ANNEX 1

Companies/Organisations in Different Renewables Categories

Listings of companies/organizations involved in various aspects of renewable energy follow below. The lists are divided into categories and in each category organizations are listed in alphabetical order, independently of importance in their field of activities. Information about the organizations will in most cases contain their web-site addresses and explanatory remarks.

Companies/Organisations in Different Renewables Categories

Biomass Energy

COMPANIES		
Company	**Website**	**Remarks**
Abirer-Systems (AS)	www.abirer.com	organic waste, sewage treatment
Abwasser-und Abfalltechnik (AAT)	www.aat-biogas.at	
Agrilelectric International Technologies		rice hull biomass electric and energy production
Alpha Umwelttechnik AG	www.alphaut.ch	biogas installations
Alstom	www.alstom.com	waste-to-energy
Altene, Inc.		waste oil technology
Asja Ambiente Italia SpA	www.asjainternational.com	landfill biogas
Babcock & Wilcox	www.babcock.com	waste-to-energy; gasification; boilers
Babcock Borsig Power Austrian Energy		fluidized bed boilers; biomass power
Bharat Heavy Electricals Ltd. (BHEL)	www.bhel.com	
Bibb and Associates	www.bibb.com	generation from waste
Biothermica International, Inc.	www.biothermica.com	biowaste
Bioscan A/S	www.bioscan.dk	biogas plants; carbon based feedstock fuel
Caterpillar	www.cat.com	gas engines for landfill gas
Clear Green Biotechnologies, Inc.	www.clear-green.com	organic waste treatment
Cimbria BioPlan AS	www.bioplan.no	biogas, composting and waste management
Deutz	www.deutz.de	landfill engines
Detroit Stoker Company	www.detroitstoker.com	stokers for biomass and other refuse

COMPANIES		
Company	**Website**	**Remarks**
Dresser-Rand	www.dresser-rand.com	reciprocating systems, steam turbines
Ebara Environmental Engineering Group	www.ebara.ch	fluidized bed systems for waste treatment
Ener-G plc.	www.energ.co.uk	landfill biogas, CHP
Ensyn Group Inc. (EGI)	www.ensyn.com	carbon based fuelstocks fuel
EnviroAsia		biogas
Farmatic Biotech Energy AG	www.farmatic.de	biotech energy
Fibrowatt	www.fibrowatt.com	agricultural biomass power plants
FLS Miljø AS (BWE)	www.flsmiljo.com	waste-to-energy
Foster Wheeler	www.fosterwheeler.com	fluidized bed boilers municipal solid waste utilization
GE Jenbacher	www.jenbacher.com	reciprocating gas engines for landfill gas; CHP
JF BioEnergy Inc.	www.jfbioenergy.com	waste-to-energy solutions
Kvaerner	www.kvaerner.com	waste-to-energy
Linde BRV Biowaste Technologies AG	www.linde-anlagenbau.de	
MAN Turbo	www.ghh-borsig.de	turbines
McBurney	www.mcburney.com	biomass boiler systems
Mitsubishi Heavy Industries Ltd.	www.mhi.co.jp	boilers
Mitsui Babcock	www.bitsuibabcock.com	boilers
Naanovo Energy, Inc. (NEI)		waste-to energy
NKK Corporation		municipal refuse treatment
Orion Energy Ltd.	www.orion-energy.com	
ORMAT	www.ormat.com	mini ORC for rural electrification
Peter Brotherhood Ltd.	www.peterbrotherhood.co.uk	CHP, steam turbines, gas compressor solutions
Primenergy LLC	www.primenergy.com	biomass gasification
PRM Energy Systems, Inc.	www.prmenergy.com	biomass gasification
Siemens AG	http://www.siemens.com/	
Solar Turbines	http://esolar.cat.com	gas turbines
Texaco Power & Gasification	www.texaco.com	gasification
Tuckson Transatlantic Trade, Inc.	www.ttthg.com/energy/	biomass gasification, stirling engines
United Technologies	www.utc.com	fuel cells

COMPANIES		
Company	**Website**	**Remarks**
Wärtsilä Corporation	www.wartsila.com	biomass and diesel
Waukesha Electric Systems	www.waukeshaelectric.com	electric gear systems; landfill engines
Wheelabrator Technologies, Inc.	www.wheelabratortechnologies.com	waste-to-energy; biosolids
Wirecom Oy	wiri@nettilinja.fi	landfill gas
Xylowatt SA (XW)	www.xylowatt.com	wood gasification; CHP
Yoshimine Co. Ltd.	www.yoshimine.co.jp	biomass HRSG

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Organization	**Website**	**Remarks**
American Biomass Association (ABA)	www.biomass.org	
Association Technique Energie Environnement (ATEE)	www.atee.fr	biogas and wood
Bioenergy Australia	www.bioenergyaustralia.org	government-industry
Bioenergy in Finland	www.finbioenergy.fi	
The Biomass Pyrolysis Network (PyNe)	www.pyne.co.uk	fast pyrolysis of biomass
British BioGen	www.britishbiogen.co.uk	
California Biomass Energy Alliance (CBEA)	www.calbiomass.org	
Canadian Agricultural New Uses Council (CANUC)	www.canuc.ca	knowledge network
Canadian Renewable Fuels Association (CRFA)	www.greenfuels.org	
European Biomass Association	www.ecop.ucl.ac.be	
European Biomass Gasification Network (GasNet)	www.gasnet.uk.net	
IEA Bioenergy Department	www.ieabioenergy.com	
IEA Program on Bioenergy	www.forestresearch.cri.nz/icabioenergy/home.htm	
National Biodiesel Board (NBB)	www.biodiesel.org	

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Oakridge National Laboratory	http://bioenergy.ornl.gov/	R&D
Renewable Fuels Association	www.ethanolrfa.org	
Swedish Bioenergy Association	www.svebio.se/	
US DOE – Biofuels Information Center	www.ott.doe.gov/biofuels/	
US DOE Biopwer program	www.eere.energy.gov/biopower/	
US DOE: EERE's BioEnergy Homepage	www.eere.energy.gov/RE/bioenergy.html	
US National Bioenergy Industries Association	www.bioenergy.org	
USDA Rural Development Program	www.rurdev.usda.gov/	
Woodgas: The Biomass Energy Foundation	www.woodgas.com	

Wind Energy

COMPANIES		
Company	**Website**	**Remarks**
ABB	www.abb.com	
Alstom	www.alstom.com	
Atlantic Orient Corporation (AOC)	www.aocwind.net	
Bergey Windpower Company	www.bergey.com	
Bonus Wind Turbine	www.bonus.dk	
Cielo Wind Power LLC.	www.cielowind.com	
De Wind GmbH	www.dewind.de	
Ecotècnia	www.ecotecnia.com	
EHN North American Corp.	www.narenewables.com	
EnelGreenPower (former ERGA)	http://enelgreenpower.enel.it/en/index.html	
Enercon GmbH	www.enercon.de	
EnergieKontor	www.energiekontor.de	windfarm developer
Eole – RES	www.eoleres.com	project developer

COMPANIES		
Company	**Website**	**Remarks**
Espace Eolien	www.espace-eolien.fr	project developer
Eurowind	www.eurowind.se/eng	project developer
Gamesa Eolica	www.gamesa.es	
GE Wind Energy	www.gepower.com/businesses/ge_wind_energy/	
Jeumont-Framatome ANP	www.jeumont-framatome.com	wind turbines
Lagerwey Windturbine BV	www.lagerwey.nl	
LM Glasfiber	www.lm.dk	wind turbine blades
Marubeni Corporation	www.marubeni.com	wind power plants
Mitsubishi Power Systems, Inc.	www.mhi.co.jp/power/e_power	
M&N Windpower		
National Wind Power Ltd.	www.natwindpower.com	UK wind farm developer
Natural Forces Technologies, Inc.	www.naturalforces.ca	
N.E.G. Micon A/S	www.neg-micon.de	
Nordex AG	www.nordex-online.com/_e	
Orion Energy LLC.	www.orion-energy.com	
PB Power	www.pbpower.net	
Pfleiderer Wind Energy	www.pfleiderer-wind.com	
Power Works, Inc.	www.powerworksinc.com	
Power@Sea NV	www.poweratsea.com	off-shore wind farms
REpower Systems	www.repower.de	windfarm developer
SeaWest Wind Power, Inc.	www.seawestwindpower.com	
Shell Renewables	www.shell.com	
Suzlon Energy Ltd.	www.suzlon.com	
Synergy Power Corporation	www.synergypowercorp.com	remote areas wind power systems
Turbowinds	www.turbowinds.com	wind turbines
UmweltKontor Renewable Energy AG	www.umweltkontor.com	windfarm developer (also solar, hydro, bioenergy)
USWindForce	www.uswindforce.com	
Vestas	www.vestas.com	

COMPANIES		
Company	**Website**	**Remarks**
Vestas Wind Systems AS	www.vestas.dk	
Vestas American Wind Technology, Inc.	www.vestas-awt.com	
WKN Windkraft Nord AG	www.wkn-ag.de	Italian-German Partnership
Western Wind Energy Corporation	www.westernwindenergy.com	Windenergy experts
WindTech International LLC.	www.windmillpower.com	Windmill pumping
Wind Turbine Industries Corporation (WTIC)	www.windturbine.net	wind plants

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Organization	**Website**	**Remarks**
American Wind Energy Association (AWEA)	www.awea.org	
Australian Wind Energy Association	www.auswea.com.au	
Austrian Wind Energy Associates	www.igwindkraft.at	
British Wind Energy Association	www.bwea.com/	
Bundesverband Wind Energie e.V	www.wind-energie.de/	
California Energy Commission – Wind Energy in California	www.energy.ca.gov/wind	
Canadian Wind Energy Association	www.canwea.ca	
Danish Wind Industry Association	www.windpower.org	
European Wind Energy Association	www.ewea.org	
Estonian Wind Power Association	www.tuuleenergia.ee	
Finnish Wind Energy Association	www.tuulivoimayhdistys.fi	
Fördergesellschaft Windenergie e.V	www.wind-fgw.de/	
Irish Wind Energy Association	www.iwea.com	
National Wind Coordinating Committee (NWCC) – US	www.nationalwind.org	
National Wind Technology Center (NWTC)	www.nrel.gov/wind	

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Netherlands Wind Energy Association	www.windenergy.citg.tudelft.nl	
New Zealand Wind Energy Association	www.windenergy.org.nz	
Sandia National Laboratories – Wind Energy Technology	www.sandia.gov/wind	
South Africa Wind Energy Association	www.icon.co.za/~sawea/	
Suisse – Eole	www.suisse-eole.ch	
US DOE Wind Energy Program	www.eere.energy.gov/windandhydro	
Windpower Monthly News Magazine	www.wpm.co.nz	

Geothermal Energy

COMPANIES		
Company	**Website**	**Remarks**
Alstom	www.alstom.com	geothermal steam turbines
Amoseas Indonesia (Chevron-Texaco)	www.amoseas-indonesia.com	geothermal power plants development in Indonesia
Ansaldo Energia	www.ansaldo.it	geothermal steam turbines
Baker Hughes	www.bakerhughes.com/bakerhughes/geothermal/	geothermal drilling technology
Barber-Nichols, Inc.	www.barber-nichols.com	ORC
Barriquand SA	www.barriquand.com	geothermal heating
Bibb and Associates (formerly Ben Holt Comp.)	www.bibb.com	geothermal power generation
CalEnergy Company, Inc.	www.calenergy.com	MidAmerican Holding affiliate; project development, IPP
Calpine	www.calpine.com	IPP, project development
Caithness Corporation	www.caithnessenergy.com	geothermal development and plant construction
Century Resources	www.centurydrilling.co.nz	geothermal drilling
De Marco Energy	www.demarcoenergy.com	GHP

COMPANIES		
Company	**Website**	**Remarks**
Systems		
EnelGreenPower (former ERGA)	http://enelgreenpower.enel.it/en/index.html	project developer
Exergy Inc.	www.exergyinc.com	**Kalina Cycle** developer, (theoretically 20% more efficient than ORC); one application in Iceland. Results lower than theoretical expectations
Fuji Electric	www.fujielectric.co.jp/eng/eco	geothermal steam turbines
Geothermal Heat Pump Consortium, Inc. (GHPC)	www.geoexchange.org	GHP
GeothermEx, Inc.	www.geothermex.com	consult, studies, resource exploration
GE Power Systems	www.gepower.com	geothermal steam turbines
GET GmbH		one small geothermal binary power plant in Germany
Global Power Solutions	www.powersolns.com	consulting firm
Kensa Heat Pumps	www.kensaengineering.com	GHP
Mitsubishi Heavy Industries Ltd. (MHI)	www.mhi.co.jp	geothermal steam turbines and project development
Marubeni Corporation	www.marubeni.com	geothermal power plant developer
Orkint (Orkustofnun International Ltd.)	www.os.is	geothermal consult
ORMAT	www.ormat.com	ORC, Geothermal Combined Cycles, total project development, IPP
Oxbow Geothermal Corp.		geothermal power plants development
PB Power	www.pbpower.net	geothermal

COMPANIES		
Company	**Website**	**Remarks**
		consult
Pertamina-Indonesian Oil & Gas Company	www.pertamina.com	reservoir and resource management
Philippine National Oil Company – Energy Development Corporation (PNOC-EDC)	www.energy.com.ph	reservoir and resource development
Philippine Geothermal Inc. (PGI)	www.unocal.com/geopower/pgi/htm	project management
Toshiba	www.toshiba.co.jp	geothermal steam turbines
Turboden srl.	www.turboden.com	ORC and project development
Sinclair Knight Merz	www.skm.com.au	geothermal consult
Waterfurnace.com	www.waterfurnace.com	GHP
West Japan Engineering Consulting	www.wjec.co.jp	geothermal consulting firm

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Organization	**Website**	**Remarks**
Bob Lawrence and Associates, Inc.	www.bl-a.com/ecb/reports.htm	International Geothermal Reports and newsletters
California Energy Commission – Geothermal Program	www.energy.ca.gov/geothermal	
Electric Power Research Institute (EPRI)	www.epri.com	
Geothermal Aquaculture Research Foundation	www.garf.org	
Geothermal Energy Association (GEA)	www.geo-energy.org	
Geothermal Energy Research – INEEL	http://geothermal.id.doe.gov/	
Geothermal Heat Pump Consortium – Geoexchange	www.geoexchange.com	
Geothermal Resources Council (GRC)	www.geothermal.org	
Geothermische Vereinigung e.V (GTV)	www.geotermie.org	
Geo-Heat Center	http://geoheat.oit.edu	
Geothermal Institute New Zealand	www.auckland.ac.nz/gei	
International Geothermal Association (IGA)	http://iga.igg.cnr.it/index.php	
Sandia National Laboratories – Department 6211	www.sandia.gov/geothermal/	
US Department of Energy – Geothermal	www.eren.doe.gov/RE/geothermal.html	

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Organization	**Website**	**Remarks**
US Geothermal Technologies Programs	www.eere.energy.gov/geothermal/ www.eere.energy.gov/geopoweringthewest	

Solar Energy

COMPANIES		
Company	**Website**	**Remarks**
ASE Americas, Inc	www.asepv.com	PV
Astro Power, Inc.	www.astropower.com	
BP Solar	www.bpsolar.com	
BP Solarex	www.solar4power.com/solar-power-solarex.html	PV power
CellSiCo, Inc.	www.cellsico.com	
CLP Group (China Light & Power, HK)	www.chinalightandpower.com	R&D in renewables
Ebara Solar, Inc. (ESI)	www.ebarasolar.com	
EnelGreenPower (former ERGA)	http://enelgreenpower.enel.it/en/index.html	
Energy Photovoltaic, Inc. (EPV)	www.epv.net	
Eurosolare SpA (ENI Group)	www.eurosolare.it	
Fuji Electric	www.fujielectric.co.jp	
Global Solar Energy, Inc.	www.globalsolar.com	PV, integrated systems
Hae Sung Solar Co. Ltd	www.hssolar.co.kr	
Ibersolar Energia SA	www.ibersolar.com	solar thermal and PV
Isofotón SA	www.isofoton.es	
Kyocera Solar, Inc.	www.kyocerasolar.com	
Mitsubishi Heavy Industries Ltd. (MHI)	www.mhi.co.jp	
Motech Industries, Inc.	www.motechind.com	PV solar cells
Orion Energy Ltd.	www.orion-energy.com.au	
ORMAT	www.ormat.com	solar pond power plant; R&D
Pacific Solar Pty. Ltd.	www.pacificsolar.com.au	
PB Power	www.pbpower.net	
Phönix SonnenStrom AG	www.sonnenstromag.de	roof tiles

COMPANIES		
Company	**Website**	**Remarks**
Photowatt International S.A.	www.photowatt.com	PV
Power Light Corp.	www.powerlight.com	
RWE SCHOTT Solar, Inc.	www.rweschottsolar.com	PV
Sanyo Electric Co. Ltd.	www.sanyo.co.jp/koho/index_e.html	
Sharp Corporation	www.sharp.co.jp	
Shell Solar	www.solarpv.com	
SolarWorld AG	www.solarworld.de	roof tiles
Solel Solar Systems Ltd.	www.solel.com	solar thermal power plants
Solterra AG	www.solterra.ch	
Sun Power Corporation	www.sunpowercorp.com	silicon solar cells
Sunways Photovoltaic	www.sunways.de	
Tata BP Solar India Ltd.	www.tatabpsolar.com	
Tenesa Pty. Ltd	www.total-energie.fr/Filiales/Tenesa	solar rural installations
Thyssen Bausysteme GmbH	www.thyssen-solartec.com	
UniSolar	www.poweriseverything.com/product/unisolar-solar-power.html	solar panels

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Organization	**Website**	**Remarks**
Australian and New Zealand Solar Energy Society (ANZES)	www.anzses.org	
European Solar Energy Association	www.eurosolar.org	
Japanese R&D Program for PV	www.nedo.go.jp	
Sandia National Laboratories PV Systems' R&D	www.sandia.gov/pv	
Solar Electric Light Fund (SELF)	www.self.org	
Solar Energy Industry Association	www.seia.org	
Solar Energy in Schools	www.schoolsgoingsolar.org	
Solar Energy International (SEI)	www.solarenergy.org	
US DOE – Concentrating Solar Power	www.eere.energy.gov/solar/csp.html	
US DOE Million Solar Roofs	www.millionsolarroofs.com	
US DOE – Solar buildings	www.eere.energy.gov/solar/	
US DOE – Photovoltaics	www.eere.energy.gov/solar/photovoltaics.html	

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
US National Center for Photovoltaics	www.nrel.gov/ncpv	
Utility Photovoltaic Group		

Industrial Heat Recovery Power

COMPANIES		
Company	**Website**	**Remarks**
Barber-Nichols Inc.	www.barber-nichols.com	ORC
Exergy, Inc.		**Kalina Cycle** developer. No working applications yet installed
IBB Engineering GmbH (SEGHERS Group Deutschland)	www.bettertechnology.com/seghers/seghers-group.nsf	heat exchanging design and consult
ORMAT	www.ormat.com	many ORC applications
Tri-O-Gen BV		ORC (no applications yet)
Turboden srl	www.turboden.com	ORC – few small applications
Spilling Werk	www.spilling.de	steam engines

Hydro

COMPANIES		
Company	**Website**	**Remarks**
Alstom Power	www.alstom.com	
Ansaldo Energia	www.ansaldoenergia.com	
Bharat Heavy Electrical Ltd.	www.bhel.com	hydro power plants
Canadian Hydro Developers, Inc. (KHD-TSE)	www.canhydro.com	
Canadian Hydro Components Ltd. (CHC)	www.canadianhydro.com	small hydro turbines
EcoWatt NV	www.ecowatt.be	small hydro turbines
EnelGreenPower (former ERGA)	http://enelgreenpower.enel.it/en/index.html	
Entech AG	www.entech.ch	consult – small hydro
GE Hydro	www.gepower.com/businesses/ge_hydro/	hydropower and water control

COMPANIES		
Company	**Website**	**Remarks**
Geppert Wasserturbinen & Maschinenbau	www.geppert.at	Pelton and Francis turbines
Gilbert Gilkes & Gordon Ltd.	www.gilkes.com	Pelton and Francis turbines
Kössler GmbH	www.koessler.com	Pelton, Francis, Kaplan turbines
Mitsubishi Heavy Industries	www.mhi.co.jp	
NHT Engineering Ltd.	www.newmillshydro.com	Kaplan, Francis and multi-jet Pelton turbines
PB Power (Australia)	www.pbpower.net	
Turbinenbau Troyer GmbH (TBT)	www.troyer.it	Pelton, Francis, Kaplan turbines
VA TECH HYDRO	www.vatech.at	
Voith Siemens Hydro Power Generation	www.vs-hydro.com	hydroelectric equipment; modern pumped storage
Weigert und Bähr Maschinenbau GmbH		

GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS		
Organization	**Website**	**Remarks**
British Hydropower Association	www.british-hydro.org	
Canadian Hydropower Association	www.canhydropower.org	
International Center for Hydropower (ICH)	www.ntnu.no/ich/	
International Hydropower Association	www.hydropower.org	
International Small-Hydro Atlas	www.small-hydro.com	
The IEA Hydropower Agreement	www.ieahydro.org	
The World Commission on Dams	www.dams.org	
US DOE Hydropower	www.eere.energy.gov/RE/hydropower.html	
US Hydropower R&D Program	http://hydropower.inel.gov	
US National Hydropower Association (NHA)	www.hydro.org	

