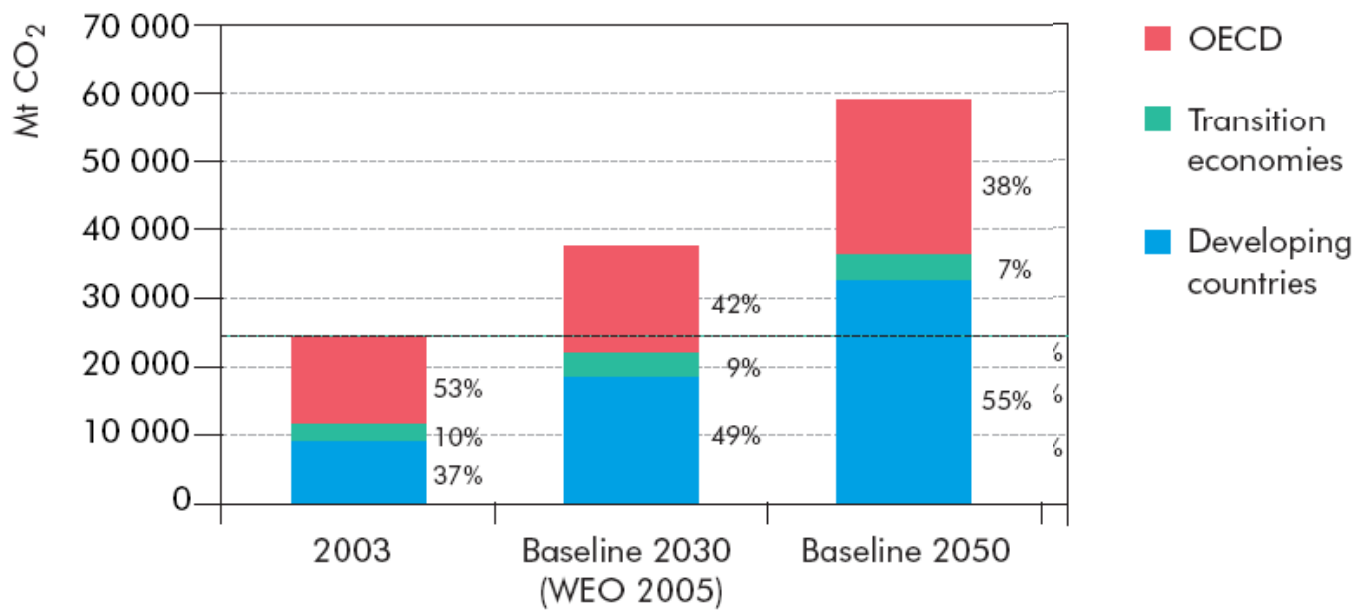
Essen Feb 19-22, 2008

Pierpaolo Garibaldi - Italy

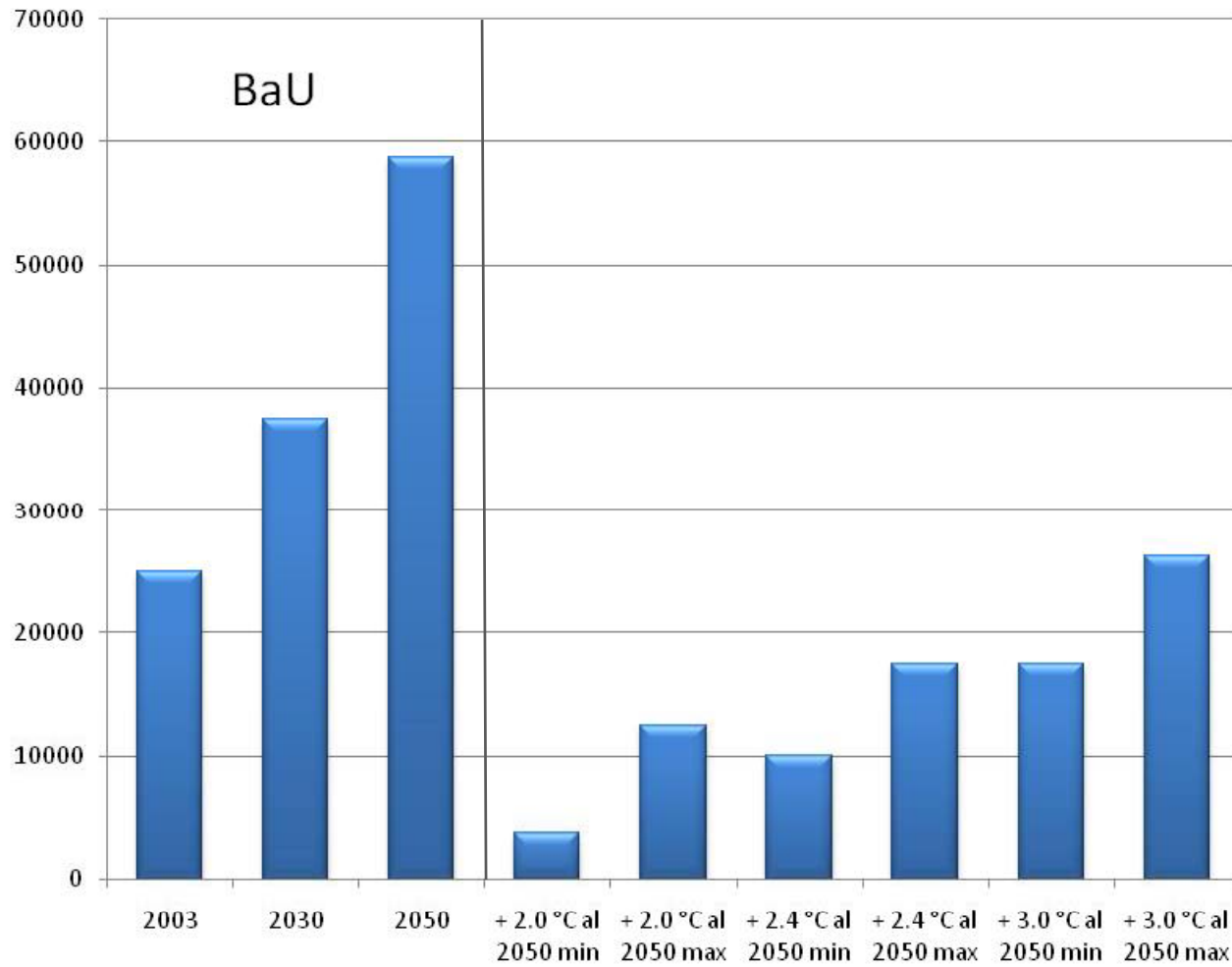
Energy use by sector in the Baseline Scenario



	Baseline Scenario	
	2003 (Mtoe)	2050 (Mtoe)
Electricity and heat plants	2 180	5 177
Other fuel transformation	1 003	2 761
Industry	2 326	4 138
Transport	1 895	4 472
Buildings and appliances	2 733	5 142



CO2 (Mt/anno)



WHAT'S A GIGATON OF CO2 ?

Coal fired plant	273 zero emission 500 MW
CCS	1000 sequestration sites like Sleipner (only 3 in operation today)
Nuclear	135 nuclear sites 1GW
Efficiency	Deploy 273 million new car at 40 mpg instead of 20 mpg
Wind	4 times the current global gen capacity of 74 GW
Solar PV	273 times the current global solar PV
Biofuels	Convert a barren area of about 4800.000 km² (2 times UK)
CO2 stor new forest	Convert a barren area of about 900.000 km² (Germany + France)

ENERGY AND CLIMATE CHANGE A POSSIBLE SCENARIO FOR 2050

BALI

194 countries agreed:

**2 year negotiation to define the road map
with the target of 25-40 % reduction of
CO₂ emission based on 1990 to be
met within 2020**

**It is an enormous amount of CO₂ to be
avoided in a short while**

GLOBAL WARMING- CLIMATE CHANGE

It is an ethic issue that needs gov actions

- **Commitment of all countries on the planet**
- **Definition of sustainability criteria for any options**
- **Definition of costs and values**
- **Definition of new market regulations**
- **Involvement of all stakeholders since the very beginning**

Governmental Partnerships are political organizations crucial to define and present proposals for decision makers

INTERNATIONAL PARTNERSHIPS FOR THE GHG MITIGATION

4 partnerships have already been set up:

- IPHE hydrogen set up in 2003
- CSLF carbon capture and storage set up in 2003
- M2M methane to markets set up in 2004
- GBEP bioenergy set up in 2006

All 4 very young, but very active: results achieved so far very promising

A new partnership in preparation EEP (Energy Efficiency Partn)

TRANSPORTATION FUELS: THE PAST PLAYGROUND

Standard fuels from refinery

- Gasoline for LDV ++++
- Diesel for both LDV and HDV +++
- MTBE-ETBE as octane boosters ++

Market drivers

- Engine performance - cooperation with car makers
- Market competition – quality of the product
- Exhaust emissions – cooperation with car makers and institutions