Other Organizations for Promotion of Renewables

ORGANIZATIONS		
Organization	**Website**	**Remarks**
Agence de l'Environnement et de la Maitrise de l'Energie (ADEME)-France	www.ademe.fr/	
American Council for Renewable Energy (ACRE)	www.americanrenewables.org	
APPA (Spain) Asociación de Productores de Energías Renovables	www.appa.es	
Australian Cooperative Research Center for Renewable Energy Ltd.	www.acre.murdoch.edu.au/acre.htm	
Center for Renewable Energy Systems Technology (CREST)	www.crestuk.org	
EU: AGORES – a Global Overview of Renewable Energy sources	www.agores.org	
Greentie	www.greentie.org	
Indian Renewable Energies	www.mprenewable.com	
Indian Renewable Energy Development Agency (IREDA)	www.ireda.nic.in	
ISES Italia	www.isesitalia.it	
New Zealand Energy Efficiency and Conservation Authority (EECA)	www.eeca.gov.nz	
Sustainable Energy Coalition	www.sustainableenergy.org	
Syndicat des Energies Renouvelables	www.ser-fra.com	
The (UK) Renewable Power Association (RPA)	www.r-p-a.org.uk	
The Australian Greenhouse Office	www.greenhouse.gov.au/renewable	
The European Renewable Energy Exchange (EuroREX)	www.eurorex.com	
U.S. Database of State Incentives for Renewable Energy	www.dsireusa.org	
U.S. Interstate Renewable Energy Council	www.irecusa.org	
US DOE – Office of Energy Efficiency and Renewable Energy	www.eren.doe.gov/	
World Council for Renewable Energy (WCRE)	www.wcre.org	

European Regulatory Offices for Renewables

Country	Organization	Website
Austria	Bundesminister für Wirtschaft und Arbeit	www.bmwa.gv.au
Belgium	VREG (Regulator) CREG (Regulator) CWaPE (Regulator) Elia (Grid Operator)	www.vreg.be www.creg.be www.cwape.be www.elia.net
Denmark	Energy Agency	www.ens.dk
Finland	Ministry of Trade and Industry	www.vn.fi/ktm/
France	ADEME CRE (Regulator)	www.ademe.fr www.cre.fr
Germany	Bundesminister für Umwelt	www.bmu.de
Greece	Regulatory Agency for Energy CRES	www.rae.gr www.cres.gr
Ireland	Department of Communications, Marine and Natural Resources CER (Grid Operator)	www.demnr.gov.ie www.cer.ie
Italy	GRTN (Grid Operator)	www.grtn.it www.autorita.energia.it/
Norway	ENOVA (State Agency)	www.enova.no
Netherlands	Ministry of Economic Affairs	www.minez.nl
Spain	CNE (Regulator) APPA (Association)	www.cne.es www.appa.es
Sweden	STEM (Energy Agency)	www.stem.se
United Kingdom	DTI	www.dti.gov.uk
E.U.	DG TREN (Regulator)	www.europa.eu.int
Australia	Office of the Renewable Energy Regulator (ORER)	www.orer.gov.au

Financial Institutions

Export Credit Agencies (ECAs)

Country	Organization	Website
Australia	Export Finance and Insurance Corporation (EFIC)	www.efic.gov.au
Austria	Oesterreichische Kontrollbank AG (OeKB)	www.oekb.co.at
Brazil	Brazilian Development Bank (BNDES)	www.bndes.gov.br
Canada	Export Development Corporation (EDC)	www.edc.ca
Czech Republic	Czech Export Bank – Export Guarantees Development Corporation (EGAP)	www.ceb.cz www.egap.cz
Denmark	Eksport Kredit Fonden (EKF)	www.ekf.dk
France	Compagnie Française d'Assurance pour le	www.coface.fr

Country	Organization	Website
	Commerce Exterieur (COFACE)	
Germany	Kreditanstalt für Wiederaufbau (KfW)	www.kfw.com/
	Hermes Kreditversicherungs – AG (HERMES)	www.hermes-kredit.com
Italy	Sezione Speziale l'Assicurazione del Credito all'Esportazione (SACE)	www.isace.it/
	Mediocredito Centrale (MCC)	www.mcc.it/mcc/index.htm
Japan	Japan Bank for International Cooperation (JBIC)	www.jbic.go.jp
Korea	Export-Import Bank of Korea	www.koreaexim.go.kr
The Netherlands	Nederlansche Credietverzekering Maatschappij NV (NCM)	www.ncmgroup.com/gerlingncm.htm
Spain	Compania Espanola de Seguros de Credito a la Exportacion (CESCE)	www.cesce.es
Sweden	Exportkreditnamden (EKN)	www.ekn.se
	AB Svensk Export Kredit (SEK)	www.sek.se
Switzerland	Swiss Export Risk Guarantee	www.swiss-erg.com
U.K.	Export Credit Guarantee Department (ECGD)	www.ecgd.gov.uk
U.S.	Export-Import Bank of the United States	www.exim.gov

International Credit Institutions (ICIs)

Organization	Website
World Bank Group	www.worldbank.org
International Bank for Reconstruction and Development (IBRD)	www.worldbank.org
International Development Organization (IDA)	www.worldbank.org/ida/
International Finance Corporation (IFC)	www.ifc.org
Multilateral Investment Guarantee Agency (MIGA)	www.miga.org
International Center for Settlement of Investment Disputes (ICSID)	www.worldbank.org/icsid/
African Development Bank (AFDB)	www.afdb.org
Asian Development Bank (ADB)	www.adb.org
European Bank for Reconstruction and Development (EBRD)	www.ebrd.org
European Investment Bank (EIB)	www.eib.org
Inter-American Development Bank (IDB)	www.iadb.org
International Monetary Fund (IMF)	www.imf.org
West-African Development Bank (BOAD)	www.boad.org

Other Banking, Investment and Insurance Institutions

Organization	Website
ABN AMRO	www.abnamro.com
ANZ Investment Bank	www.anz.com
Australia-Commonwealth Bank	www.commbank.com.au
CDC Capital Partners	www.cdcgroup.com
Citibank	www.citibank.com
Credit Suisse First Boston	www.csfb.com
Deutsche Bank	www.deutsche-bank.de
Dresdner Bank	www.dresdner-bank.com
Hypo Vereinsbank	www.icfb.hypovereinsbank.de
ING Barings	www.ing.-barings.com
JP Morgan Chase	www.jpmorgan.com
Merill Lynch	www.ml.com
Morgan Stanley	www.morganstanley.com
Salomon Smith Barney	www.salomon.com
St. George Bank, Australia	www.stgeorge.com.au
Rabobank International	www.rabobank.com
Funds	
Energy Force International Ltd.	www.energyforce.co.uk
Energy Foundation	www.ef.org
Mertz Gilmore Foundation	www.mertzgilmore.org
Turner Foundation	www.turnerfoundation.org
Insurance	
Energy Insurance Brokers (EIB)	www.energyinsurancebrokers.com
Germanischer Lloyd	www.germanlloyd.org
Trade Wind Insurance Brokerage	www.tradewind-ins.com/
Worldlink Insurance Services, Inc.	www.worldlinkinsurance.com

Greenhouse Gas (GHG) Trading, Policies and Regulation

Organization	Website
General	
United Nations Framework Convention on Climate Change	www.unfccc.int
WEC Pilot Program on GHG Emissions Reduction	www.worldenergy.org/wec-geis/ghg 2001/
Worldwide green	www.worldwidegreen.com
Green Certificates	
Renewable Energy Certificates (RECs)	www.recs.org
Center for Resource Solutions/Tradable Renewable Certificates (TRC)	www.resource-solutions.org
Expert Meeting on Tradable Renewable Certificates (TRC)	www.ica.org/trc

Organization	Website
UK and Ireland RECs registry	www.m-co.eu.com
UK Climate Change Levy (CCL)	www.climate-change-levy.com/ccl.htm
UK Climate Change Levy Information	www.cclinfo.com
OFGEM Statistics on Renewables Obligation (RO)	www.ofgem.gov.uk/
Platts RO Certificate Price Marker	www.platts.com
US Green Initiatives	www.eren.doe.gov/greenpower/
US Green-e Labeling	www.green-e.org
Netherlands Green Certificate Body – Groencertificatenbeheer (GCB)	www.groencertificatenbeheer.nl
The Australian Greenhouse Office (AGO)	www.greenhouse.gov.au
Canada – Pembina Institute for Appropriate Development	www.pembina.org
GHG Emissions Trade	
EcoSecurities – Environmental Finance Solutions	www.ecosecurities.com
World Bank Prototype Carbon Fund	http://prototypecarbonfund.org
Senter International (incl. ERUPT and CERUPT) – Netherlands	www.senter.nl
PriceWaterhouseCoopers Certification	www.pwcglobal.com
CDM Marketplace	www.cdm-marketplace.com
Trexler and Associates, Inc.	www.climateservices.com
Emissions Marketing Association (EMA)	www.emissions.com
Chicago Climate Exchange	www.chicagoclimatex.com

Other Organizations

Organization	Website
World Energy Council	www.worldenergy.org
International Energy Agency (IEA)	www.iea.org
Organization for Economic Cooperation and Development (OECD)	www.oecd.org
United Nations (UN)	www.un.org
UN Capital Development Fund (UNCDF)	www.uncdf.org
UN Development Program (UNDP)	www.undp.org
UNDP, Global Environmental Facility (GEF)	www.gefweb.org
UN Economic & Social Cultural Organization (UNESCO)	www.unesco.org
UN Economic & Social Commission for Asia and the Pacific (ESCAP)	www.unescap.org
UN International Fund for Agriculture Development (IFAD)	www.ifad.org
UN Food and Agriculture Organization (FAO)	www.fao.org
US Agency for International Development (USAID)	www.usaid.gov
South Asian Association for Regional Cooperation (SAARC)	www.saarc.com

Organization	Website
Cambridge Energy Research Associates (CERA)	www.cera.com
Global Energy Concepts, Inc.	www.globalenergyconcepts.com
Winrock International	www.winrock.org

ANNEX 2 – RESOURCE INFORMATION

CONTENTS

CASE STUDY ON BIOMASS ENERGY TECHNOLOGIES (BETS)

1. Location: Gornji Grad, Slovenia
2. Plant Name: ENGO d.o.o.
3. Year of Installation: 1998, the 2nd phase of DH net is in construction
4. Capacity of the plant: 2 biomass fired boilers of 2 MW each (total 4 MW)

5. Description of the process:

Gornji Grad is a small town in the mountains north east of Ljubljana. The town has around 800 inhabitants. There are around 250 apartments and individual homes, various public buildings, industries, enter-prises and sports centres and leisure centres serving the growing tourism. The district heating plant was designed to supply approximate 220 buildings: 200 households, 20 larger buildings and wood-working industry Smreka with hot water and space heating.

The town is situated in the upper Dreta Valley at around 500 m above sea level. The valley is densely forested and offers very good conditions for all kinds of use of wood. One industry utilising this vast amount of wood resources is the factory SMREKA.

SMREKA is the largest industry of Gornji Grad. It produces prefabricated houses, garden houses, doors and other timber products. SMREKA exports over 80% of its products and employs 117 full-time employees, of whom almost every-body live in Gornji Grad. SMREKA is the major consumer of heat and continuous process heat for the wood kilns. The wood waste from the fabric can easily be used as a resource to produce heat.

In Gornji Grad, the heat demand stems from both small and large consumers. The smaller consumers are the individual households, whereas the large consumers include SMREKA and municipal buildings. The heat demand from the smaller consumers is estimated by using the key figure of 180 kWh per m^2 per year. The large consumers are evaluated individually on the basis of the existing heat supply.

There are 226 individual households in the town itself. It was projected that 199 of these households would be connected to the district heating network. The heat demand for these houses was estimated to a total of 8,775 MWh per year. SMREKA is estimated to have an annual consumption of 2,250 MWh per year. The other large consumers are estimated to 3,465 MWh per year with a further expansion to 7.680 MWh per year in 2004. The heat loss is estimated to approximately 20%.

With temperatures on a daily basis for a reference year, it is now possible to calculate the heat load duration curve. SMREKA's consumption is estimated to be 80% process heating and 20% space heating. For the other large consumers, ie office buildings etc, it is estimated that 88% is space heating and the rest hot water.

On the heat load duration curve, SMREKA's space heat demand is included in large consumers. The duration curve shows a maximum heat load of 8 MW. From this curve it would seem reasonable to install a biofuelled boiler with a capacity of 4-5 MW. 4 MW was chosen and because the project is divided in phases, two boilers of 2 MW were installed. It gives a greater flexibility and an important duplication factor

providing a high security of supply. This gives a high number of full load operation hours for one boiler, something that gives a high efficiency. When the network is fully developed, however, it must be foreseen to install additional capacity to further increase the heat production on very cold winter days.

6. Environmental indicators for BET assessment:
    - Flue gas Composition

The Slovenian law sets minimum requirements for the emissions from wood biomass fired boilers. At least the following limit values must be achieved, with regard to dry flue gas in a normal state with a rest of oxygen of 13%:

- Efficiency without condensation: minimum 85%
- Darkness (blackness) of flue gas: 1
- Total dust: 50 mg/m^3
- Carbon monoxide CO: 250 mg/m^3
- Nitric oxides, given as NO_2: 300/250 mg/m^3 (depends on the fuel)
- Unburned Hydrocarbon HC: 20 mg/m3
- Organic compounds, given as total organic carbon (TOC): 50 mg/m^3
- Noise pressure level internal: max. 85 dBA-weighted.
- Noise pressure level external in distance of 10 m: 50 dBA during the day, 40 dBA during the night.

These values apply to the whole system including condensation device and flue gas cleanup.

- Ash generation per unit biomass consumption: 5 -6 %
- Composition of Ash
    - 28,2% CaO
    - 5,4% K_2O
    - 4,2% MgO
    - 2,3% P_2O_5
    - 0,6% Na_2O

7. Types of fuel used:

- Capacity of fuel used: 3000 - 7900 t/year
- type of fuel: sawdust, dry wood waste and wet wood waste
- moisture content: 20 – 60 %
- HHV (on dry basis): up to 5,2 kWh/kg; LHV: 1,6 (fresh wood, 60% water content) - 4,7 kWh/kg (dried in closed space, 8 % water content)
- cost total (as delivered at the factory gate) (exchange rate: 1 US$ = 250 SIT):
    - Sawdust 0.7 US$/GJ
    - Dry wood waste 2.088 US$/GJ
    - Wet wood waste 2 US$/GJ

8. Manpower requirement for the plant:

In order to keep the fixed costs low, the company has outsourced the main part of its activities to external parties. Consequently, the only permanent staff of the company is the managing director, which also is the mayor of the municipality.
The main activities in the company in relation to the operation and maintenance are contracted to the municipal company Kommunalna d.o.o. Further, a number of suppliers have entered into a service agreement with ENGO d.o.o. The external accountant is taking care of the billing of the consumers and the general accounting. In relation to legal matters as contracting, ENGO is assisted by an external lawyer.

9. Cost calculation:

a) plant

- approximate capital cost of similar new plant

In table below the investment specification is presented with average costs of capital, calculated as credit annuity in the time period of investment. The calculated interest rate taken into account is 3%, life period for each part of investment was specified separately.

Table 1: Investment specification of wood biomass district heating in Gornji Grad

		Investment costs (SIT)	Life period (year)	Capital interests (%)	Yearly costs (SIT)
A.	**Investment costs**				
A.1	Two Boilers with automatic control system	98.262.000	15	3,0%	8.231.072
A.2	Silos	5.580.000	20	3,0%	375.064
A.3	Pipelines with fittings	0	25	3,0%	0
A.4	Wood Chipper	12.767.350	15	3,0%	1.069.477
A.5	Electric installation with regulation	13.111.250	15	3,0%	1.098.285
A.6	Road	1.550.000	30	3,0%	79.080
A.7	Chemical water preparation	3.826.300	20	3,0%	257.187
A.8	Store house / construction work	0	50	3,0%	0
A.9	Boiler house	46.021.700	50	3,0%	1.788.656
A.10	Pumping station, hydraulic	3.534.000	20	3,0%	237.540
A.11	Expansion vessel	1.004.400	18	3,0%	73.029
A.12	Land	10.750.800	50	3,0%	417.835
A.13	District heating network	284.319.600	30	3,0%	14.505.775
A.14a	Heating substations + installation (big consumers)	22.134.000	25	3,0%	1.271.108
A.14b	Heating substations + installation (small consumers)	80.835.600	25	3,0%	4.642.216
A.15	Installation of heating substations	0	25	3,0%	0
A.16	Engineering services	12.090.000	15	3,0%	1.012.738
A.17	Planning and monitoring services	33.052.200	15	3,0%	2.768.670
	Summary A.1 - A.17	628.839.200	0,060		37.827.733

(exchange rate: 1 US$ = 250 SIT)

- operating cost of the plant

The average operating costs are presented in table below. The operating costs are designed for the whole size investment, considering lower wood biomass consumption in the first three years. The presumptions are: full size investment, operation of two wood biomass boilers with average working regime.

Table 2: Operating costs of biomass district heating project in Gornji Grad (in SIT)

B.	**Material costs**		
B.1	Wood biomass (whole size investment)		21.829.850
B.2	EL-oil (peak load demand)		0
B.3	Electricity		1.116.009
B.4	Stroški drugih materialov za obratovanje		93.000
		Summary B.1 - B.4	**23.038.859**
C.	**Maintenance and operating costs**		
C.1	Management, billing, controlling, etc.		3.087.600
C.2	Boiler house maintenance		2.627.406
C.3	Maintenance of DH network and heating substations		2.843.196
C.4	Chimney sweep work, emission control, canalisation, water		186.000
		Summary C.1 - C.4	**8.744.202**
D.	**Other costs**		
D.1	Fire insurance (0,07%)		93.000
D.2	Machine and equipment insurance (0,45%)		520.800
D.3	Duties, other costs		0
D.4	Profit		0
		Summary D.1 - D.4	**613.800**

(exchange rate: 1 US$ = 250 SIT)

b) fuel

Fuels in the Gornji Grad DH system are sawdust, dry wood waste and wet wood waste. SMREKA is the main supplier of sawdust and dry wood waste. The prices of the fuels delivered at the gate of the plant are estimated to be the following (exchange rate: 1 US$ = 250 SIT):

- Sawdust 0.7 US$/GJ
- Dry wood waste 2.088 US$/GJ
- Wet wood waste 2 US$/GJ

In general, it could be argued that wood waste from industries that should otherwise have been disposed of by landfills should be delivered at a very low price or even at the cost of the transport only.

c) others

- wages of labours: average monthly gross salary in Slovenia is aprox. 220.000 SIT (880 US$)
- cost of hiring trucks
  - vol/truck (m^3/truck): aprox. 20
  - cost per distance (US$/$m^3$/km): not available
- on-site chiping of prepared wood biomass by local farmer: 3 US$/$m^3$ (exchange rate: 1 US$ = 250 SIT)

10. Performance

- Technical - overall efficiency, capacity factor etc.

Boiler operation and efficiency depends on the outside temperature and on the consumption of SMREKA factory. Since the DH-net have been not completed yet, only one boiler is enough to cover all heat demand at this moment.

Month	Boiler efficiency
January	1 boiler, 70% - 80%
February	1 boiler, 70% - 80%
March	1 boiler, 40% - 50%
April	1 boiler, 40% - 50%
May	1 boiler, 40% - 50%
June	1 boiler, aprox. 30%
July	1 boiler, aprox. 30%
August	1 boiler, aprox. 30%
September	1 boiler, 40% - 50%
October	1 boiler, 40% - 50%
November	1 boiler, 70% - 80%
December	1 boiler, 70% - 80%

- Financial and economic

The cash flows are investigated every year for a period of 20 years, which is the expected lifetime of the plant. These cash flows are used to evaluate the economy of the whole project. The cash flows include repayments of loans, heat sales and operation costs.

The cash flow for the DH company is illustrated in the figure below. As it can be seen, the company runs a deficit the first five years of operation. This is due to relatively heavy initial investments primarily in network and substations. In 2000 it is assumed that phase 2 is initiated. This implies an increase in the number of connections to the system, as well as further loan financed investments in the network. In 2004, it is planned that some new large consumers are connected to the system, which has a positive impact on the cash flow. In 2014 and 2015, the two loans are running out. The investment has an internal rate of return (IRR) on 7% and a net present value (NPV) on approx. SIT 50 mio.

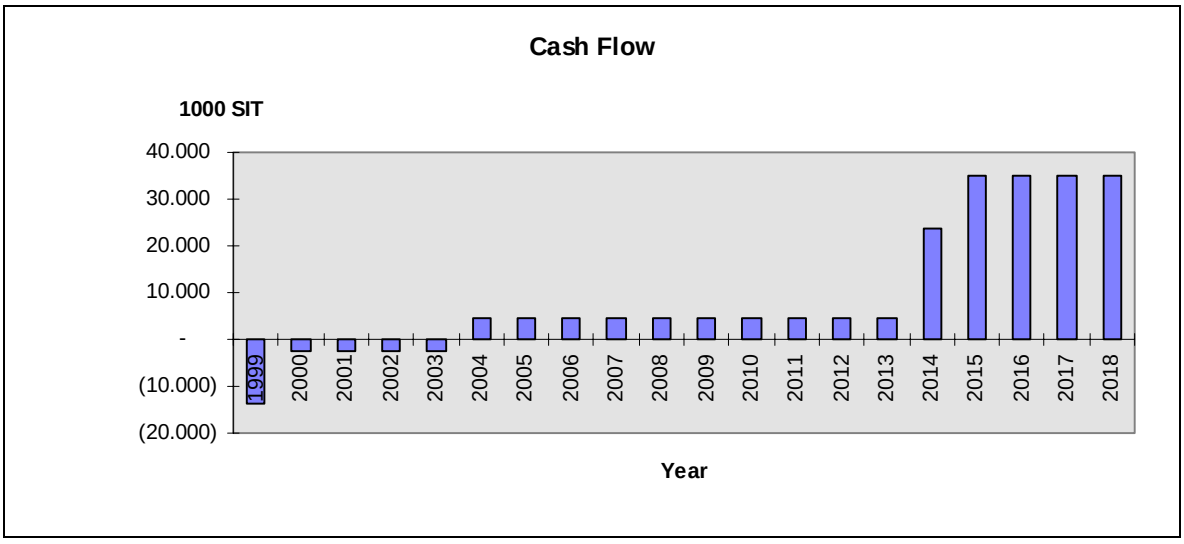


Figure 1: The cash flow of the biomass district heating scheme in Gornji Grad

11. Institutional arrangement and management system

The district heating enterprise in Gornji Grad, ENGO d.o.o., is formed as a private shareholding company with two owners; the municipality of Gornji Grad (75%) and SMREKA (25%).

The enterprise owns the production facilities, the transmission and the distribution network. The substations are owned by the consumers.

The purpose of the enterprise is to provide the service of delivering heat to the district heating consumers in Gornji Grad. The services provide all aspects from fuel purchase, heat generation, transmission and distribution over maintenance to administration including tariffing and billing of the consumers.

In order to keep the fixed costs low, the company has outsourced the main part of its activities to external parties. Consequently, the only permanent staff of the company is the managing director, which also is the mayor of the municipality.

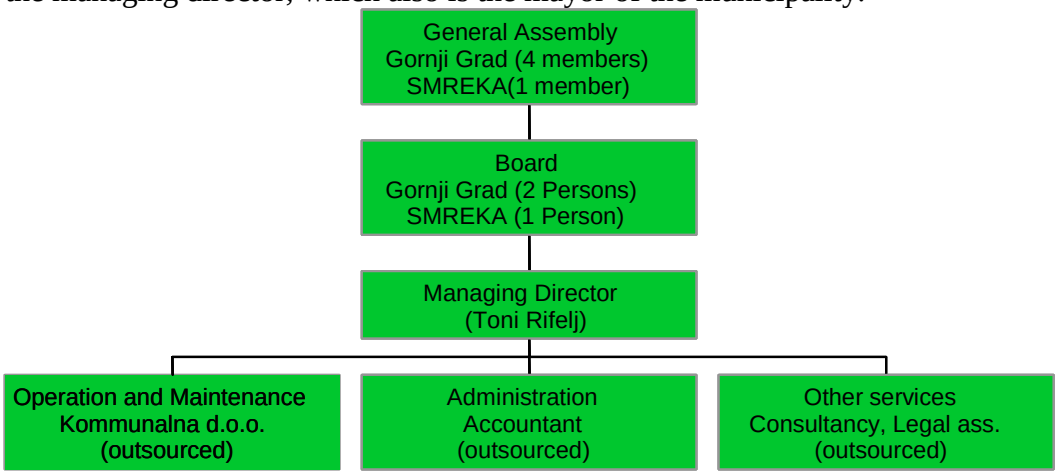


Figure 2: Organisational structure of the company.

The managing director is referring to the Board who again is referring to the General Assembly. The structure of the company is illustrated above. As it is seen from the figure, the Municipality of Gornji Grad has the majority of votes in the assembly as well as in the board. The consumers are not represented in the assembly or in the board. The company has aslo outsourced the main part of its activities to external parties.

12. Policy issues and barriers:

a) The government policies and barriers which contributed to the failures of commercialisation of BET

Although the potential of RES in Slovenia is considerably high the conducted analysis identified a series of barriers, as the reason for relatively slow progress of BET implementation.

Technical barriers

The following technical barriers were identified:

- lack of experience and “success stories” of BET projects in Slovenia (for example: co-generation using biomass, pirolisys etc.),
- lack of trained professionals to promote and support BET activities, and to ensure reliable operation of the new installations,

- lack of information and awareness of the local communities, industry and consultants on the latest available technical options for using BET,
- lack of capacity and guidelines for preparing feasibility studies and "bankable" BET project proposals.

Financial barriers

The following financial barriers were identified:

- lack of information about the possible sources of financing;
- uncertainties on the long term market price of renewable energies;
- absence of stable, long-term financing mechanisms to support BET projects (the present Government support is dependent on the decisions made during the preparation of the annual budget, which for long term planning purposes does not provide enough financial assurance);
- weak financial status of the companies to apply for commercial credits, although the projects themselves would be financially strong;
- interest rates of the local banks which are still above the average European level;
- short requested pay-back time of the commercial loans;
- high project preparation costs without any assurance of the possibility to obtain financing support for the actual implementation of them;
- lack of information to determine accurately the specific investment and operational costs of BET projects.

Social barriers

The following social barriers were identified:

- lack of information and awareness on the social and environmental benefits of increasing the use of BET;
- lack of awareness of the end users regarding the costs and benefits for switching to BET;
- lack of information about the possible substitutions of the out of dated technologies with new high-efficient ones (for example: changing from oil and hard fuel boilers or traditional wood boilers to modern biomass ones in individual households).

Environmental barriers

As environmental barrier was identified perception of some BET as an environmentally not friendly technology (for example: biomass boilers due to the inefficient and polluting traditional boilers).

Legal and administrative barriers

The following legal and administrative barriers were identified:

- lack of communication and co-operation between the different sectoral ministries dealing with BET related activities (energy, environment, agriculture and forestry, finance);
- Relatively complicated and not well defined and transparent requirements for obtaining the location and construction permits;
- lack of a cross-sectoral strategy and policy framework to promote BET projects;
- lack of a strong national focal point to support and promote BET activities in Slovenia;

- strong competition with strong, well organized oil and gas companies;
- lack of capacity and information of the local communities to assess the sustainability of the wood fuel supply and to mobilize/organize the local fuel wood market (biomass);
- lack of capacity and experience of the local communities to finalize all the other documentation needed to present RES projects for financing;
- bad correlation of targets between the governmental bodies and NGOs regarding the ways to achieve GHG reduction.

b) Recommendation of policies to overcome the identified barriers

Technical solutions

Increase of the experience with implementation of so called "success stories" of BET projects in Slovenia (for example: co-generation using biomass, pirolisys etc.) are required. There should be also organised training of the energy professionals (energy consultants, engineers etc.) and architects to promote and support RES technologies and to ensure reliable operation of the new installations. Information and awareness of the local communities, industry and consultants on the latest available technologies should be enhanced and guidelines for feasibility studies and "bankable" BET project proposals should be prepared.

Financial solutions

The existing state support at co-financing the feasibility studies and technical documentation for BET development and at providing subsidies for RES investments, is the basis for the start. In continuation the stronger and continuing support shall be assured. The secured long-term financing of the BET projects, by at least partial use of CO_2 tax, is one of the principal bases for theirs successful development.

Key activities to improve financing of BET projects are:

- Carrying out the first phase of the demonstration BET projects

  Within this framework, an increased demand for BET will be stimulated and technological development will be accelerated. All reflect in increased demand for new technologies. Acquired experience and international contacts will augment the professional level for design and execution of BET project. All these facts will lead to price reductions.

- More efficient incentives

  Based on deficiencies that will emerge during the execution of NEP, new improvements should be proposed according to available incentives (grants, favourable loans with subsidised interest rate, tax relief).

- Acceleration of the process to acquire investment grants

  Endorsement of investment grants from various sponsors will be most probably subject to different regulations that will require certain time. It will be proposed to make the licensing procedure more efficient, and according to requested enclosures for licensing, to combine different licensing procedures.

- Improvement of economic conditions for the execution of NEP

Adoption of agreements between sectors on partial use of CO_2 tax for long-term (10 to 15 years) financing for projects within NEP, which will be a clear signal for potential investors, that the state is supporting BET projects.

If the existing CO_2 taxation will be changed or any other new energy tax will be adopted, the tax rules must should financial viability of BET.

Social solutions

A wider promotion program (campaign) that would facilitate the dissemination of information and awareness on the social and environmental benefits of increasing use of BET among the end users of energy, is recommended. The costs, benefits and possible constrains of changing to BET should be presented as well as information about the possible substitutions of the out of dated technology with new high-efficient one. The campaign should be driven also by the traditional energy supply companies (i.e. Petrol, OMV Istrabenz, ELES, Elektro Primorska etc.).

Environmental solutions

All the environmental issues of setting up the BET power plant should be carefully examined and requirements for the most suitable sites should be rationally considered by the experts. The regularity of restrictions must be well studied and based on the comparison with the negative impact of fossil fuels.

The environmental friendly image of the BET should be pointed out and all existing and new BET power plants should operate clean and exemplary to change possible perception of some BET as an environmentally not friendly technology.

Legal and administrative solutions

The imminent task of the Ministry for economic affairs is to put in operation the new *Energy act* and so far prepare the *Subact on qualified power producers*. The *Subact on qualified power producers* has to define the development criteria and real position of BET in the energy sector. The Energy act is delineating the general provisions and importance of BET, more detailed provisions should be set out in the in the *Subact on qualified power producers*. This legal act has to set out in detail the provisions that on a non-discriminatory way will promote the qualified production of electricity (and heat). The act will cower the most part of the BET producers.

It is recommended that the main aim of the new legal framework is to establish a favourable and competitive market situation, which would induce efficient and innovative solutions for the energy supply. Institutional arrangement of the competitive situation together with the defined conditions for qualified producers should be efficient and provide also the necessary environmental and social development.

Further actions that the ministry may decide on, shall include preparation of the draft decrees, regulations, model licenses and contracts, as well as other guidance needed for timely and efficient implementation of the legislation.

The Ministry of economic affairs should decide, in co-operation with other ministries, especially the Ministry of environment and physical planning, whether the new

circumstances warrant revision of the energy policy and planning acts. The Ministry of economic affairs should also consider establishment of an advisory board that would facilitate the process of reviving the RE sector and relevant associated technologies, such as CHP, biomass and wind utilization.

A review of the national energy policy, especially in view of the accession requirements and the Kyoto obligations, may be warranted. More reliance on the district heating and CHP options based on BET may be an important component of the program for meeting these challenges.

An advisory board to the ministry, either specifically for BET development, or with wider field of obligations may be appropriate. A promotion program that would facilitate the understanding, implementation and further development of the legal and subsequent structural changes in the energy sector and specifically the BET sector, is also recommended.

It is recommended that current promotional and co-financing programs, such as co-financing of feasibility studies of local energy concepts that include heat supply and CHP facilities, energy audits in industry and biomass heating projects, will be continued and reinforced. The government should decide on continuing and possibly increasing support of RE related activities, through promotion programs and funds. In this regard the change of CO_2 tax decree in the way to become an instrument for promotion of BET will be appreciated. There also seems to be a need for technology, economy and legal-administrative feasibility demonstration for RE technologies.

13. Any other relevant data:

- Acceptance by local people/users/other beneficiaries

The biomass district heating is a welcome addition to the scheme of Gornji Grad as an ecologically sound town, which already includes separate waste collection and some other projects (wastewater treatment plant etc). The green image will help Gornji Grad in developing eco-tourism and production of healthy food. The heat from district heating will also be used for heating the new tourist settlement (wood bungalows produced at SMREKA) and greenhouses for production of vegetables. Because of these reasons the project is, except the distrust at the very beginning, very well accepted among the people.

- Replicability/potential market

The biomass district heating systems are going on well in some EU countries such as Austria, Denmark etc. The first information and practical experiences were obtained on the visits of similar systems in Austria. The engineering company from Austria also collaborated at design of the plant. There are going on the activities for another two new projects of biomass district heating systems in Preddvor and Logarska dolina. These two projects were inspired by the Gornji Grad case.

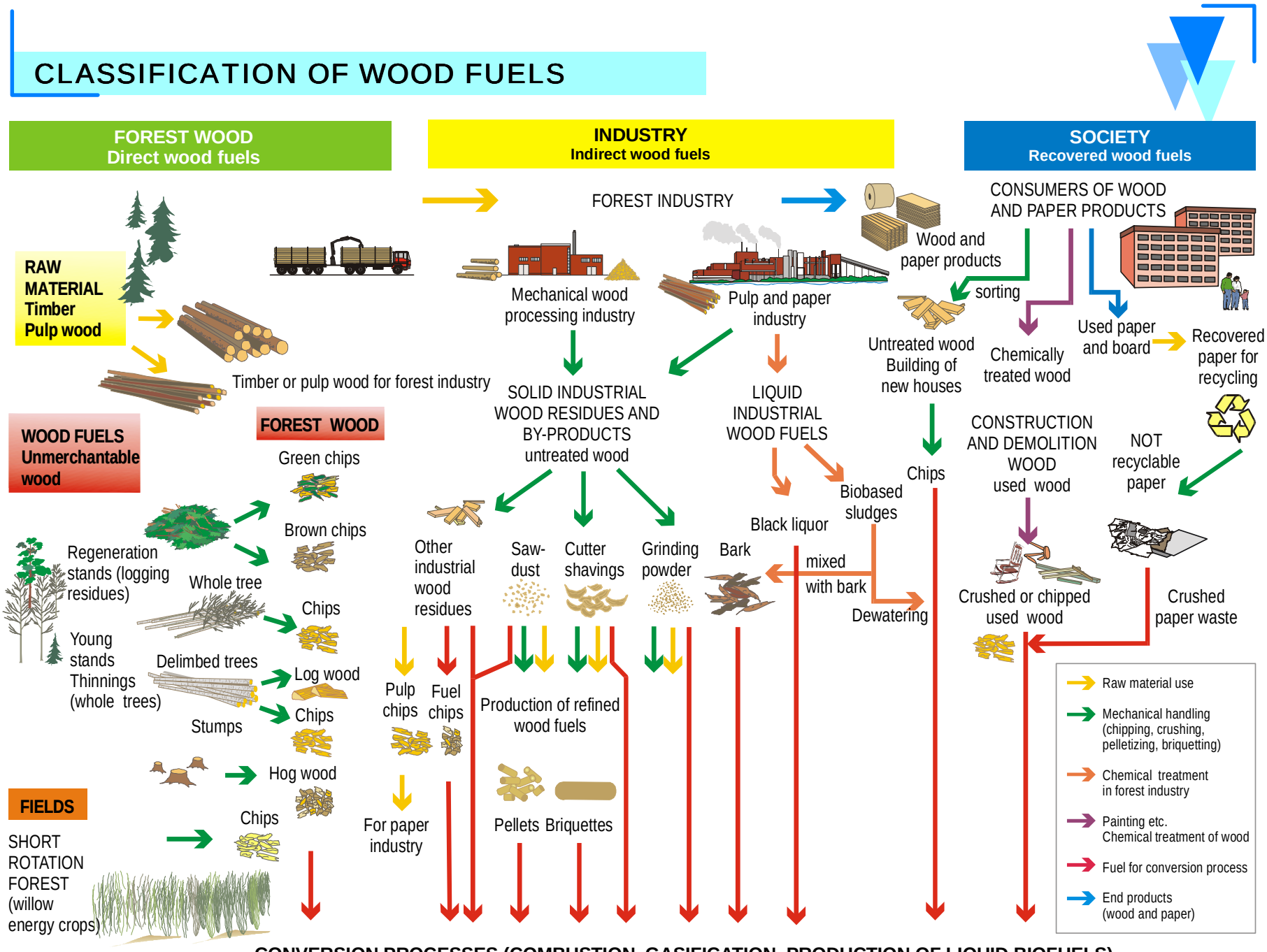
14. Overall conclusions/remarks:

Slovenia provides good conditions for the use of biomass as around 50% of the area of the country is forested. In 1991 a government subsidy programme for renewable energy was initiated. In order to demonstrate the technology and the organisational requirements of biomass fuelled district heating schemes the government initiated the pilot biomass district heating in Gornji Grad in 1995. The project received financial

support from the Slovenian government and Phare with the aim that this district heating scheme in Gornji Grad should act as model for replication in Slovenian villages and towns.

The project in Gornji Grad has been characterised by some highly motivated individuals in the Ministry of Economic Affairs (AURE), the municipality of Gornji Grad as well as in the wood working industry SMREKA. This commitment has led to a successful implementation of the full bio fuelled district heating scheme in Gornji Grad, which is an indeed useful demonstration of the concept.

CLASSIFICATION OF WOOD FUELS



CONVERSION PROCESSES (COMBUSTION, GASIFICATION, PRODUCTION OF LIQUID BIOFUELS)

VTT Energy E. Alakangas

FUEL CELLS

Contribution of Hydrocarbon Fuel Cells to Electricity Generation

Histograms of frequency distribution of the role of hydrocarbon fuel cells in electricity generation across scenarios, number of scenarios (from a total of 34) and generation in EJ per year. Figure A shows the fuel cells contribution in 2020, Figure B in 2050 and Figure C in 2100. Two technologies, Gas FC and Coal FC technologies (see Box 1), constitute the aggregate fuel cells contribution. The relative positions of IIASA-WEC scenarios are indicated in the histograms. After clustering during the first decades within the region of up to 20 EJ per year, some scenarios lead to very substantial contribution of fuels cells by 2050 of up to 120 EJ per year. The distribution is very skewed in 2050. Virtually all scenarios that fall above the mean are mitigation cases. All other scenarios fall within the interval up to 40 EJ per year. The spread of scenarios is quite wide by the end of the century. Mitigation cases are mixed with other scenarios without any obvious pattern as was the case 50 years earlier. Thus, fuel cells are a robust technology option in the long run.

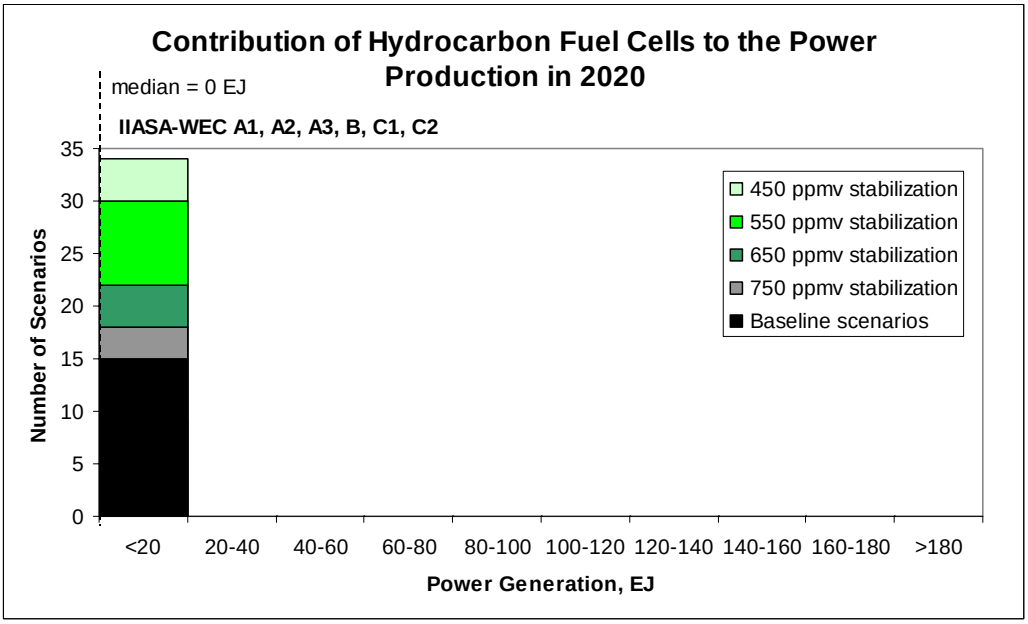


Figure A. Histogram of the hydrocarbon fuel cells contribution to electricity generation across scenarios in 2020. Fuel cells contribution is an aggregate of two technologies, Gas FC and Coal FC (see Box 1).

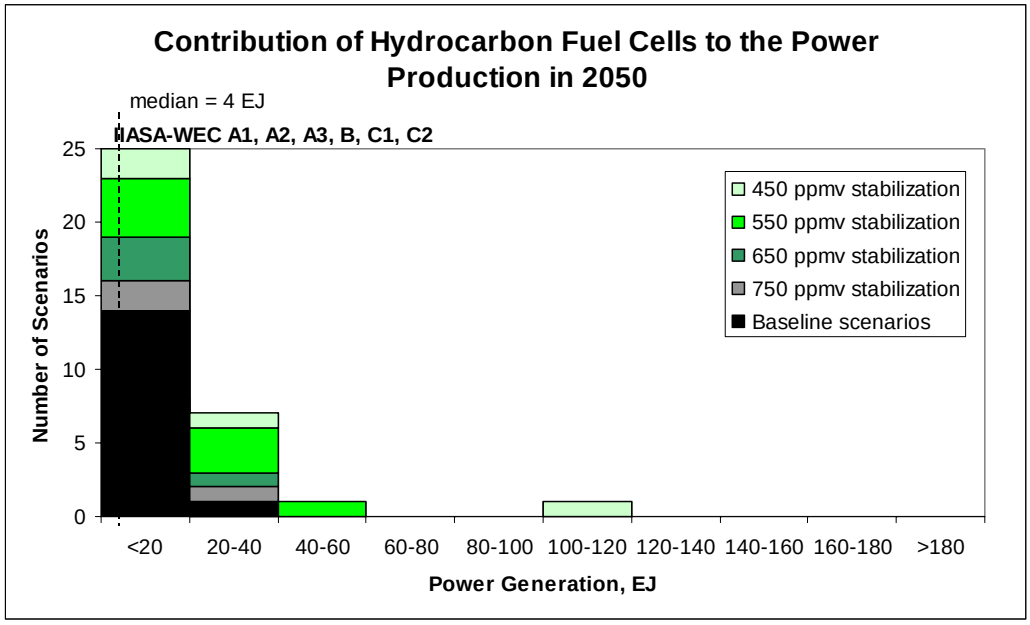


Figure B. Histogram of the hydrocarbon fuel cells contribution to electricity generation across scenarios in 2050. Fuel cells contribution is an aggregate of two technologies, Gas FC and Coal FC (see Box 1).