TRANSPORTATION FUELS: THE PAST PLAYGROUND

Alternative fossil fuels

- LPG +
- CH₄ ++
- FT gasoline from coal +
- FT diesel from NG +++
- Methanol fuel - -

Market drivers

- Refinery by product, air pollution in cities, apartheid economy, stranded natural gas, zero emission vehicle

TRANSPORTATION FUELS: THE PAST PLAYGROUND

Alternative biofuels

- Bioethanol ++
- Biodiesel +
- Bio n-butanol -

Market drivers

- Oil alternative (energy security – Brazil)
- Regional and local help to agriculture and industry (US)
- Niche markets (heavily subsidized)

LESSONS LEARNED IN THE ALTERNATIVE FUELS: methanol fuel

- Main target: exhaust emission reduction (air quality)
- Second target: energy source different from oil (energy security)
- **Technology success**
- **Industrial failure**

LESSONS LEARNED IN THE ALTERNATIVE FUELS: LNG

- Technology success
- Huge investment
- Long term contracts
- Alternative to oil and coal
- Clean
- People ready to pay even more
- Problems with local population for safety reasons
- No impact on automotive

LESSONS LEARNED IN THE ALTERNATIVE FUELS

Syngas through tar gasification in Italy

- **Technology success**
- **Huge investment**
- **Governement supported the first 8 ys economics**
- **Three units in Italy; the forth without any financial support**

LESSONS LEARNED IN THE ALTERNATIVE FUELS: CTL

- Main reason strategy for oil embargo in South Africa
- Technology success
- Huge investment
- Oil price helped (delta coal vs oil increased)
- Tehnology transfert to GTL (the only available option so far)

H2 much more difficult than the previous cases

- CO2 balance of the overall cycle **mandatory**
- **FC or ICE ? A final decision needed**
- H2 presently should compete with well established market products
- Car and bus efficiency still improving with new technologies (hybrid)
- H2 production from fossil needs CCS (**a very critical step**)
- H2 production from renewables (energy efficiency) and competition with other more efficient final uses (**direct electricity or grid connection**)
- H2 logistic doesn't exist
- Final user to compete with well established machinery
- Cost in the present market regulation much higher

H2 can be a valid option for helping fossil and renewables to reduce CO2 emission in automotive sector

- CO2 has a global social value (like the health of a population)
- H2 can be produced from cheap fossils (coal, oil residues), and low quality biomass (waste)
- H2 can be used for integrated production of electricity and automotive (cycle flexibility and market optimization)
- Long term perspectives of H2 production from new renewables very exciting (HT solar, LT water photolysis)

H2 as fuel for stationary power gen and for automotive: is it time for an early market ?

1. BALI: a new global commitment for CO2 reduction
2. IPHE should have its own scenario on energy demand and CO2 emission; such scenario can be shared with IEA and others, but a IPHE “Task Force” should work specifically on that issue only
3. Starting from Kyoto, a new CO2 emission scenario should be designed: maximum CO2 emission allowed for the entire planet and for each country (see introduction)
4. Several options for CO2 reduction: how to make possible a kind of comparison and ranking among the options ?
5. **IT IS NECESSARY MAKING A COMPARISON?**
6. How would be the first MT of CO2 obtained?, and the second, and the third? Which role for H2 in this scenario?
7. Conclusion of this session: H2 can contribute for (20-30) ?% in the CO2 reduction or better H2 can reduce CO2 for so many MT per year

How to reach such goal

There are two options:

1. The standard one: R&D&D with public money; wait for favorable market conditions that, in case of H2 as in case of all options for the CO2 mitigation, never could apply.

H2, as well as all other options could not wait for the oil price at 200 \$/bbl

2. The present one: IPHE sets up a special task force for the definition of several options (prefeasibility study); the task force defines a value for CO2 not emitted. Such value should be paid by each country according to the amount of CO2 not emitted. The task force presents such options to the member country government and ask their willing to joint the WHP. If a reasonable number of countries will join the WHP, this project could start and build up the H - Economy step by step

WHP 1 phase

According to the available knowledge, design of the best options for several H2 chains:

- H2 from chemical complex; (ad hoc production or byproduct) how to separate, storage, transport, utilization (n° cars, n° busses, n° stationary FC in such specific area)
- H2 from refinery (the same as above)

Feasibility study according to the standard procedure used in the industries for new investment decision

In this phase 1 we could obtain a large enough quantity of H2 to fill up a certain number of FCs (stationary and mobile)

An early market can start in different location worldwide.