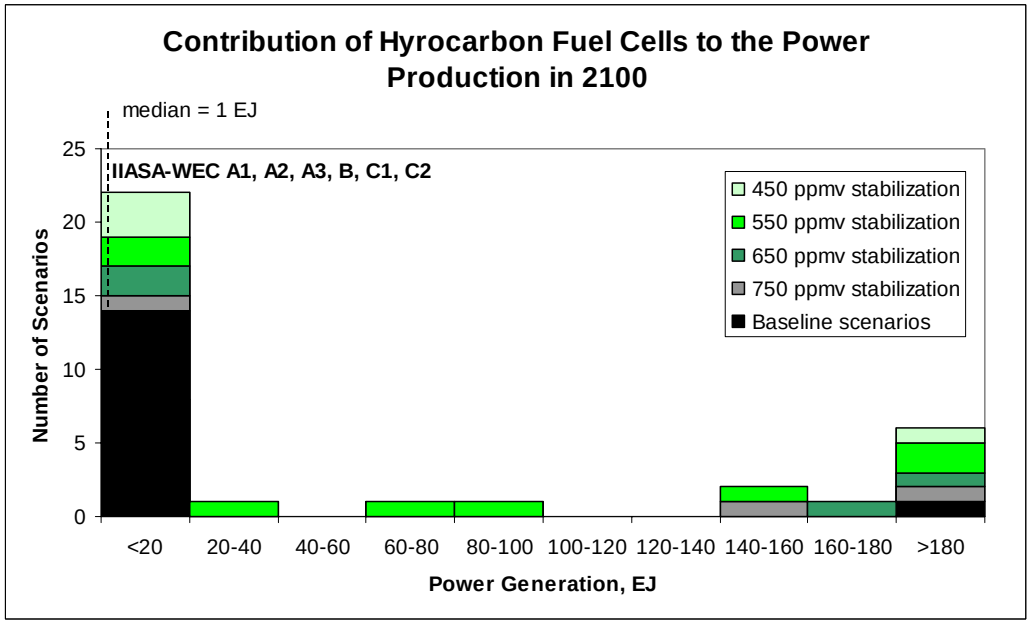


Figure C. Histogram of the hydrocarbon fuel cells contribution to electricity generation across scenarios in 2100. Fuel cells contribution is an aggregate of two technologies, Gas FC and Coal FC (see Box 1).

Contribution of Hydrogen Fuel Cells to Electricity Generation

Histograms of frequency distribution of the role of hydrogen fuel cells (H2FC, Box 1) in electricity generation across scenarios, number of scenarios (from a total of 34) and generation in EJ per year. Figure A shows the fuel cells contribution in 2020, Figure B in 2050 and Figure C in 2100. The relative positions of IIASA-WEC scenarios are indicated in the histograms. After clustering during the first decades within the region of up to 20 EJ per year in much the same way as hydrocarbon fuel cells (see above), some scenarios lead to a substantial contribution of fuels cells by 2050 of up to 80 EJ per year. The distribution is very skewed in 2050. A few scenarios that fall between 20 and 40 EJ per year are mitigation cases. Mitigation and baseline scenarios are otherwise well mixed with respect to the contribution of hydrogen fuel cells below and above these levels. The spread of scenarios is quite wide by the end of the century. Again, mitigation and baseline scenarios jointly presented in most of the categories. . Thus, the hydrogen fuel cells penetration in the long run is quite independent on the need to control carbon emissions. The hydrogen fuel cells are apparently favored and a robust technology choice across the scenarios despite the thigher complexity of the respective energy chains.

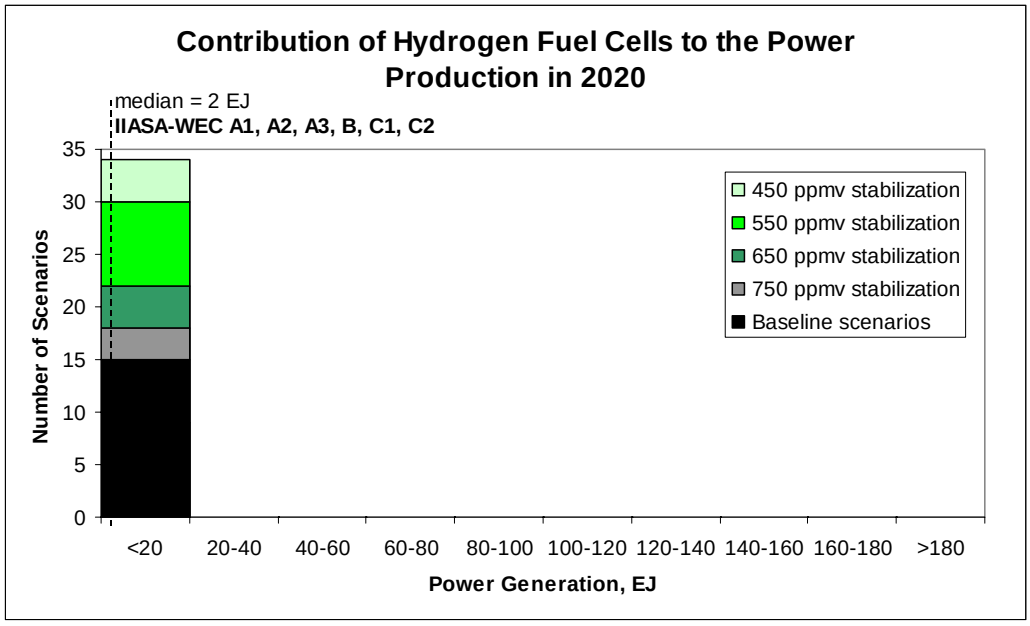


Figure A. Histogram of the hydrogen fuel cells (H2FC) contribution to electricity generation across scenarios in 2020.

Investment Costs for Coal Fuel Cells

Histograms of frequency distribution of the investment costs of coal fuel cells across scenarios, number of scenarios (from a total of 34) and 1990 dollars per kW installed electric capacity. Figure A shows the investment costs in 2020, Figure B in 2050 and Figure C in 2100. The relative positions of IIASA-WEC scenarios are indicated in the histograms. After clustering during the first decades within the region of more than $1800 per kW installed electric capacity, the investment costs bifurcate into two categories, one with costs between $1400 to 1600 and the other with $1800 and more

per kW installed during the period from 2050 to 2100. Most of the mitigation scenarios fall within the lower cost category interval primarily because the scale of application of these technologies is higher in these scenarios leading to higher assumed rates of costs reductions.

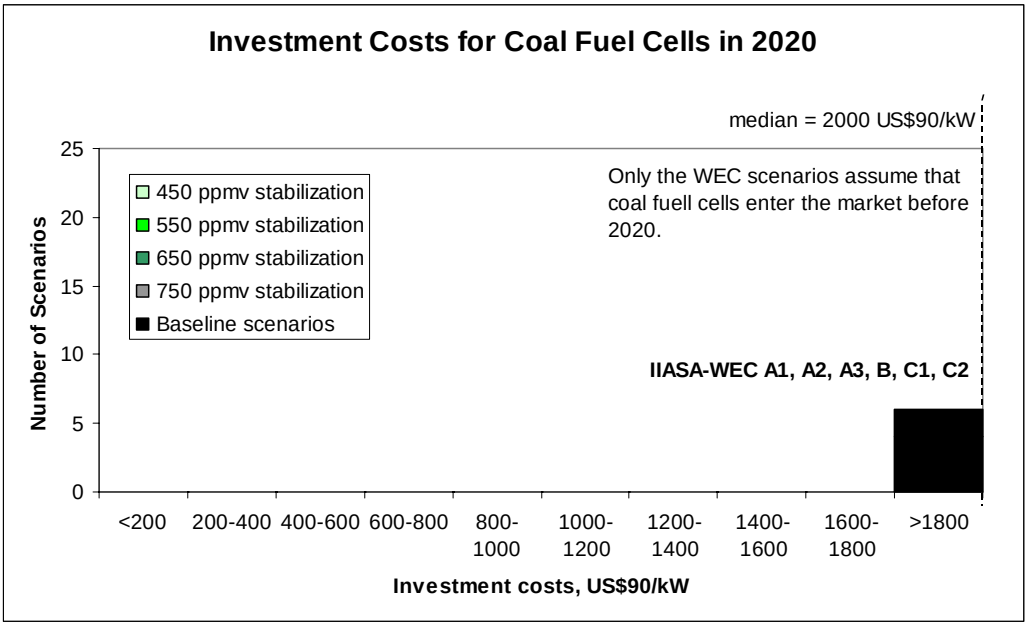


Figure A. Histogram of investment costs for coal fuel cells (Coal FC) across scenarios in 2020.

Investment Costs for Natural-Gas Fuel Cells

Histograms of frequency distribution of the investment costs of natural gas fuel cells across scenarios, number of scenarios (from a total of 34) and 1990 dollars per kW installed electric capacity. Figure A shows the investment costs in 2020, Figure B in 2050 and Figure C in 2100. The relative positions of IIASA-WEC scenarios are indicated in the histograms. After clustering during the first decades within the region of between $1000 and 1200 per kW installed electric capacity, some of the investments in 2050 in new capacity become lower extending down to $800 per kW installed and start bifurcating into two categories with costs between $600 to 800 and between $1000 and 1200 per kW installed by 2100. Most of the mitigation scenarios fall within the lower cost category interval primarily because the scale of application of these technologies is higher in these scenarios leading to higher assumed rates of costs reductions. The IIASA-WEC scenarios fall in the upper category primarily because the scale of application is not as high as in IPCC scenarios.

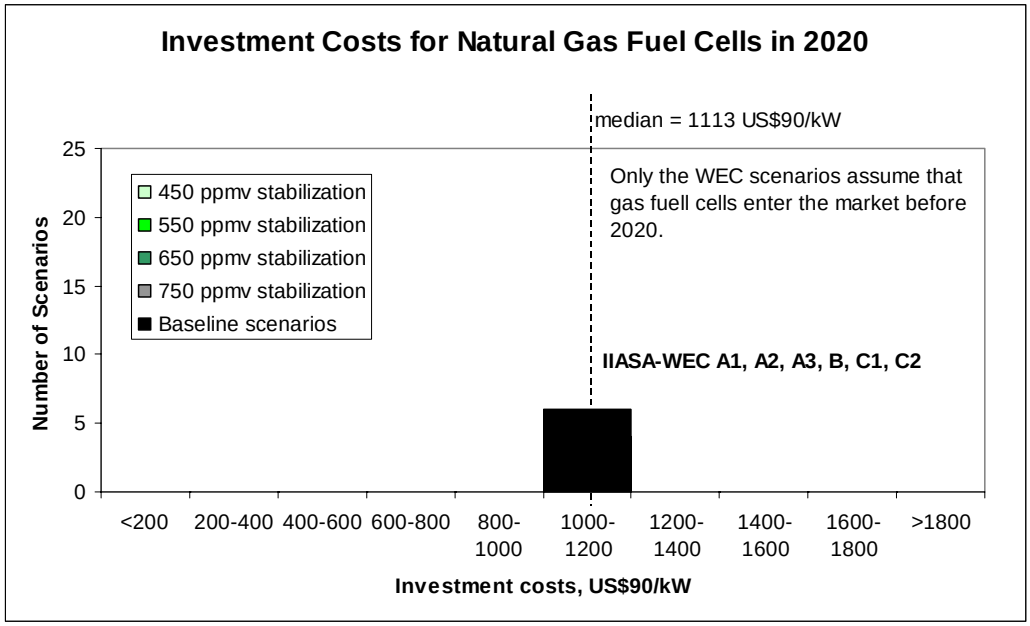


Figure A. Histogram of investment costs for natural-gas fuel cells (Gas FC) across scenarios in 2020.

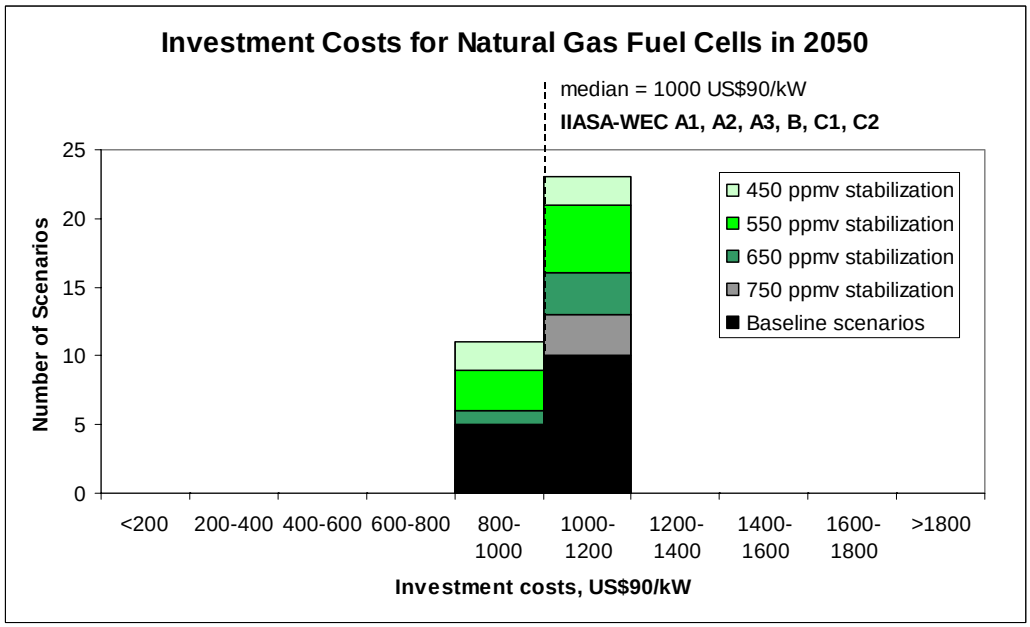


Figure B. Histogram of investment costs for natural-gas fuel cells (Gas FC) across scenarios in 2050.

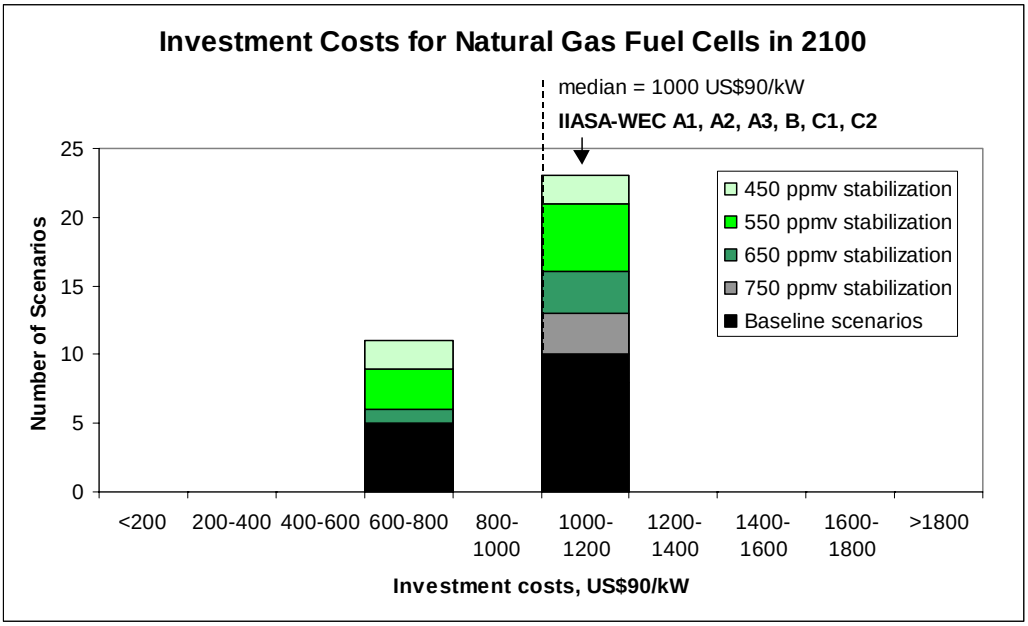


Figure C. Histogram of investment costs for natural-gas fuel cells (Gas FC) across scenarios in 2100.

Abbreviation	Technology Description
Coal Std	Aggregation of various types of traditional (single steam cycle) coal power plants. These include plant types without FGD and DENOX, but also other types with FGD up to 90 percent and DENOX up to 50 percent. Some potential for district heat co-generation. Efficiencies for the model base year (1990) range between 38 and 40 percent. Plant life is 30 years and plant factor (availability of utilization) 65 percent.
IGCC	Integrated (coal) gasification combined cycle with 99 percent FGD and DENOX. Some potential for co-generation. Initial efficiency in the base year (1990) is 43 percent plant life is 30 years and plant factor 65 percent.
Oil ppl	Aggregation of various types of oil power plants (includes e.g., Rankine cycle with low NOx emissions and 90 percent DENOX, but also light oil fueled engine plants). Some potential for co-generation. Initial efficiency in the base year (1990) ranges between 40 and 46 percent, plant life is 30 years, plant factor 65 percent.
Gas Std	Standard natural gas power plant (Rankine cycle) with district heat co-generation. Initial efficiency in the base year (1990) is 40 percent, plant life is 30 years and, plant factor 65 percent.
GCC	Natural gas combined cycle power plant including some potential for co-generation. Initial efficiency in the base year (1990) is 50 percent, plant life is 30 years and plant factor 65percent.
GCC 0C	Natural gas combined cycle power plant with zero carbon emissions. CO_2 is assumed to be re-injected in gas or oil fields (e.g., for enhanced recovery). Efficiency loss due to re-injection (compared to GCC) about 1 percent. Plant life is 30 years and plant factor 65 percent.

Coal FC	Coal based high temperature fuel cell. Efficiency is 50 percent, plant life 25 years and plant factor 65 percent. It is assumed in most of the scenarios that this technology will be available commercially after 2010.
Gas FC	High temperature fuel cell powered by natural gas. Rejected heat is available for co-generation. Efficiency is 60 percent, plant life 25 years and plant factor 65 percent. It is assumed in most of the scenarios that this technology will be available commercially after 2010.
Waste	Standard municipal waste power plant (Rankine cycle) with 90 percent FGD and 50 percent DENOX. Initial efficiency in the base year (1990) is 29 percent, plant life is 30 years and plant factor 65 percent.
Bio STC	Biomass power plant (single steam cycle) with some potential for district heat co-generation. Initial efficiency in the base year (1990) is 29 percent, plant life is 30 years and plant factor 65 percent.
Bio GTC	Biomass gasification power plant. Initial efficiency in the base year (1990) is 46 percent, plant life is 25 years and plant factor 65 percent.
Nuc LC	Low-cost conventional nuclear power plant (light and heavy water reactor) . Initial efficiency in the base year (1990) is 30 percent, plant life is 30 years and plant factor 70 percent.
Nuc HC	High-cost conventional nuclear power plant (light and heavy water reactor). Initial efficiency in the base year (1990) is 35 percent, plant life is 30 years and plant factor 75 percent.
Nuc HTR&FBR	Aggregation of various types of advanced nuclear power plants including high temperature and fast breeder reactors with some potential for district heat and hydrogen co-generation. Initial efficiency ranges between 40 and 45 percent. Plant life is 30 years and plant factor 75 percent.
Hydro	Aggregation of various types of hydroelectric power plants. Low and high cost plants are distinguished in all scenarios in order to reflect the influence of different sites and other factors on the plant costs. Plant life is 60 years and plant factor 50 percent.
Solar Th	Solar thermal power plant with storage and some potential for district heat and hydrogen co-generation. Plant life is 25 years and plant factors differ significantly across world regions ranging from 10 to 50 percent.
Solar PV	Aggregation of various types of solar photovoltaic power generation including large-scale power plants and small-scale onsite electricity production. Plant life is 25 years and plant factors differ significantly across world regions ranging from 10 to 50 percent.
Wind	Wind turbine power plant. Plant life is 25 years and plant factor 25 percent.
Geothrm	Geothermal power plant. Plant life is 30 years and plant factor 70 percent.
H2FC	Aggregation of types of hydrogen fuel cells for industrial and residential use with some potential for district heat co-generation. (Note that explicit assumptions for investment costs are not part of the MESSAGE model for all end-use technologies including these types of hydrogen fuel cells. Consequently, it was not possible to include the H2FC fuel cells in the comparison of investment costs.)

PROMOTING GEOTHERMAL POWER GENERATION
SUMMARY OF ALMOST TWO DECADES OF ORMAT EXPERIENCE

Michael Lax
ORMAT Group of Companies

Background

During the past two decades ORMAT has constructed 700 MW of geothermal energy power plants in 11 countries, from the USA to Iceland, New Zealand and the Philippines. One can see ORMAT in almost every recent active geothermal development. During these years ORMAT's geothermal plants have avoided some 13 million tons of CO_2 emissions, contributing to environmentally benign power generation.

ORMAT's systems for electricity generation using geothermal energy have proven to be reliable and flexible. ORMAT's power plants are modular, tailor-made to the resource, and on-line at an impressive average of 98%.

The following presentation is designed to share ORMAT's experience in promoting geothermal power projects, and in tackling conceptual, institutional and financial difficulties for successful and even accelerated development of renewable energy implementation as a positive contribution to increasing the quality of life on a worldwide basis.

Geothermal Power Generation Status

In 2001 the total global geothermal installed capacity has already exceeded 8,000 MW. Yet the rate of developmental growth slowed from 22.5% per 5 years in the eighties, to about 16.7% in the nineties (Huttrer, 2000). The slowing rate of growth of international geothermal development was caused by “objective” influences in the energy market, i.e. the decrease in prices of petroleum products or the economic crisis in Southeast Asia (just where geothermal development was accelerating), as well as hurdles caused as an outcome of the overall misperception of the role of renewable energy in general, and geothermal in particular.

Geothermal energy is perceived as a small-scale, highly dispersed resource (often located in rural, less important areas). Geothermal power projects are characterized by higher initial capital costs than large thermal power projects (due to the fact that these capital costs include a lifetime supply of fuel), the resource development is perceived as a high-risk. The conclusion is obvious… While geothermal power generation today supplies electricity to some 40 million people, its ultimate potential is substantially untapped. Worldwide, geothermal power could serve the electricity needs of some 865 million people, or 17% of the world’s population (Gawell, Reed and Wright, 1999). The study identified 33 countries that could be 100% geothermal powered, mostly in Africa, Central and South America and the Pacific.

Private-Public Partnership for Enhancement of Geothermal Projects

The growth rate of geothermal energy power generation is, in ORMAT's experience, heavily dependent on optimization of inputs from both public and private sources. Three basic stages are involved in geothermal power project development:

- Geothermal resource development and preparation of other conditions for successful project implementation.
- Contracting and project financing process.
- Technology research, development, manufacture, installation and maintenance.

At each stage ORMAT has accumulated years of experience on how to deal with difficulties, hurdles and how to pre-arrange conditions for securing public-private involvement in successful development of the renewable energy market.

Geothermal Resource Development and Preparation of Other Conditions for Successful Project Implementation

At this preliminary stage, public investment and other governmental involvement in geothermal development is more than necessary to secure inflow of private capital at a later stage. One-third of the investment in a geothermal facility has to be made ***before*** there is adequate definition of the resource to ensure targeted production. Certainly many business risks are involved: in identifying a geothermal resource, its size and deliverability, and evaluating its sustainability (resource degradation, scaling, depletion of reservoir, etc.). Moreover, well drilling costs and rates of exploration success can vary widely, increasing even more the perception of risk.

To cope with the problem we need ***active governmental or multilateral agency participation*** in promoting the initial geothermal exploration and development. Governments should contribute to project credibility by ***appropriate geothermal legislation*** to allay the private and banking sector fears. ***Multilateral and bilateral agencies*** should provide support to improve geothermal reservoir exploration and drilling techniques to decrease exploration costs and risk perception.

Furthermore, governments should prepare ***basic laws and regulations to accommodate private investment***. The legal environment and regulatory framework must be one which supports ***private ownership*** including transfer (repatriation) of private investors' (and potential lenders') rights.

Investment income must be ensured through ***power purchase agreements*** (PPAs), ***BOT/BOOT/BOO schemes, political stability currency convertibility and transferability*** and other measures. Enforceability of ***international arbitration*** is another element required to support the basic project equation.

For the actual geothermal field development, the precondition would be ***transparent laws*** governing geothermal concessions which encourage exploration. These laws or regulations

should provide certainty about the conditions of the whole process of geothermal resource extraction, and its transfer to electrical power.

Successful implementation of this approach can be demonstrated through ORMAT's experience in geothermal developments in the nineties in the Philippines, where this private-public partnership scored highly and contributed to that country's spectacular geothermal development (see Case Study No. 1).

Contracting and Project Financing Process

Once the preconditions for a geothermal power generation project are set up, the private company identifies business opportunities, attracts potential lenders, and then encounters numerous hurdles on the way to their implementation.

A. Difficulties Due to the Small-Scale Nature of Most Geothermal Projects

Geothermal energy projects are generally small and often located in rural areas, far from the decision makers. From the financing point of view a "small" project can be seen as a "thin" project – one that cannot tolerate all of the transaction costs and financing hurdles resulting from some of the traditional project finance elements.

To cope with this problem we need to use ***"bundling" of prospective geothermal projects*** to achieve magnitudes of over 50 MW to obtain economies of scale. This can be done mainly under two different structures. The first, by the entity issuing the project by taking separate facilities and "binding" them into one project, under one set of documents, with joint structure (duration, tariff, securities, etc.). The second structure can be created by the sponsor by taking a few separate facilities, with no, or limited, relation between them and "bundling" them into one project to be financed by one financing scheme.

To demonstrate ORMAT's experience in project "bundling", see Case Study No. 2, ORMAT's project development "Leyte Optimization" in the Philippines.

B. Contracting and Financing

Financing structures, contract reviews, costs, procedures, timetable and review standards are usually geared for large-scale projects. For "small" projects not all traditional "project financing" elements are a "must" and, therefore, adjustment of the financing package is required in order to fit the specific nature and structure of "small" projects. Flexibility is also expected from lenders to small projects so that their requirements would be reasonable. The implementation of these projects can be accelerated by reducing the expenses and time delays required to arrange and close financing.

Fast Track Process for "One Stop" Financing:

Financing of geothermal projects should be processed on a ***fast track***, utilizing experience with similar projects, ***standardized procedures*** and increased reliance on the history of the project participants.

Agency Financing Requirements:

The Agency financing requirement should be identified at the beginning of the review period to keep the financing process on a smooth fast track, as follows:

The Review Period for the project through financing approval, should be targeted at six months. This period is generally sufficient for a diligent and thorough review of a geothermal project.

The Financing Participants should choose a ***team leader***, who will represent the needs of the participants without having to coordinate the time schedules. This will keep the financing process on schedule and control its costs. Limitations on the percentage of investment which a single agency can undertake should be raised to 75% to minimize the number of participants.

Agency Teams should be assigned to the projects from inception through project review and financial closing. The shorter financing period will avoid the need to change teams during the process because of the needs of other projects, resulting in a smoother financing process.

Standard Power Purchase and Project Agreements such as were used in the USA for small power projects, should be developed and specifically tailored for financing of geothermal and other renewable energy projects.

The Closing Schedule, including costs and timetable should be agreed upon during the review period, with reasonable efforts made by all parties to adhere to this schedule.

To illustrate "the costs" of financial and contractual hurdles experienced by ORMAT in developing its geothermal project in Guatemala, see Case Study No. 3.

C. Further Commercial Financing Barriers

These result from the higher up-front costs of renewable energy projects. The cost of fossil fuel power includes the power plant capital cost and a per unit fuel cost, while in renewable projects the capital cost, which includes the equipment for converting natural energy, is much greater than the comparable cost for a fossil fuel project of the same size. Commercial institutions as well as the Export Credit Agencies (ECAs) view this as increasing the project's financial risk profile.

To promote renewable projects and remove the above hurdle, an orchestrated effort in public legislation should be initiated. It should promote rapid ***inclusion of externalities*** (i.e. GHG Emissions Reduction Accountability, avoided fossil fuel costs, etc.) in power tariffs and cost evaluations. A ***Renewable Portfolio*** should be established as part of the energy market.

Technology Research, Development, Manufacture, Installation and Maintenance

The last step in the equation of a successful geothermal power project development is the area of "technology". Two decades of experience in the business lead us to the conclusion that in this area the ***private sector*** takes the lead and bears the risks.

Government sponsored ***RD&D processes*** suffer under severe cuts and the trend is applied worldwide, as public budgets decrease, but in parallel, we have recently witnessed an impressive inflow of ***venture capital*** and a broader opening of financial markets to energy-related RD&D processes. The venture capital investments in pioneering renewable energy companies in the U.S. and the E.U. indicate the trend of future developments. In order to stimulate ***private investment*** in renewable energy related to RD&D, including venture capital, we have to create market mechanisms, such as ***energy set-asides***, stressing ***energy quality, eco-efficiency***, etc., as complementary requirements.

At this stage of the project erection and installation the technology risk is fully underwritten by the private sector. ORMAT has accumulated broad experience in a variety of markets in developed and developing countries, in power markets moving toward a competitive marketplace or regulated markets. Generally, there is a need for ***transparent "market-rules"***, which guide the business behavior in the market. In this case the scheme of business development is of less importance (whether a turnkey project or BOT, BOO, BOOT, or others).

Last but not least, is the importance of ***technology and skill transfer***. This is mostly important in ***developing countries***. In order to let them feel confident that the development of geothermal energy is carried out in a way which protects their national interests it may be useful to wage some technology transfer to those countries and, more importantly, to prepare a strategy of skill transfer to local personnel (who would provide the maintenance of the power plant after it starts to operate).

In the past two decades in various countries of Southeast Asia, Latin America and Africa, ORMAT has contributed to sustainable geothermal, environmentally friendly power generation. In these countries ORMAT has also contributed to the creation of jobs, transferring skills. For example, 100% of ORMAT's employees in the Philippines are Philippine citizens. Several of them were chosen to participate in the construction, start-up and training in ORMAT's new power plants in New Zealand, Guatemala, and Kenya, in the latter case transferring skills from one country to another.

Summary

The potential growth of geothermal power generation is vast. The technologies for power generation are attainable. The private sector is the moving force behind the process. It has to tackle different difficulties, some inherent in the nature of the geothermal resource, and others, barriers caused artificially – by institutions, competing forces, and false perception. These artificial barriers have to be removed in order to set real market conditions, where everything is accountable. The development rate of geothermal energy is heavily dependent on the general will to promote renewable indigenous energy resources, but also on the availability of funding from both private and public sources. The role of private capital and the need to leverage public funds, is expected to expand in the future. We have therefore suggested, based on ORMAT's long experience, ways to optimize the private-public endeavor to develop renewables in general, and geothermal energy, in particular.

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CASE STUDIES

CASE STUDY NO. 1

GEOTHERMAL POWER DEVELOPMENT IN THE PHILIPPINES

In the late eighties the Philippines suffered a severe energy crisis, which influenced the overall economy of the country. The power shortages and brownouts characterized the situation of the country. Geothermal power generation was some 880 MW, despite the existence of the country's proven potential to use this indigenous resource for enlargement of its generating potential.

At this point, the Global Environment Facility (GEF) agreed to grant US $30-million to enable the Philippine National Oil Company (PNOC) to invest in geothermal field development. The Government of the Philippines took it upon themselves to implement the necessary legislation. After drilling geothermal production wells in the most prospective geothermal areas, the resource was developed and PNOC, with governmental guarantees, initiated an international bidding process for the development of geothermal power generating projects under a BOT (Build-Operate-Transfer) scheme. The leading forces from the private sector of the geothermal industry took part in the process, from the leading U.S. firms such as ORMAT, Magma, California Energy, and Oxbow, and the Japanese, such as Marubeni, Fuji, Toshiba. Private industry played a role in underwriting its responsibilities in the process for technology transfer and for the transfer of skills on a proven performance basis.

The outcome was impressive. The combined effort of GEF investment and Government initiated legislation triggered an impressive investment of about US $1.5 billion to build more than 600 MW of geothermal power plants. The power crisis was overcome, the geothermal power generating capacity of the Philippines increased during the last decade by more than 1,000 MW (115%), to over 1,900 MW, generating 21.52% of the nation's energy supply.

A concerted effort of the Multilateral Agencies with local governments to implement the right legislation leads to trigger strategic projects, to enable the private industry to finance the implementation and reduce the cost of private renewable energy projects in emerging markets.

CASE STUDY NO. 2

LEYTE OPTIMIZATION PROJECT IN THE PHILIPPINES

Project Overview

- PNOC-EDC (The Philippines National Oil Company – Energy Development Company) issued a Request for Proposal in March 1995, to convert unused geo-energy to electricity at 4 sites on the island of Leyte in the Philippines.
- Existing plants generated 370 MW from steam supplied by PGI, a PNOC/Unocal Joint Venture.
- After being successful in the international bidding process, ORMAT was awarded a 10-year energy conversion agreement in July 1995 by PNOC-EDC.
- PNOC-EDC sells power to NPC under a long term Power Purchase Agreement (PPA) guaranteed by the Government of the Philippines.
- Financing was closed ten months later in May 1996, due to bundling of 4 facilities into one project. Construction was completed in September 1997.
- The project consists of 4 new power plant units:

Leyte Plant	Existing MW	New Plant Type	Added MW	Total MW
Tongonan	112.5	(1) Topping unit	16.0	128.5
Mahanagdong (A and B Plants)	180.0	(2) Topping units	19.1	199.1
Malitbog	77.0	Bottoming unit	14.7	91.7
Total	**369.5**		**49.8**	**419.3**

Financing Structure

Financial Advisor	:	Delphos International, Washington DC
Project Financing	:	Limited recourse, BOOT
Total Project Cost	:	$66.1 million
Construction Loan	:	Consortium Leader, ING Bank Political risk by US Ex-Im Bank
Equity	:	$16.5 million by ORMAT
Long Term Debt	:	$50 million by US Ex-Im Bank
Power Sales	:	10-year energy conversion contract
On-line Date	:	January 1998

Comments on Financing

- **Financial Closing occurred less than 10 months after award of contract to ORMAT**
- **Success elements included:**
    - Good credit rating of power purchaser
    - Low country risk
    - ORMAT's track record as developer in the Philippines and elsewhere
    - No geothermal (= fuel) risk
    - Single Equity Investor, ORMAT at financial closing. Later additional participants in Equity (Itochu 10%, EPDCI 10%)
    - Single term debt lender, US Ex-Im Bank
    - Construction lender consortium with strong lead bank
    - Similar lender to previously financed project
    - As of July 2001, more than 660,000 tons of CO_2 avoided

CASE STUDY NO. 3

ORMAT's 25 MW GEOTHERMAL POWER PLANT ZUNIL I, IN GUATEMALA

The 25 MW Zunil I Binary Geothermal Power Plant, the first commercial geothermal power plant in Guatemala, utilizes two-phase geothermal fluid consisting of steam and separated geothermal brine for power generation by using ORMAT Combined Cycle Units (OCCU) and ORMAT Topping Units (OTU).

The original contract between ORMAT and INDE (Guatemalan Electricity Utility) was signed in December 1993. The plant was built in the framework of a Build-Own-Operate (BOO) agreement. The lengthy contract and financing negotiations was caused by statutory difficulties, credit risk barriers, institutional difficulties and many other hurdles ORMAT and its partners had to address.

The plant, which is owned and operated by ORZUNIL as a joint investment of ORMAT, the International Finance Corporation (IFC), Scudder Latin America Power Fund, the Commonwealth Development Corporation began its successful commercial operation in September 1999.

Had it been developed on a fast-track manner, overcoming the institutional and project finance hurdles, INDE could have enjoyed electricity provision based on this geothermal power plant at least four years before its actual inauguration (assuming 98% of availability, some 850,000,000 kWh). In addition to project development fees and long financing costs and time consuming process, ORMAT has also lost income equaling these lost 850,000,000 kWh.

INDUSTRIAL WASTE HEAT UTILIZATION

A NOVEL APPROACH TO INDUSTRIAL ENERGY EFFICIENCY WITH POSITIVE ENVIRONMENTAL CONTRIBUTIONS

Michael Lax
ORMAT Group of Companies

Background

Although an industrial waste heat resource for electricity generation does not entirely comply with the traditional definition of renewable energy, and is more connected to energy eco-efficiency, the WEC Committee on Renewables was right to include it in its Terms of Reference. The resource is renewable in the sense that it doesn't deplete primary energy resources (by using heat streams which, until now, were unused, wasted, or released to the atmosphere, often with negative consequences), it can provide base load reliable power, and has a highly positive impact on the environment.

ORMAT "discovered" this hidden distributed resource some twenty years ago as a viable potential for medium sized (up to 20 MW) power generation. During this time the company has completed numerous industrial waste heat power projects using a wide variety of heat resources in applications such as ***chemical, cement and glass plants, oil refineries, waste incinerators, pulp and paper mills and gas pipeline compressor stations***. ORMAT's air- or water- cooled Organic Rankine Cycle (ORC) power units have been installed worldwide, in the ***U.S.A., Canada, Europe, Japan and China***, providing on-site generation to reduce the capacity required at the industrial site, or for sale to the grid.

The field-proven technology contained within the ORMAT ORC power units exists; it is available and cost effective. However, during the years of promoting and attempting to commercialize this renewable technology, ORMAT had to cope with an assortment of difficulties, hurdles, misperceptions and an overall lack of interest within the marketplace.

The following describes ORMAT's experiences in promoting industrial waste heat utilization for power generation, the difficulties encountered and are still encountering, and ORMAT's suggestions for ways to exploit this under-utilized resource to its full commercial value.

The Potential of Unused Industrial Heat for Power Generation

Industrial processes, even cogeneration based, with waste heat at different temperatures: ***gases of 275-500ºC, condensing vapors and fluids of 100-250ºC, and hot oils of 200-350ºC***, can increase their eco-efficiency by adding power generation to their basic process. There are many such heat streams, especially in industrialized countries. Potential generation, in the ***U.S.A.*** alone from unused industrial heat, is estimated at 8,000 MW, equivalent to 16 utility size power plants and enough for 8 million homes. Industrial ***European countries*** can also contribute non-marginal amounts of electric energy, without using any additional energy resources. The same applies to

industrialized ***developing countries***, such as ***India, China, Brazil, Mexico, Argentina*** and many others.

The industrial applications for waste heat recovery have proven advantages:

- Provide fuel-free electricity, no additional energy resource is required
- No gaseous or liquid emissions and no solid residue
- Short and simple implementation
- Low cost, baseload, reliable capacity
- No new siting is required, power units are installed at an existing industrial site
- Reduces peak load demand from the grid

Lessons from ORMAT's Experience in Implementing Waste Heat Recovery Power Generation Projects

As mentioned earlier, ORMAT has completed numerous waste heat utilization projects (see, for example, Case Study No. 1 summarizing ORMAT's first waste heat recovery system for the cement industry at the Heidelberger Zement AG Plant in Lengfurt, Germany).

The main obstacles that have prevented/limited successful industry/power producer cooperation are due to the wide differences in which the two parties view on-site generation.

(a) Power generation is not the primary business of the industry
The industry considers on site generation a nuisance; it has long-term contracts for the purchase of electricity with the local utility and does not feel the need to alter this practice. The development budgets are directed to production-enhancing activities. Electric power is merely an overhead expense issue.

(b) The industry is in the process of continuous adaptation
The modernization of industry makes it difficult for the plant owner to commit to the required amount of heat source for power generation for a period of at least 10 years (the minimum production period of the power producing facility).

(c) The reluctance of the industry "to host" non-integral processes in its backyard
There are several issues to be solved. The industrial host is often concerned that the boundaries between the power generation and industrial processes overlap. In so doing this may present a risk (real or imaginary) to the process that the host may not wish to accept. Industry requires a clear commitment that the power plant process not intervene in the industrial production process.

(d) Ambiguity in responsibility for the energy domain at different industrial plants
The power producer often has to cope with the divergent agenda of the industrial company's management. The business of energy may create conflicting interests between the General Manager, Energy Department Manager, Maintenance Manager or Business Development Manager. Sometimes these conflicts are so severe they scuttle even those projects that are obvious winners.

Recommendations:

- From a public goods point of view, Waste Heat Power Generation should be included in the broader renewable energy resources promotion. The ***set-asides for the Renewable Portfolio*** should also include industrial waste heat (as it saves primary energy resources). Industry will be more receptive to including waste heat energy in its adaptation/modernization plans when and if it is promoted/supported or even partially subsidized by Government.

- Government may contribute further by implementing more ***flexible general rules for waste heat utilization projects***, e.g. eliminate the need for ***permitting*** ("inside the fence" the units are to be considered as energy saving equipment and not power plants); ***eliminate costly utility interconnection*** delays, etc.

- Industries involved must be allowed to ***aggregate environmental credits*** and other incentives (avoidance of transmission costs) to compensate for the expense of modifying the industrial production process.

Conclusion

Recognition of industrial waste heat as a renewable resource is a necessary first step leading towards widespread implementation of medium sized (up to 20 MW) industrial waste heat power projects. Effective use of this resource has the potential of saving millions of tons of fossil fuels and avoiding large amounts of CO_2 emissions. The prospective industries need the public's support in this endeavor. Enlightened public policy towards energy conservation will encourage industry to adapt and successfully implement energy saving projects within their backyards.

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CASE STUDY NO. 1

ORMAT's WASTE HEAT RECOVERY POWER PLANT AT A CEMENT PLANT IN LENGFURT, GERMANY

On 23 July 1999, at the Lengfurt plant of Heidelberger Zement AG, east of Würtzburg, Bavaria, an Organic Rankine Cycle-facility (ORC) waste heat recovery power plant began operation.