The country should pay the value of CO2 avoided; the market should pay the final energy output in competition with standard fuels

WHP 2nd phase

- H2 from coal with CCS: (Fut Gen scheme): production of electricity on site, distribution of H2 for automotive and/or for distributed generation (so many FC cars, so many FC busses, so many stationary FC) Such unit produce energy (electricity and km) with a CO2 reduction of X tons compared with a power gen with coal, and so many km with gasoline or diesel vehicles.
- H2 from heavy oils (as above)
- H2 from wind or solar pv: capacity, where, why, CO2 balance in comparison with the direct utilization of electricity or electricity to the grid (so many cars and bus and stationary FC).
- H2 from biomass gasification (assuming the technology available)
- We should discuss and support member countries to make plans in this direction

WHP 3rd phase

- H2 from biomass fermentation
- H2 from HT solar
- H2 from LT water photolysis

- If R&D&D needed this could be done according to the current experience for the IPHE projects.
- In this case Research, Development, Pilot, Demo activities will be much better focused
- Today we don't know the reason why IPHE does 30 projects
- If H2 will not enter the market all these projects are a waste of time and money
- **IPHE is not a partnership to promote knowledge**
- **IPHE is a partnership to promote business with a well defined objective (CO2 mitigation)**

WHP

A prefeasibility study per each one option with the CO2 balance , the CO2 value (the same), the cost, investment all included, H2 storage , refueling pump, FC cars etc.

The country should pay to the industry group the value of the CO2 avoided. The industry group will take care of anything else at its own risk and benefit

The critical point is the definition of the CO2 value. (40 Euro /ton CO2 ?) This is a task for the IPHE Steering Committee to make a proposal to their respective govts

If 10 projects in 10 different IPHE member countries will be approved, we will have a market for a certain number of car, busses and stationary and industries can compete among themselves in this early market

Such market will increase step by step according to new H2 units

WHP – H2 EARLY MARKET

Technologies

- First generation H2 production technologies available with long experience from the chemical industry and from refinery.
- Second generation technologies (coal gasification, tar gasification, NG reforming, including CCS) available (several storage units already in operation)
- Electrolysis available
- Biomass gasification (demo needed) (O2 or air?)
- Third generation technologies (biomass fermentation, HT solar, LT photolysis) needed further activity
- FC polymer available, FC solid oxide development needed
- Logistic available, storage available (to be improved)

WHP – H2 EARLY MARKET

Status as per today

- Long distance pipe system in operation since long in the refinery
- So many H2 pumps at 350 and 700 bar in operation worldwide
- LH2 pumps in operation ?
- FC cars on service ?
- City busses on service ?
- Stationary FC on service ?
- IPHE should have all data in its files

The present knowledge and know how could allow to start an early market now

WHP – H2 EARLY MARKET

- A step further from pilot-demo activity
- H2 availability the most critical aspect
- Infrastructure of industrial scale
- Utilization early market scale
- CO2 has a global social value
- H2 can be produced from cheap fossils (coal, residues)
- H2 can be produced from difficult bio-mass (industrial wastes municipal wastes, agriculture waste, ad hoc cultivation)
- H2 can be used for integrated production of electricity and automotive (optimization expected)
- Long term perspectives from new renewables very promising

Example of the activity to be done in each member country

- H2: how much and where available today with low investment
- H2: how much and where available in 2 years with such investments
- H2: how much and where available in 5 years from now with investment of..
- H2: how much and where can be produced in 10 years from now through specific projects sited somewhere
- H2: how much and where can be produced in 20 ys from now
- How many cars, bus, stationary FC can be fed with H2 in 2, 5, 10, 20 ys
- How to bring H2 to the nearest market (automotive /stationary)
- How to distribute such H2 in the nearest market

Example - economics

- Extra cost to make such H₂ available in the next 2; 5;10; 20 ys
- Logistic cost
- Extra cost to buy FC cars, FC busses or stationay FC
- Where money could come from ?
- How much CO₂ is saved ?
- How many \$ or Euro per ton CO₂ saved ?

WHP WORLDWIDE

- This analysis should be done for the 16 member countries and for all 25 EU countries.

EXPECTED RESULTS

- Total amount of H2 available in the next 2, 5;10 YS
- Total amount of FC cars can be fueled (true market)
- Total amount of city busses can be fueled (true market)
- Total amount of H2 for stationary FC units (true market)

- Total investment required
- Total extra cost to be paid fo the same energy outlet

Practically an early market has been created where industries could start a business competition

WHP conclusions

- **This WHP could be a true road map to implement the H-Economy**
- **Each country government should pay the CO2 saved in the unit sited in the country**
- **Each project will be shared among WHP partners with leverage of cost**
- **The value of CO2 should be the same world wide to avoid miscompetition**