The ORC facility at Lengfurt is the ***world's first to be installed at a cement plant***. Heidelberger Zement built the pilot project. Thirty percent of the project's cost was provided as a ***grant*** from the German Federal Ministry for Environment and the Bavarian State, in recognition of the ***innovative technology*** and ***environmental acceptability*** of the facility. The Heidelberger Technology Center was responsible for the implementation of the project.

In total, the facility generates approximately 1.3 MW. After deduction of the facility's internal power demand about 1.1 MW is supplied to the plant's electric power network, thus providing a significant percentage of the plant's electric power consumption.

The ORC facility's principle of operation is fairly simple. Significant amounts of low to moderate temperature waste heat is generated during the cement clinker manufacturing process. The heat emitted during the cooling of the clinker is captured and then converted into electric power.

ORMAT's power generation module accommodates the hourly temperature fluctuations in the clinker cooler air flow, without any effect on the operation of the cement plant itself. Operating fully automatically and remotely monitored via a modem, ORMAT's power generation equipment is expected to displace approximately 45,000 tons of fuel over its expected lifetime, and so avoids the emission of some 120,000 tons of CO_2.

Summary of Operating Experience During the First TwoYears

With the completion of the first two years of plant operation the following significant features evidencing the system's success are noted:

1. The implementation of the ORC facility (which has proved to be an effective operating system in the renewable / geothermal market) into the cement manufacturing process was justified, and proved to be extremely successful.

2. On line availability, similar to that of geothermal power plants of above 98%, was achieved.

3. Empirical data have shown that the system was still performing well at off- design conditions, in fact capable of generating approximately 17% more power than defined under the design point operating conditions.

4. Operation and maintenance costs have proven to be negligible. The required spares (used ~$3000) and the rate of motive fluid loss (0%) have been proven to be far below the expected values. No additional staff was needed or hired for operation of the system

5. The user friendliness and simplicity of system operation have been proven to be of great value to the host plant operators and maintenance staff, as the ORC does not interfere with their tasks for clinker and cement production. The capability of remote monitoring of the ORC performance by ORMAT engineers proved to be a powerful tool aimed to optimize the operation of the system.

6. Savings of electrical energy have been determined as follows:

Total electricity demand for clinker production	4.2 MW
On site generation by the ORC (average)	1.1 MW
Savings	26%

7. Savings of CO_2 7,200 t/y

KING RIVER POWER DEVELOPMENT IN AUSTRALIA

Submission for the IHA BLUE PLANET AWARD

HYDRO TASMANIA

Executive Summary

Hydro Tasmania submits the King River Power Development on the rugged west coast of Tasmania as a candidate for the Blue Planet Award. This scheme is submitted as a good example of excellence in hydro-electric power development, and in many ways provides a guide for the overall development and sustainable operation of other hydro-electric power schemes. The King River Power Development is considered a worthy candidate for the Blue Planet Award for predominantly environmental and economic development reasons, and it has complimentary technical innovations of significant merit.

The King River Power Development, with an installed capacity of 143 MW, contains the following classic elements of a hydro scheme: 2 dams, one 83 m high; a large diameter 7 km long headrace tunnel; a single machine, remotely controlled power station; 50 km of 220 kV transmission line and some 36 km of road works. The lake created by the scheme has been developed to support both recreation and fishing and is of benefit to the whole west coast community of Tasmania.

This hydro power development was born in controversial circumstances, after a more ambitious development that would have produced competitively priced energy was prevented from being constructed in 1982 due to environmental sensitivities. The substitute King Power Development incorporated environmental lessons learned from this recent experience.

Notable environmental measures were implemented during construction, for example, those relating to water quality, timber salvage and land rehabilitation. These were the catalysts for development of a formalised environmental management system that underpins the maintenance of a sustainable environment for both hydro schemes and their associated catchments. A major benefit of this scheme was its contribution to the recognition of the need for the development of an expert environmental management team to support Hydro Tasmania's operations. The activities of the environmental team have grown to the point where the operation of hydro schemes within Tasmania can be considered as an exemplar of environmental best practice within the industry.

The scheme is significant in the future business direction of Hydro Tasmania. It will play a very important role when Tasmania joins the Australian National Electricity Market in 2003 and Hydro Tasmania exports peak power across the Basslink undersea cable. In addition, because it has a large water storage with a single large turbine, it enhances Hydro Tasmania's ability to store wind energy from its planned large wind farm developments.

A notable feature, which Hydro Tasmania considers to be of technical merit, is the Crotty concrete-faced rockfill dam that incorporates an articulated chute spillway on the downstream face. This innovation was a world first and continues Hydro Tasmania's pioneering developments in concrete-faced rockfill dams.

The hydro scheme was designed and built by Hydro Tasmania's own workforce and constructed between 1983 and 1993. It features benefits accruing not only to Hydro Tasmania, adding to its renewable energy portfolio which stands at approximately 60% of Australia's total, but also to the wider community.

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The King River Power Development on the west coast of Tasmania, Australia is an ideal candidate for the Blue Planet Award sponsored by the International Hydropower Association. The award seeks to recognise a hydro-power scheme which exhibits outstanding examples of environmental, technical, social and economic considerations. The scheme put forward is a good example of excellence in a hydro-electric power development, and in many ways provides a guide for the overall development and sustainable operation of other hydro-electric power schemes.

1. THE ORGANISATION

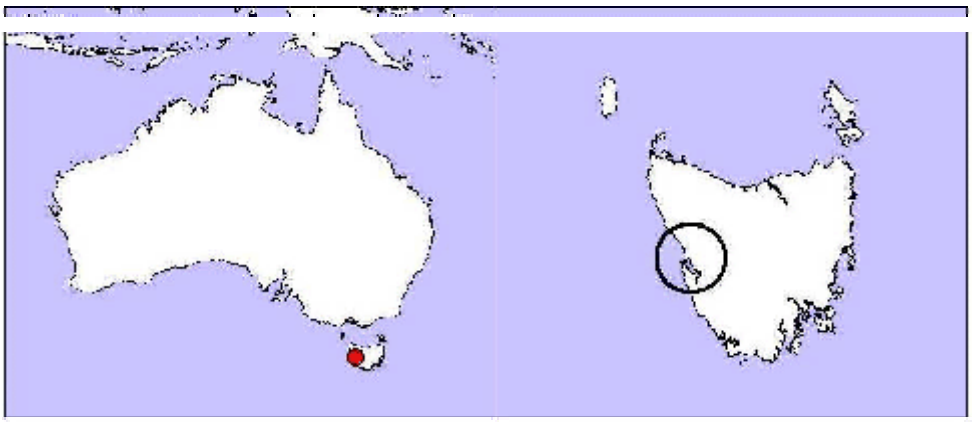
This proposal for the International Hydropower Association's Blue Planet Award is put forward by Hydro Tasmania. Hydro Tasmania (previously the Hydro-Electric Commission) is the organisation, which had the responsibility for planning and execution of this scheme, and is now responsible for its operation and maintenance. Hydro Tasmania is a government-owned generation authority that produces all of the electricity for the state of Tasmania. For nearly 100 years, Hydro Tasmania has been building dams and harvesting rivers and streams for power generation in Australia's island state. Hydro Tasmania's generating system, in its present configuration, is an integrated statewide network of 54 significant dams and 27 hydro-electric power stations, with an installed capacity of approximately 2,260 MW.

Hydro Tasmania's vision is to be a world leader in the renewable energy business.

On a global scale, Tasmania produces more electrical energy per head of population than anywhere else in the world with the exception of Norway. 99% of Tasmania's electricity generation is from clean, self-renewing water. Hydro Tasmania generates approximately 60% of Australia's renewable power generation, and the business has a key goal to increase that share through the development of wind energy projects.

2. THE SCHEME

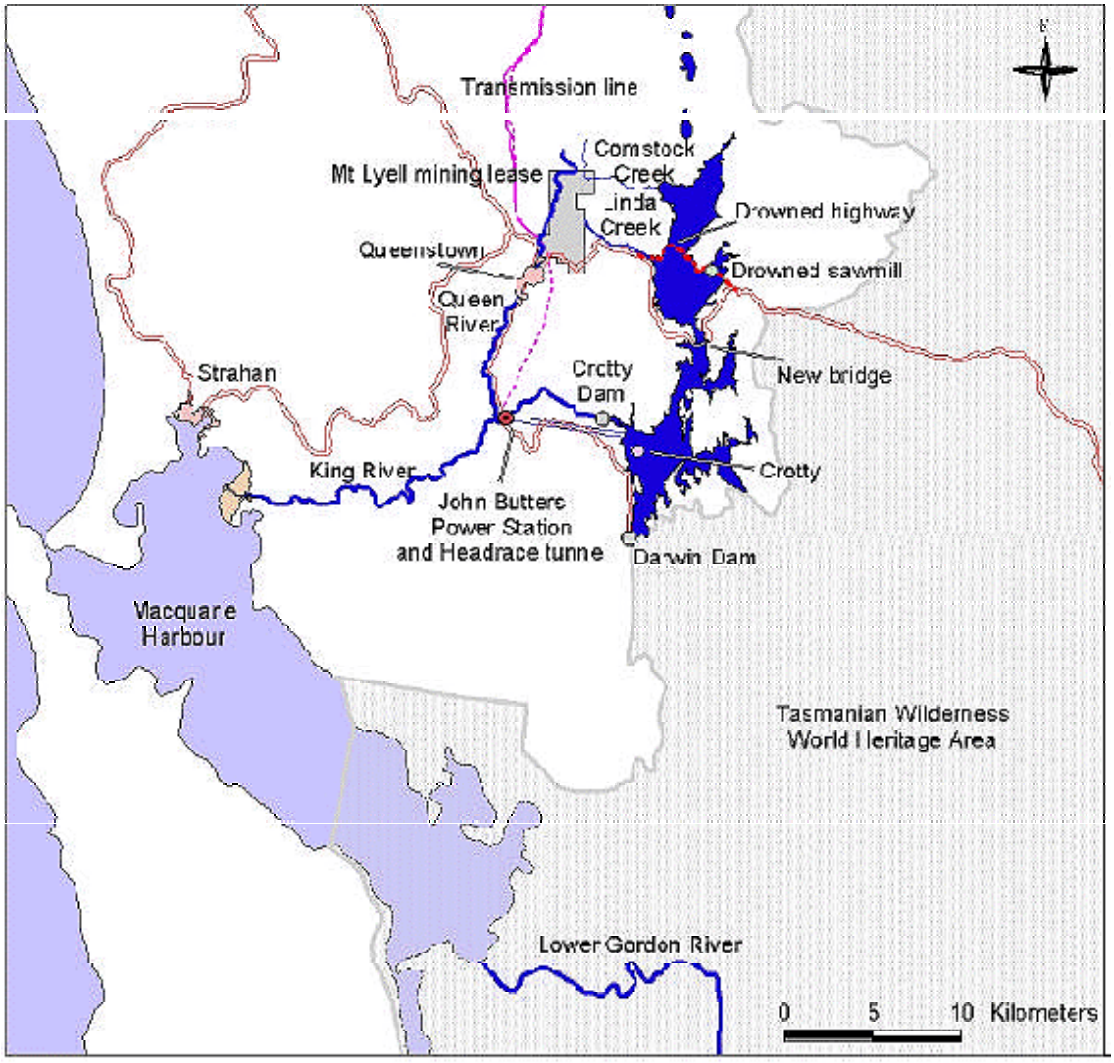
The scheme proposed for this award is the King River Power Development in the south-west of Tasmania, shown on Map 1.



Map 1. Location of King River Power Development in Australia, and the state of Tasmania

The King River Power Development has the following components, shown on Map 2:

- Two dams – the 83 m high Crotty Dam, and the 20 m high Darwin Dam (a saddle dam), whichtogether create the 53 km^2 Lake Burbury;
- A 7 km long headrace and 7.2 m diameter power tunnel;
- The John Butters Power Station, containing a single 143 MW machine which is controlled remotely from Hobart;
- A 50 km long 220 kV transmission line, connecting the John Butters Power Station to the State grid;
- A 12 km deviation of the Lyell Highway which includes a major bridge over Lake Burbury; and
- The Mt Jukes Road, a 24 km main access road crossing the West Coast Range from Queenstown.



Map 2. The King River Power Development and associated environs.

Construction commenced in 1983 and was completed in 1993. Hydro Tasmania's staff and workforce carried out most of the investigation, design and construction, while contracts were let for the mechanical and electrical equipment.

The King River Power Development is considered a worthy candidate for the Blue Planet Prize for predominantly environmental and economic development reasons, and it has complimentary technical innovations of significant merit:

- it is located in a catchment containing massive environmental issues, which created some unique environmental challenges at all stages of the development; these were very successfully met;

- a major benefit of this scheme was its contribution to the recognition of the need for the development of an expertly resourced environmental management team. The activities of Hydro Tasmania's aquatic environmental team have grown to the point where the operation of hydro schemes within Tasmania can be considered as an exemplar of environmental best practice within the industry;

- it was constructed in a climate of intense public disquiet about the environmental effects of Tasmania's future power schemes. The project was widely accepted by the community as a suitable alternative development to the 'Lower Gordon' scheme that was dramatically halted by Commonwealth Government intervention;

- the scheme plays a significant role in the future business direction of Hydro Tasmania:
  - because it is a large water storage with a single large turbine, it enhances Hydro Tasmania's ability to store wind energy from planned large wind farm developments;
  - it will play a very important role when Tasmania joins the Australian National Electricity Market in 2003 and Hydro Tasmania exports peak power across the Basslink undersea cable;

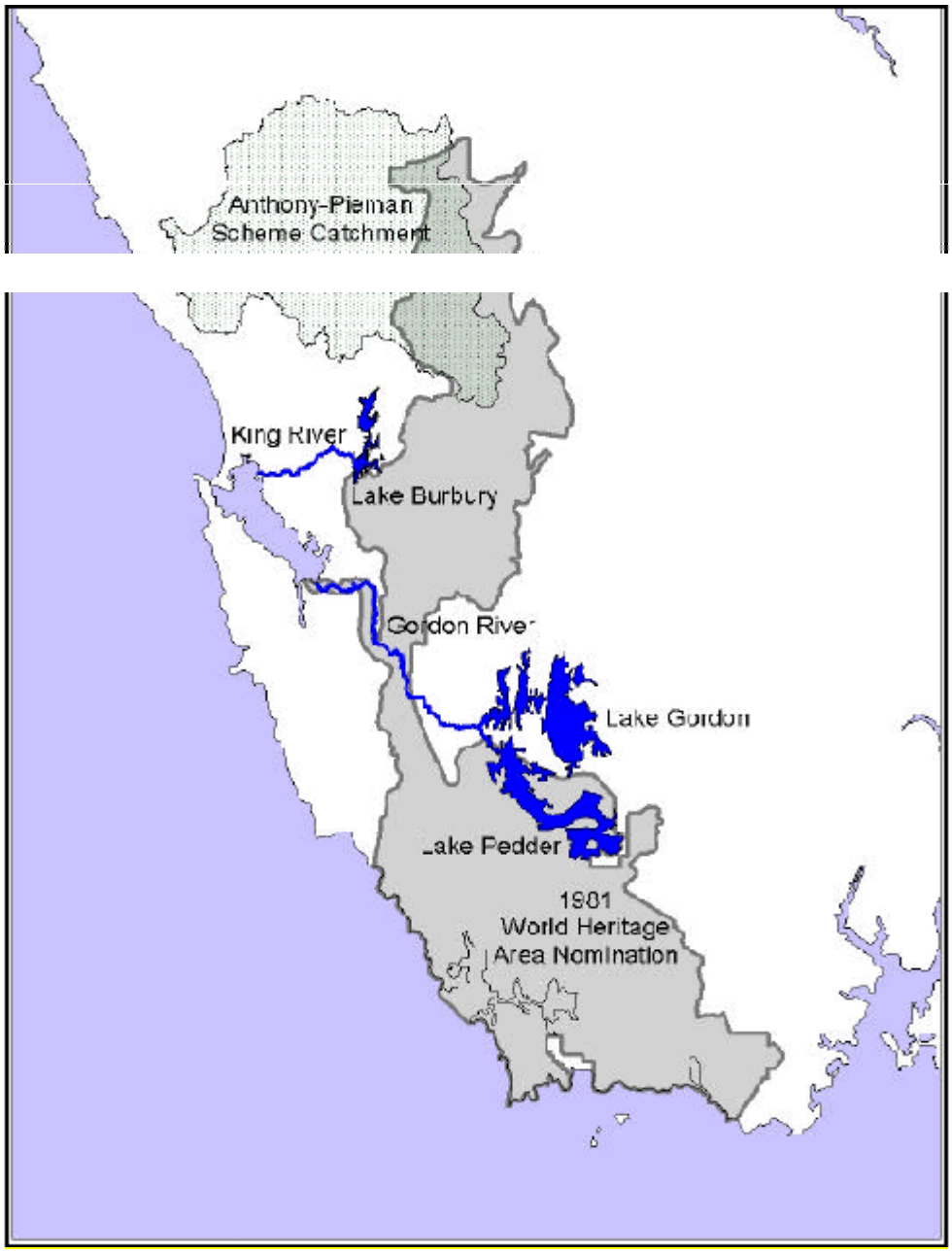
- it anticipated by two decades many of the International Energy Agency's guidelines for Hydropower and the Environment outlined in its report of October 2000 (2nd edition);

- it has many features of technical excellence, notably with respect to the dam which, contrary to traditional practice, has an articulated chute spillway located on the downstream face of the rockfill embankment. This is a world first for a high rockfill dam. This choice significantly lowered the cost of construction and eliminated any scarring to the adjacent environment.

This submission presents first some political context to development of the King River Power Development. It then describes the notable aspects of the scheme's investigation stage and development of an Environmental Management Plan, construction features, considerations at the commissioning stage, social benefits, business contribution, operational considerations, and aspects of the scheme's ongoing environmental management. Aspects of the scheme consistent with the guidelines for Hydropower and the Environment outlined by the International Energy Agency in its report of October 2000 are clearly identified.

3. POLITICAL CONTEXT

The King River Power Development was constructed in a climate of intense public disquiet about the environmental effects of Tasmania's future power schemes. This disquiet arose from events relating to the Gordon River Power Development Stage 2 in Tasmania's south west (see Map 3).



Map 3. King River and Lake Burbury (King River Power Scheme) in relation to Lake Gordon and Lake Pedder (Gordon River Power Scheme, Stage 1); the Pieman/Anthony Scheme and the Tasmanian Wilderness World Heritage Area (1981 WHA nomination).

Opposition to hydro schemes in Tasmania began in 1967 with the flooding of Lake Pedder, as part of Stage 1 of the Gordon River Power Development. The emerging conservation movement ran a strong "Save Lake Pedder" campaign with a high national profile. This anti-dam campaign sparked major public unrest at both state and national levels, and was the catalyst for the formation of the Tasmanian Wilderness Society and The Greens, groups which grew to become major community and political influences. Following an official inquiry into the flooding of Lake Pedder, the Commonwealth Government ratified the World Heritage Convention in 1974, thus giving it extra powers over State governments.

Flooding of the Lower Gordon River was proposed in 1981, as part of Stage 2 of the Gordon River Power Development (the “Lower Gordon scheme”). This proposal was strongly opposed by the Tasmanian Wilderness Society and green groups from around Australia. Significantly, in 1982, the then South West National Park, Franklin-Lower Gordon Wild Rivers National Park and the Cradle Mountain – Lake St. Clair National Park were designated as the ‘Tasmanian Wilderness World Heritage Area’ (see Map 3 – 1981 World Heritage Area Nomination). The Lower Gordon power development proposal would have led to inundation of parts of this area, including significant Huon pine habitat and caves containing Aboriginal artefacts.

Demonstrations continued after Stage 2 of the Gordon River Power Development received State parliamentary approval. When the national Labor Party came to power in 1983, it used the external powers under the World Heritage Convention to override the State Government, and construction of the Lower Gordon power scheme was permanently halted.

Hydro Tasmania had carefully planned the development of hydro-power in Tasmania to meet the rising demand for electrical energy. This planning was thrown into disarray by the blocking of the Lower Gordon development, and the future ability of the State to meet the demand for electricity was thrown into doubt. Up to 1000 jobs were put in jeopardy in a region, which offered little alternative employment for the skilled workforce.

After swift but careful consideration, two smaller hydro schemes were proposed that were both outside the Tasmanian Wilderness World Heritage Area - the "King" and the "Anthony". Together these schemes would have an average annual output of 120 MW, somewhat less than the 180 MW planned for the Lower Gordon scheme. The King and Anthony schemes were also less economic than the Lower Gordon scheme. The Commonwealth Government agreed to fund part of the capital cost so that the unit price of power from the two alternative schemes would be the same as that forecast for the Lower Gordon scheme.

These events set the stage for the King River Power Development. Both Tasmanian houses of parliament gave their approval promptly, as did the wider Tasmanian community, and Hydro Tasmania embarked on the engineering investigation, design and construction activities concurrently instead of in the normal planned sequence. While there was no legal requirement for Hydro Tasmania to produce an environmental management plan, the decision to do so reflected a business recognition of the need to demonstrate more socially and environmentally responsible development.

4. INVESTIGATION AND ENVIRONMENTAL MANAGEMENT PLAN

The King River Power Development presented some very unique site investigation and design challenges, primarily arising from a suite of environmental issues associated with a large copper mine which had been operating in the catchment over the past 100 years.

The Mount Lyell Copper Mine in Queenstown (see Map 2), at the time of site investigations, still continued to practice direct discharge of its tailings (fine-grained waste sediments) directly into the Queen River. Substantial accumulations of tailings and smelter slag could be found stored in the bed, banks and delta of the lower King River. Additionally, considerable sulphidic rock is found exposed to air and rainfall on the mining lease. Heavy metals associated with this sulphidic rock, notably copper, aluminium and zinc, are liberated due to the creation of acid drainage and are present in high concentrations in the run-off from the lease site.

At the time the Lower Gordon scheme was halted, significant studies had already been carried out on the King River catchment as part of Hydro Tasmania’s considerations into alternative power development options. These studies were released for public scrutiny in 1980, and included:

- identification of the main heavy metal pollution sources arising from the historical and ongoing mining activities in the catchment;
- estimates of the amounts of heavy metals that would enter a proposed storage;
- modelling of the heavy metals within a proposed storage;
- the status of the biota in the river systems and assessment of the effect of heavy metals on the biota; and
- proposed methods of reducing pollution off the lease site to acceptable levels.

Based on these studies, the dam and power station are located upstream of the Queen River tributary that delivers tailings to the lower King River, but acid drainage off the lease site into the proposed storage would occur. Diversion works were undertaken on the lease site to address this occurrence, and are described in Section 6.

Although in 1983 Hydro Tasmania was not required to prepare environmental impact statements, the business voluntarily prepared an Environmental Management Plan for the construction of the King scheme. This was the first hydro-power scheme built in Australia to have a formal Environmental Management Plan, and this plan influenced the design and construction activities for the development. An Environmental Committee was formed for the construction period to ensure that unnecessary impacts were avoided and unavoidable ones were minimised and treated.

The power scheme is located very close to the Tasmanian Wilderness World Heritage Area. In recognition of this, great care was taken to minimise visual damage to the landscape. Measures in the Environmental Management Plan to minimise visual impact included:

- siting temporary access tracks, camps, works areas and quarries for rockfill below minimum water levels so they would not be visible after commissioning;

- placing excess road spoil and material from other engineering works below minimum water levels;

- locating permanent roads and structures as unobtrusively as possible including:

  - reducing the size of roadside excavations (batters);
  - more closely spacing horizontal steps in the batters to allow greater coverage by vegetation;
  - having a single lane road (rather than two lanes); and
  - lowering the design speed of the road;

- stockpiling of peat and topsoil removed in the constructio n process for reuse during restoration and revegetation of road cuttings, spoil dumps and disturbed areas;

- using native species for revegetation;

- developing hydro-mulching strategies effective in the local environment for the revegetation of rocky or steep areas;

- salvaging timber from the storage area before commissioning to avoid unsightly dead trees and hazards for boats using the lake; and

- using materials for and siting the transmission line to make it as visually unobtrusive as possible.

Further environmental issues addressed in the Environmental Management Plan included:

- designation of special “no-go” areas;
- strategies to limit waterway siltation and erosion;
- considerations for drainage and the disposal of effluent;
- guidelines for drilling and blasting;
- the removal of litter and rubbish; and
- fire management.

Parts of the King River Valley, now inundated by Lake Burbury, have a rich history associated with the North Mt Lyell Mining Company, which built a railway from Macquarie Harbour to the mine via a village and copper smelter at Crotty (see Map 2). The village had a population of 900 in 1900, but virtually disappeared overnight when the smelter failed to produce any metal, and was uninhabited at the time of dam construction and subsequent inundation. Relics of that era have been recorded in an archaeological study commissioned by Hydro Tasmania.

A considerable effort was devoted to the sensitive issue of studying the potential impact of the inundation of the King River valley on Aboriginal heritage. Expert external archaeological resources of natural repute were engaged to investigate and report on this potential impact, with findings carefully and exhaustively chronicled. The investigations proceeded with the involvement of representatives of the Aboriginal community. The findings of these comprehensive studies were provided to the Aboriginal community and the authorities with legislative authority to approve or prevent the inundation of the valley. As a result of this, the permit to inundate the valley was issued without delay.

The following technical features of the dam and associated infrastructure were chosen to lessen their impact on the environment or as cost-saving strategies.

- The dam’s chute spillway is located on the downstream face of the embankment. This choice eliminated any scarring on the adjacent environment.
- Long headrace tunnels are normally excavated from the downstream end on a gradually rising grade so that water inflows can drain away. In contrast the King headrace tunnel was excavated from upstream resulting in a tunnel intake that is permanently submerged with the highest point in the tunnel near its downstream end.
- Where the headrace tunnel becomes the power tunnel and descends to the power station, a vertical surge shaft would normally be provided. The cost of a surge shaft was avoided by constructing a tunnel rising to the surface at road grade from this point. Surges take place in the access tunnel, which also meets the need for road access when inspection or maintenance is required.

5. TECHNICAL ASPECTS OF THE SCHEME

Hydro Tasmania has won a number of Engineering Excellence Awards from the Australian Institute of Engineers for technical excellence in relation to the King River Power Scheme.

Dams

Located at the head of the King River gorge the main dam, Crotty Dam is 83 m high. It is a concrete-faced gravel and rockfill embankment. The fill is local river gravels from the King River floodplain upstream of the dam. Their use avoided the need for quarrying and thus reduced costs and visual impacts, but required special techniques to avoid saturation in a high rainfall area.

The spillway consists of a 3.6 m diameter bottom outlet in the diversion tunnel and, contrary to traditional practice for rockfill dam design, a chute spillway is located on the downstream face of the embankment. This choice significantly lowered the cost of construction and eliminated any scarring to the adjacent environment. The reinforced concrete chute is designed to accommodate settlement of the embankment and ensure safe operation. Hydro Tasmania was emboldened to proceed with this world's first innovative step because of its 20 year history of building and monitoring very successful concrete-faced rockfilled dams.

Darwin Dam is a gravel dam located on a saddle between the King and Andrew Rivers. The foundations were found to be very complex, with several geological faults and some karstic limestone, all hidden below a thick mantle of gravel. Defensive measures have been taken against the possible development of sinkholes in the storage.

Hydro Tasmania has a world class dam safety program focussed on ensuring that the dams perform in a manner that does not place the community or assets at risk. Ongoing programs of surveillance, performance analysis and emergency preparedness assure safety.

Tunnels

Normally, long headrace tunnels are excavated from the downstream end on a gradually rising grade so that water inflows can drain away. In contrast the King headrace tunnel was excavated from upstream for both technical and environmental reasons. The result is that the tunnel intake is permanently submerged and the highest point in the tunnel is near its downstream end.

Where the headrace tunnel becomes the power tunnel and descends to the power station, a vertical surge shaft would normally be provided. The cost of a surge shaft was avoided by constructing a tunnel rising to the surface at road grade from this point. Surges take place in the access tunnel, which also meets the need for road access when inspection or maintenance is required. The geology of the liner was complex, with numerous faults and folds in the predominantly metamorphic rocks. The tunnel was permanently supported using dowels, avoiding concrete lining, which resulted in substantial savings.

Power Station

The power station is of circular slip formed construction. It is located at the downstream end of the narrow King River gorge and is tucked into a left bank excavation clear of any flows, which might deposit gravels in the tailrace. With an effective head of 184 m on the turbine, the rated output is 143 MW for a flow of about 85 m^3/s. The station is designed for unmanned operation and is controlled remotely from the System Control Centre in Hobart. Signals reach the station via a passive reflector on an adjacent hill. Oil bunding was custom designed and built into the transformer yard, which ensures that any spills will be captured and contained.

Transmission Line

A single line 220 kV line connects the power station to the state grid at the Farrell Switchyard 50 km away. Community consultation and careful planning ensured that throughout its length the line was sited to make it as visually unobtrusive as possible. The use of naturally brown (Austen) steel towers, non–reflective conductors and brown insulators helps to make the line generally unobtrusive across various terrains.

Roads

Well-researched route selection and careful revegetation maximised the scenic vistas of the area to take full advantage of its tourism potential and virtually nullified visual impacts on the environment. The Mt Jukes Road provides access from Queenstown to all parts of the scheme. In crossing the rugged West Coast Range, it presents visitors with views of the mountains, Lake Burbury and the World Heritage Area.

- On the Mt Jukes Road, parking areas were constructed at vantage points so that the vistas could be enjoyed and photographed clear of passing traffic. Both this road and the Lyell Highway command splendid views of the lake and the surrounding mountains.

- A rain forest interpretation site on the Mt Jukes Road explains the forest ecology and names the main species.

- The Lyell Highway Deviation was built to State Highway standards. This new section contrasted so much with the adjoining section that the Tasmanian Government Department for Mains Roads decided to upgrade several kilometres on the eastern side. Thus the motoring public and local workforce received a double bonus.

- After consultation with the Queenstown Council, a new picnic area was built near Lake Burbury to replace one inundated by the lake.

- Timber was salvaged from Mt Jukes Road in conjunction with the Tasmanian Forestry

- Commission.

Highway Deviation

As Lake Burbury would inundate part of the original Lyell Highway linking Hobart with the West Coast, 12 km of new highway was constructed, together with a seven span bridge across a narrow point of the lake.

6. ENVIRONMENTAL MEASURES DURING CONSTRUCTION

In addition to measures already identified, some particularly notable environmental measures were implemented at the construction stage of this scheme, relating to water quality diversion works, timber salvage, and land rehabilitation.

Water Quality Diversion Works

Water quality in the new lake was a concern due to acid drainage and heavy metal runoff from old mine workings and spoil dumps in the catchment. High copper concentrations in particular were identified as having potential to interfere with the development of a recreational trout fishery in the lake.

Following intensive studies into the relative contributions of the various sources of pollutant in the catchment, remediation works were designed and implemented to reduce a significant

amount of the copper flux entering the new storage. The work involved passive diversion of some flows to the already heavily polluted Queen River, and the sealing and revegetation of old tailings dumps to reduce leaching by rain water. The Queen River joins the King River downstream of the power station (see Map 2).

Timber Salvage
48,900 m 3 of timber was salvaged from Mt Jukes Road and the storage area in conjunction with the Tasmanian Forestry Commission.

The storage area was cleared from full supply level to two metres below the minimum operating level, to avoid unsightly dead trees and remove water hazards for boats using the lake. By maximising timber salvage, Hydro Tasmania generated favourable publicity, created jobs, provided the state government with revenue and minimised the areas that remained for storage clearing.

Land Rehabilitation
Immense effort was directed towards ensuring that the scheme should be as invisible as possible. Many environmental management plans were drawn up and adhered to from design through to construction and commissioning. Measures included stockpiling of peat and topsoil generated during construction for later re-use, use of native species for revegetation, and developing and utilising hydro-mulching for rocky and steep sites.

7. COMMISSIONING

The most important considerations in commissioning of the King River Power Development were environmental. These were, in particular, concerns with:

- heavy metals and water quality associated with the filling of the storage, Lake Burbury;
- rescuing of stranded animals during lake filling; and
- oxygen levels in the power station discharges.

Water Quality in Lake Burbury
Hydro Tasmania, working with the Inland Fisheries Commission Biological Consultancy (IFCBC), began a Lake Burbury water quality monitoring program with the commencement of filling of the lake in August 1991. The program was implemented in response to concerns about heavy metal contamination via polluted Linda and Comstock Creeks, which drained into the new storage, and as a means to monitor the effectiveness of ameliorative measures such as diversion works which had been put in place.

The main objectives of the program included:

- monitoring the development of the physico-chemical environment of the new storage, including changes associated with thermal stratification and decay of flooded vegetation;
- assessing the spatial and temporal distribution of metal contamination in the water and sediments of Lake Burbury;
- assessing the affect of any contamination on the productivity of the lake;

- monitoring the fish populations and development of the trout fishery in the lake; and

- assessing the effect of releases from the lake on water quality in the King River and Macquarie Harbour.

The monitoring program included ongoing water, soil and sediment sampling; lake productivity measurements; and investigations into aspects of the fishery such as heavy metal levels in trout, distribution of fish in the lake, growth rates, physiological condition and reproductive success of the fish.

By 1996 ongoing monitoring had established there were no major problems with either copper toxicity or the development of the Lake Burbury fishery. Testing by the Tasmanian IFCBC found that even though mean soluble copper concentrations were 2-3 times higher than recommended ANZECC levels, the toxicological response in fish was much less than predicted. This was attributed to the presence of high levels of naturally occurring dissolved organic matter in the water (creating the 'tea' colour associated with river systems on Tasmania's west coast). Dissolved organic matter binds with copper, rendering it biologically unavailable, and so protects organisms from any toxic effect of this heavy metal. Based on these results, the remediation works described earlier were found to be adequate for the protection of a recreational fishery in Lake Burbury. Lake Burbury presently supports a successful recreational trout fishery, and Hydro Tasmania now conducts its own copper surveys on a routine basis to ensure these conditions do not deteriorate.

Animal Rescue Program

As the lake filled, Hydro Tasmania implemented an animal rescue program. For this program, the business created a fauna recovery team that removed stranded animals from islands. The rescued animals were relocated to suitable habitats in the surrounding area, thereby ensuring minimum casualties amongst the native species.

Oxygen Levels in the Power Station Discharges

Soon after commissioning of the power station in 1992, water containing very low levels of oxygen accompanied by hydrogen sulphide was noted in the tailrace, a common problem in the early life of a reservoir. The low level of oxygen was caused by thermal stratification in the reservoir. This resulted in the release of cold, de-oxygenated bottom water into the King River. After investigation and consideration of ameliorative measures, water discharged downstream from the power station was aerated by operation of a jet pump installed on the turbine. This is now utilised to increase dissolved oxygen concentrations at appropriate times. Ongoing and continuous monitoring of the water quality leaving the tailrace ensures adequate notice of low dissolved oxygen levels, and timely utilisation of the air injection facilities in the turbines.

8. SOCIAL BENEFITS

During design and construction, significant community consultation took place with interested stakeholders including the people of Queenstown, those seeking access to the proposed lake, the local councils, the Mount Lyell mine, recreational fishermen interested in the potential for a trout fishery in Lake Burbury, and aquaculture interests in Macquarie Harbour.

The power scheme provided a very welcome boost to local employment opportunities during construction, as the copper mining industry was winding down. With Queenstown so close to the scheme, Hydro Tasmania made increasing use of local labour and contractors.

The building of a new transmission line also provided the opportunity to upgrade the power supply to Queenstown and to prepare for the future line from Anthony Power Station. When construction of the King scheme was completed, the local workforce was utilised to build the nearby Anthony Power scheme.

A number of public amenities were built into the scheme, including picnic areas, boat ramps, and public viewing points.

The power scheme has provided some additional tourism opportunities for existing and potential businesses in Queenstown. Comprehensive and early revegetation of disturbed areas has enabled many areas to recover by the time tourist visits began.

The intended future of the lake as a major recreational trout fishery was a consideration guiding numerous design and construction activities affecting the lake. The local community has greatly appreciated Hydro Tasmania's efforts to establish a recreational fishery in the lake by the diversion works to reduce the inflow of heavy metals. Several construction roads have been converted into convenient boat ramps for public use, and the clearing of timber from the lake has made it safer for boating.

9. BUSINESS CONTRIBUTION

The King River Power Development cost A$463 million (January 1993 dollars) and the assessed long term average energy output is 67 MW.

Since commissioning in 1993, the scheme has operated satisfactorily and has incurred no abnormal costs. Annual power production has averaged 97% of the original project estimate due to the average rainfall being about 4% below the long-term average. This output represents about 6% of the annual power generated in Tasmania.

The scheme plays an important role in the integrated generating system operated by Hydro Tasmania, primarily as a supplier of step load or frequency demand. The power station can be operated to vary its generation within a particular range to meet the fluctuations of the daily load curve not met by other stations, and so discharge out of the power station tends to be variable over very short periods. This scheme, therefore, provides considerable flexibility in the operation of the system and contributes to system stability, hence making the overall Hydro Tasmania generating system more economic.

Role in National Electricity Market

Hydro Tasmania plans to enter the National Electricity Market in 2003 when the Basslink undersea cable is completed. The 270 km HVDC Basslink cable will enable up to 600 MW to be exported into the well established Australian wholesale electricity market. John Butters Power Station, on the King River Power Development, will be a key player in this peak power export. There are significant financial incentives for Hydro Tasmania to join to the National Electricity Market, namely in maximising the value for water in the Hydro Tasmania generating system, and providing a market for expansion of renewable energy development in Tasmania.

Wind Energy Development

Significant potential for additional renewable energy development in Tasmania is brought by the winds of the Roaring Forties, the prevailing westerly winds that circle the earth's southern latitudes. The wind resource is amongst the best in the world and is presently largely untapped. In the north-western corner of Tasmania, Hydro Tasmania is planning to develop what will be one of Australia's largest wind farms. Around 70 turbines will eventually be installed, giving a total generating capacity of 130 MW. The first 10.5 MW stage is scheduled for completion by May 2002.

The synergy between hydro power and wind power offers improved returns compared with stand alone wind developments. When the wind blows, energy can be stored in Hydro Tasmania's substantial water storages by curtailing hydro turbine operation, and when the wind is calm the fast response hydro plant can supply the market. This mechanism enables energy production to be shifted to the most valuable time of the day, thereby targeting premium priced peak demands. The King River Power Development is an ideal example of a scheme that will contribute strongly to an integrated hydro and wind operation.

10. OPERATING CONSIDERATIONS

Hydro Tasmania has put considerable effort into understanding the interactions of power station operations with downstream water quality and tailings transport, particularly in light of the growing aquaculture industry in the receiving waters, Macquarie Harbour.

Downstream of the power station the King River carries the heavily polluted inflows from the Queen River tributary, on which the Mount Lyell Copper Mine lease is located. For 78 years the Mt Lyell copper mine directly discharged its tailings into the Queen River at Queenstown. Most of the tailings have been washed down to Macquarie Harbour via the Queen and King Rivers to form a large delta, but a considerable storage still remains in the bed and banks of the lower King River. Discharge of tailings in the river ceased in December 1994 when a tailings dam was built. Power station operations affect the transport and deposition of tailings and the metal-laden acid drainage arising from lease site run-off.

Hydro Tasmania was a major contributor to a large-scale environmental investigation program in the lower King River and Macquarie Harbour between 1992 and 1995. The King River-Macquarie Harbour Environmental Study was a collaborative study of the Tasmanian Department of Environment and Land Management, the Mount Lyell Copper Mine, and Hydro Tasmania. It involved extensive water quality surveys, sponsorship of a Ph.D. study into storage and transport of the mine tailings, and hydro-dynamic and water quality monitoring in Macquarie Harbour.

Arising from these investigations was the essential understanding of how power station operating patterns influence patterns of pollutant transport to the downstream environment. An important consideration is the highly successful aquaculture industry in Macquarie Harbour, producing Ocean (rainbow) Trout and Atlantic Salmon. 'Worst case' conditions for the fish farms are well understood and can be avoided by strategic operations of the station.

11. SUSTAINABLE ENVIRONMENTAL MANAGEMENT

Hydro Tasmania takes its environmental responsibilities very seriously. It was the first government business enterprise in Tasmania to introduce a statement of environmental policy in 1992, and has continued its commitment to promoting best practice environmental management of its operations. For example, in 1994, a formalised Environmental Management System (EMS) was put in place, and the Aquatic Program was developed in 1998 to enable sustainable management of water resources. This program has already delivered a number of changes to Hydro Tasmania's water management practices, and anticipated the requirements of Tasmania's new *Water Management Act 2000* and associated water license by two years.

Environmental Management System ISO 14001

Since introducing its statement of environmental responsibility in 1992, Hydro Tasmania has continued its commitment to promoting best practice environmental management as part of its operations.

In 1995 Hydro Tasmania put in place a formalised Environmental Management System. The EMS has been independently certified by Bureau Veritas Quality International (BVQI) to the international standard ISO 14001 during 1998, and re-certified in 2001. Continued satisfactory performance has been monitored by six-monthly surveillance audits by BVQI. Regular internal reviews and audits ensure conformance to the standard is maintained and environmental performance subject to continual improvement.

The ISO 14001 standard provides a framework for the systematic approach to the evaluation of how our business activities, products and services interact with the environment.

Aquatic Environment Program

Hydro Tasmania manages an extensive network of modified lakes, rivers, streams and canals, flowing through a diverse range of landforms and land use zones, each of which have unique aquatic issues. Hydro Tasmania recognises that water is central to its business and that for its business to be sustainable, the aquatic environment must contain healthy ecosystems.

Hydro Tasmania has developed a comprehensive Aquatic Environment Program. This program utilises skills in environmental assessment and management in conjunction with other areas of expertise within the organisation, including survey/GIS, hydrology and engineering, to provide balanced, well-considered solutions that incorporate community needs and expectations. This comprehensive program, involving over A$1,000,000 annually, incorporates a major commitment to research, consultative programs and works programs.

The Aquatic Environment Program includes:

- an aquatic environment policy;
- reviews of a range of aquatic environment issues in catchments that affect Hydro Tasmania's water storages;
- strategies, priorities and long term programs for issues such as threatened species and fish migration,
- a broad based multi-disciplinary water monitoring program of Hydro Tasmania - impacted lakes and rivers involving physico-chemical, biological and physical habitat monitoring;

- setting up of and active involvement in catchment management studies and water management plans; and

- increased liaison with the community, university research and other government and research agencies.

Hydro Tasmania has demonstrated its commitments to sustainable waterway management by such means as:

- minimum environmental flow releases;

- constraints on management of water levels in lakes;

- construction of barriers to exotic fish migration and ladders for native fish passage;

- modifications to water transfer infrastructure to improve water quality and consequently threatened species habitat; and

- commitments to ongoing environmental investigations and monitoring.

One of the most pro-active aspects of the Hydro Tasmania Aquatic Environmental Program is the Water Management Reviews. Hydro Tasmania is progressively undertaking reviews of its current water management practices in all its catchments with the aim to develop sustainable water management strategies. The process involves gathering background information, consulting the community and stakeholders to identify important issues, researching solutions to these important issues, and developing Hydro Tasmania water management plans. These plans can contribute to water management plans being established by the state Department of Primary Industry, Water and Environment for all waterways in Tasmania.

EAGIS

The Environmental Assessment Geographical Information System (EAGIS) was developed by Hydro Tasmania's Environmental Services department as a tool to support environmental impact assessments, by allowing rapid access to the information required to produce these documents. The GIS application draws together data from government and community organisations that is related to environmental factors such as land tenure and land use planning, geology, vegetation, aquatic environments, threatened species distribution, cultural heritage, community projects and threatening processes such as weeds, disease and fire. EAGIS allows the highly user-friendly presentation of this data through the production of cartographic quality maps for ready visualisation of environmental issues associated with new developments.

12. INTERNATIONAL ENERGY AGENCY GUIDELINES FOR HYDROPOWER AND THE ENVIRONMENT

This section shows, with the benefit of hindsight, how the King River Power Development relates to the guidelines for Hydropower and the Environment issued by the International Energy Agency in the second edition of their technical report dated October 2000.

1. Energy Policy Framework

At the time of the King River Scheme's development the policy was to develop the most competitive energy source available. In Tasmania that was hydro-power. When the King River Power Development was put forward as an alternative to the Gordon River Power

Development Stage 2 in 1983, the only other cost effective alternative to provide power for Tasmania at the time was a coal fired power station.

Subsequently, due to changed economic and political factors such as renewable energy credits, wind power and the Basslink undersea cable have become much more cost-effective than they were in 1983. The Australian Government is currently providing a major boost to renewable energy as a key part of its overall strategy for reducing Australia's greenhouse gas emissions. The Government passed the *Renewable Energy (Electricity) Act 2000* which requires the generation of 9,500 gigawatt hours of extra renewable electricity per year by 2010.

By building the King Scheme the government of the day anticipated by 20 years the push for increasing renewable energy sources and moving away from power sources that produced greenhouse gases.

2. Decision-making Process

The broad outline of the political background to the development of the King River Scheme is given in Section 3 of this document. In summary, Hydro Tasmania was required to put a proposal to the Tasmanian Parliament. The initial scheme put forward was that of the Gordon River Power Development – Stage 2. This was stopped by the National Government of the day and Hydro Tasmania put forward the less controversial King River Scheme, which gained the approval of both Houses of the Tasmanian Government as well as that of the wider Tasmanian community.

At the time, there was no regulatory requirement to have an environmental assessment in place for such developments. However, studies had been conducted on the catchment and there was an awareness of the potential problems that may occur due to high levels of heavy metals (see Supporting Documentation – 12. – reference list of reports and publications).

Decision-making is now carried out in a more formalised framework. Hydro Tasmania has striven to develop and maintain a credible and efficient environmental management culture as demonstrated by development of an EMS, certification to ISO 14001 and a well resourced Environmental Services department. This has been effected before any legislative necessity to do so. The catalyst for this was the development of the King River scheme which was the first hydro-power scheme built in Australia to have a formal Environmental Management Plan.

3. Comparison of Hydropower Project Alternatives

All reasonable alternatives to further hydro power development were presented and assessed in the Report to Parliament on the Gordon River Power Development Stage 2 proposal. The main alternative of thermal power generation using coal was not seen as environmentally friendly or economical and other alternatives such as wind power and an undersea cable were too costly (see also newspaper clippings from 1983 in Supplementary Documentation). When the Gordon River Power Development Stage 2 scheme was stopped through Commonwealth Government intervention, an acceptable alternative was presented at short notice. Two non-controversial hydro schemes were proposed and approved as appropriate to meet future energy demand.

Visual amenity was of high priority given the proximity of the World Heritage Area and this was taken into account from the design stage and the Environmental Management Plan was strenuously adhered to throughout the project.

With the introduction of wind energy in Tasmania, the King River Power Development will be able to realise additional benefits. Electricity generated by wind turbines will reduce the

load on the hydro power system, so that effectively some wind energy can be stored in Hydro Tasmania's long-term water storages which include Lake Burbury.

4. Improving Environmental Management of Hydropower Plants

The King River Power Development was the first hydro-power scheme in Australia to have an Environmental Management Plan influencing planning and construction. Along with the Environmental Committee formed for its implementation, it ensured that unnecessary impacts were avoided and unavoidable ones were minimised and treated. The Plan dealt with minimisation of visual impacts, reduction of heavy metal inflows from historical use of the catchment, significant revegetation and rehabilitation of areas disturbed by construction activities, and a reservoir logging program for improved visual amenity and safer recreational boat use.

With the filling of Lake Burbury, there were concerns about heavy metal contamination from sources in the catchment. A water quality monitoring program for the lake was implemented to address these concerns and to monitor the effectiveness of ameliorative measures implemented during the construction phase. This program included ongoing water, soil and sediment sampling; lake productivity measurements; and investigations into aspects of the fishery such as heavy metal levels in trout, fish distribution within the lake, growth rates, physiological condition and reproductive success of the fish. After five years it was established that there were no sig nificant problems with copper toxicity or the development of the Lake Burbury fishery. Lake Burbury presently supports a successful recreational trout fishery, and Hydro Tasmania now conducts copper surveys on a routine basis to ensure these conditions do not deteriorate.

When water quality problems downstream of the John Butters Power Station became apparent after commissioning, Hydro Tasmania investigated appropriate mitigation measures and implemented a mitigation strategy (air injection). This is now utilised at appropriate times. Continuous water quality monitoring is now conducted to detect water quality problems so that timely ameliorative measures can be implemented.

From experience gained during the King River Power Development, Hydro Tasmania has gone on to develop organisation-wide policies and strategies for environmental management of its activities. These are continually being revised, updated and improved. Hydro Tasmania's environmental policy is in the public domain; its environmental management system is certified to ISO 14001 and externally audited twice a year. Hydro Tasmania now has a well-resourced Environmental Services department, which is integrally involved in the environmental management of Hydro Tasmania’s assets and developments.

Hydro Tasmania is licensed under the *Water Management Act 200*0, which requires regular aquatic monitoring and reporting. The Aquatic Environment Program within Environmental Services achieves this through a comprehensive monitoring program of the waterways managed by Hydro Tasmania. Importantly, this program also allows strategic and pro-active investigation of issues such as fish migration and environmental flow allocation. The Water Management Review process is also co-ordinated by the aquatic program. It allows not only immediate stakeholders but also the wider community to have input into development of sustainable water management plans, and enables the community to highlight areas of concern that may require further investigation. The Aquatic Environment Program has received a ministerial award for environmental excellence (see Supplementary Documentation).

Hydro Tasmania is determined to meet or exceed its legal, environmental and social responsibilities, and has a track record of doing so. It is moving towards triple bottom line

reporting to demonstrate the sustainability of its operations socially, environmentally and financially. To demonstrate its commitment to clear and transparent reporting of its activities and interaction with the environment, Hydro Tasmania's Environmental Report for the year 2000 was independently verified by external sources (see Supplementary Documentation - Hydro Tasmania's 2000 Environmental Report, p11).

The environmental credentials of Hydro Tasmania have been recognised by the wider Tasmanian community. An independent survey performed by the Farley Consulting Group in June 1999 of Tasmanian residents rated the environmental performance of Hydro Tasmania highly, giving it a score of 7.6 out of 10. This is a hig h score when compared to that received by other organisations and industries from similar surveys and is a reflection of the continuing aims of Hydro Tasmania.

5. Sharing Benefits with Local Communities

Benefits from the King River Power Development include the production of renewable energy and the absence of greenhouse emissions. Lake Burbury has had no impact on homes, farms or industry. Releases from the power station may affect jet boat operators and aquaculture farmers in Macquarie Harbour. Any future concerns will be handled through on-going studies, the water management review process and negotiations with stakeholders when required.

The creation of the lake, a recreational fishery and new roads from which to view the scenery has increased the tourist opportunities in the areas. No livelihoods were jeopardised by this project and substantial employment was provided during construction.

13. CONCLUSIONS

For the wealth of reasons presented in this submission, Hydro Tasmania proposes the King River Power Development as a worthy candidate for the Blue Planet Award sponsored by the International Hydropower Association. This submission seeks to demonstrate the excellent elements of this development, particularly the environmental and economic development aspects, and highlights the consistencies of the power scheme with recommendation number 4 (Improving Environmental Management of Hydropower Plants) put forward by the International Energy Agency in their report of October 2000.

SUPPORTING DOCUMENTATION

1. Policies:

- Hydro Tasmania's Environmental Policy
- Hydro Tasmania's Aquatic Environmental Policy

2. Hydro Tasmania's latest Environmental Report (2000)

3. Two publications about Hydro Tasmania's relationship with the environment written just after the King River Power Development was commissioned:

- A New Environment – Hydro Power and the Environment
- Hydro Electric Commission – a statement of environmental policy

4. Copy of 1998 BVQI Certificate of Approval for Environmental Standards ISO 14001 (Hydro Tasmania is currently awaiting receipt of certificate for 2001)

5. Letter, newspaper articles and photo of Hydro Tasmania receiving the 2000 Environment Minister's Government Business Enterprise and Infrastructure Award for Environmental Excellence for Hydro Tasmania's Aquatic Environment Program.

6. Newspaper article detailing Tasmanian 1999 Case Earth Award won by Hydro Tasmania for rehabilitation of village and construction sites.

7. Copies of certificates for Engineering Excellence Awards won for the King River Power Development:

- Winner, Engineering Excellence Awards 1993, King River Power Development, Resource Development Category
- Highly Commended, 1994 Engineering Excellence Awards, King River Power Development, Resource Development Category
- Highly Commended, 1993 Engineering Excellence Awards, Bradshaw Bridge, Public Works Category

8. Selection of time series photos illustrating rehabilitation and revegetation following construction of the King River Power Development

9. Two papers reporting on revegetation and rehabilitation by Hydro Tasmania on the west coast, including the King River Power Development:

- "Revegetation at two Power Developments on Tasmania's West Coast", by Michael Cooper
- "Soil conservation and rehabilitation measures used during the construction of Mt Jukes Road by the Hydro-Electric Commission, Tasmania", by B.D. Cartwright

10. A range of pamphlets and brochures detailing technical and environmental information about the King River Power Development:

- King River Power Development (pamphlet)
- King River Power Development (booklet)
- Bradshaw Bridge (pamphlet)
- Touring Guide to Hydro Tasmania's Power Developments – Anthony, Pieman, King

LIFE CYCLE ASSESSMENT FOR WIND TURBINES

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ABSTRACT: Tech-wise A/S has conducted a life cycle assessment of a 2 MW offshore wind turbine. A life cycle assessment (LCA), also known as a cradle to grave analysis, is an inventory of all environmental impact of a product, process or service within its complete lifecycle. An LCA includes a recovery of the resources used in the production through the utilisation to the dismantling and disposal of the product. As sample wind turbine a 2 MW offshore wind turbine placed at Horns Rev in the North Sea has been used, since this project is under development and Tech-wise A/S is the main consultant to this project. In this LCA assumptions have been made where there is information about certain materials. The assessment revealed - as expected - that the environmental impact is concentrated in the production and disposal phase. Mainly the use of normal and high-strength steel are contributors. This means that the main impact is found to come from the nacelle and the foundation.

Keywords: Environmental Aspects, Off-shore, Materials, Life Cycle Assessment, EDIP-method

The results of this LCA will be used to identify the most essential environmental impact in all life phases of a 2 MW offshore wind turbine. This project is the first step in an examination of the possible improvement of the environmental performance of that particular wind turbine and was finalised in spring 2001. The plan is to finalise the next project by the end of 2001.

1. METHOD

As basis for the LCA the Danish EDIP computer tool is used based on the EDIP method (EDIP stands for Environmental Design of Industrial Products. In Danish it is called UMIP). The development of the EDIP method has been supported by the Danish Environmental Protection Agency. Using that method it is ensured that the LCA follows ISO 14040.

The EDIP tool includes a comprehensive database covering materials, semi-manufactured components and working processes, but the aim is to identify processes and materials that need further description to achieve a more correct assessment. Data from the environmental management system of Vestas Wind Systems A/S and data from subcontractors are utilised for the LCA.

2. BACKGROUND

In 2000 Tech-wise A/S concluded an LCA project of the Danish heat and electricity production in 1997, which was conducted in collaboration with other partners from the energy sector. In that project the wind turbines where represented by an average 600 kW land-based wind turbine. The conclusions from that project were that wind turbines are amongst the most

[1] All correspondence

environmentally friendly power production techniques. The main impact from wind turbines was found in the production process of the wind turbines and not so much in the utilisation phase, as is the case for traditional coal and gas fired power plants. The results from that project are used as a basis for this LCA for a 2 MW offshore wind turbine.

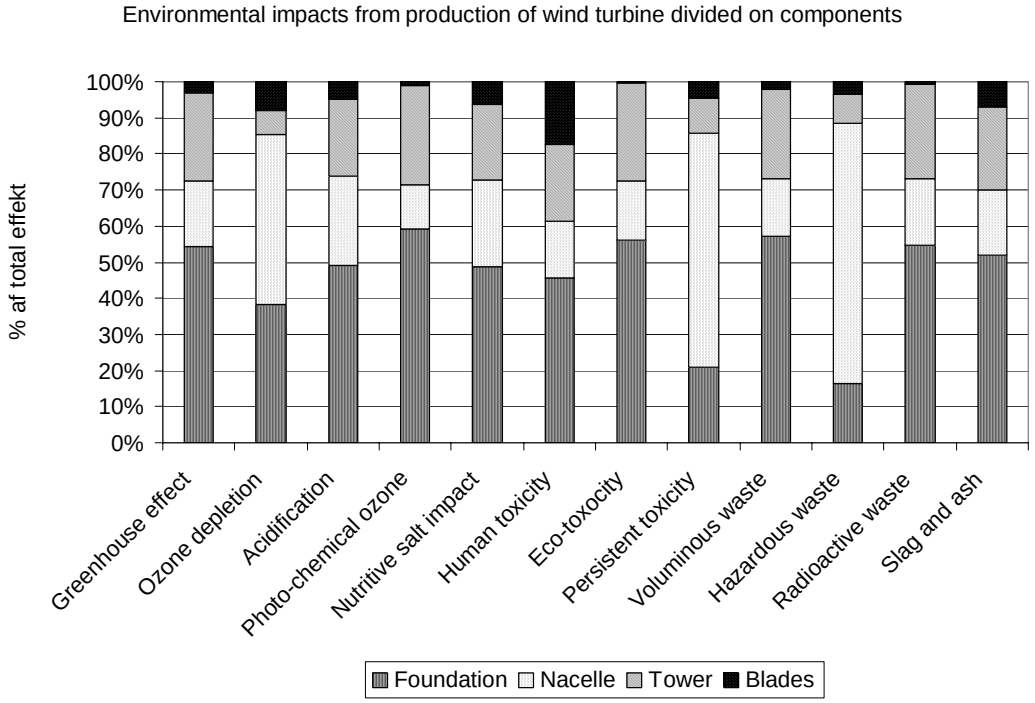

Figure 1

This LCA focuses on an offshore wind turbine and as a sample turbine for the assessment it has been chosen to apply a 2 MW wind turbine as the ones to be erected in the Horns Rev Offshore Wind Farm in the North Sea. This allowed the project group to use the data from the actual project at Horns Rev, e.g. the size of the foundation.

The innovation of this project is primarily the combination of an environmental management system with the LCA tool. An LCA has previously been conducted for wind turbines, but with this new procedure for data collection the assessment is expected to be more accurate and detailed.

2.1 Description of Horns Rev Wind Farm

The planned offshore wind farm at Horns Rev is used as example for the 2 MW offshore wind turbine model in this LCA. The wind farm will be established by Elsam A/S.

The Horns Rev wind farm will consist of 80 2 MW Vestas offshore wind turbines. All turbines will be 3-bladed rotors placed on a tubular tower. The foundation will be monopile. The farm will be located about 15 km off the coast of Blåvands Huk. The average water depth at the site is about 10-13 meter. The wind turbines will be connected to an offshore transformer from which the electricity is transmitted via a submarine cable to the land-based transmission grid.

3. ASSUMPTIONS AND BOUNDARIES

The foundations and wind turbine are included in this LCA, while the grid connection is disregarded. It means that this LCA only deals with the wind turbine itself, and does not include the distribution of the generated electricity.

Not all materials are included, as this is unrealistic to achieve. The goal has been to include a certain amount of the materials, as follows:

- 80% of the weight of all materials for the nacelle
- 95% of the weight of all materials for the tower
- 90% of the weight of all materials for the blades
- 90% of the weight of all materials for the foundations

In this study the nacelle is taken to comprise the generator, gear, transformer, control electronics, cables etc.

The above-mentioned goals have been reached. But for some materials/products the information has been inadequate, and here the information has been estimated from identical products.

The LCA is based on the following main assumptions:

- A production of 8 GWh/wind turbine per year.
- A wind turbine lifetime of 20 years.
- No replacement of main components during the lifetime.

4. DATA QUALITY

Data on the production of the tower, nacelle and blades have been collected from Vestas Wind Systems A/S, who has collected a valuable infinite number of data through their environmental management system. Data for the materials have been collected from suppliers.

Data about the production of the foundations have mainly been based on in-house information, since Tech-wise A/S is main consultant to the Horns Rev Wind Farm.

Information about transport, assembly, erection, installation, maintenance and decommissioning of the wind turbine has partly been acquired in-house from Tech-wise A/S, from contractors and from Vestas Wind Systems A/S' service department.

The data are of varying quality, and the focus has been on the areas where the greatest environmental impact originate.

5. RESULTS

The main result of the LCA study is an improvement of the former LCA model for wind turbines. In an LCA the result is often presented as normalised environmental impact which is also the case here. A normalisation means that the contribution from 1 kWh of electricity is related to the average contribution from a normal citizen to the relevant environmental impact

during one year. The results are reported in the unit milli-person-equivalent (mPE). If e.g. the greenhouse effect from 1 kWh of wind turbine electricity is 0.15 mPE it corresponds to 0.15‰ of a normal citizen's contribution from consuming 1 kWh electricity. The environmental impact of 1 kWh electricity produced by a 2 MW offshore wind turbine is presented in Figure 1.

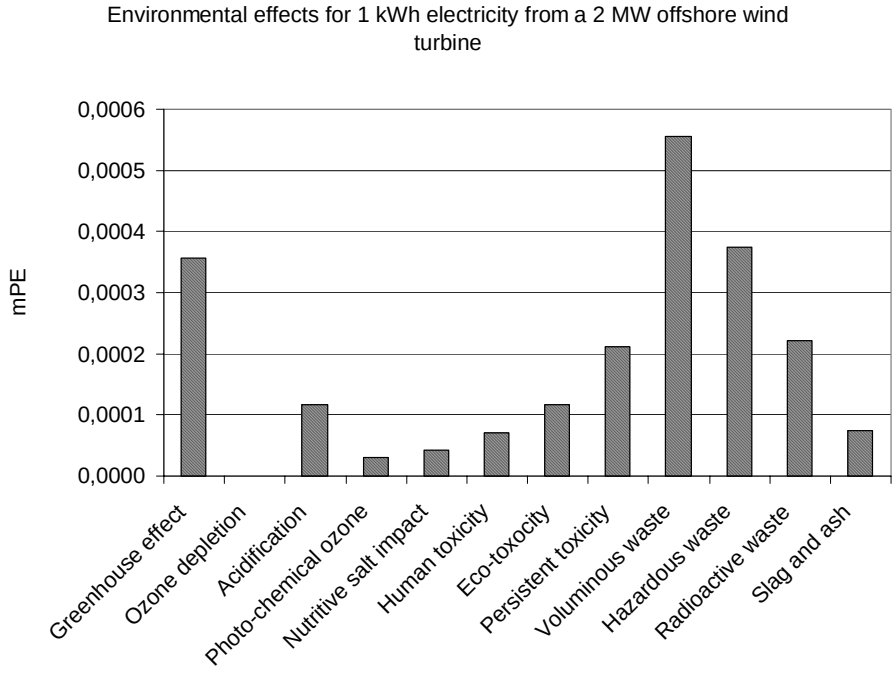

Figure 2

The environmental impact for the 2 MW offshore wind turbine mainly originates from the nacelle, the foundations and tower due to the use of high strength steel and normal steel. See Figure 2 for a breakdown of the environmental impact from the production of the wind turbine divided onto the main components.

Apart from the normalisation the result of the LCA can be an inventory of the consumed resources, as shown in Table 1. This inventory shows the main resources for 1 kWh electricity produced by a 2 MW offshore wind turbine. The dammed water is utilised for energy production at hydro power plants, and the 119 g of dammed water correspond to approximately 0.0002 kWh electricity.

To give an impression of the magnitude of the impact of 1 kWh from a 2 MW offshore wind turbine, this impact is compared to an average kWh of Danish electricity in 1997. See Figure 3.

The composition of the electricity produced in Denmark in 1997 is shown in Figure 4.

The comparison to the average Danish electricity in 1997 reveals that the wind generated electricity is much more clean than the average electricity.

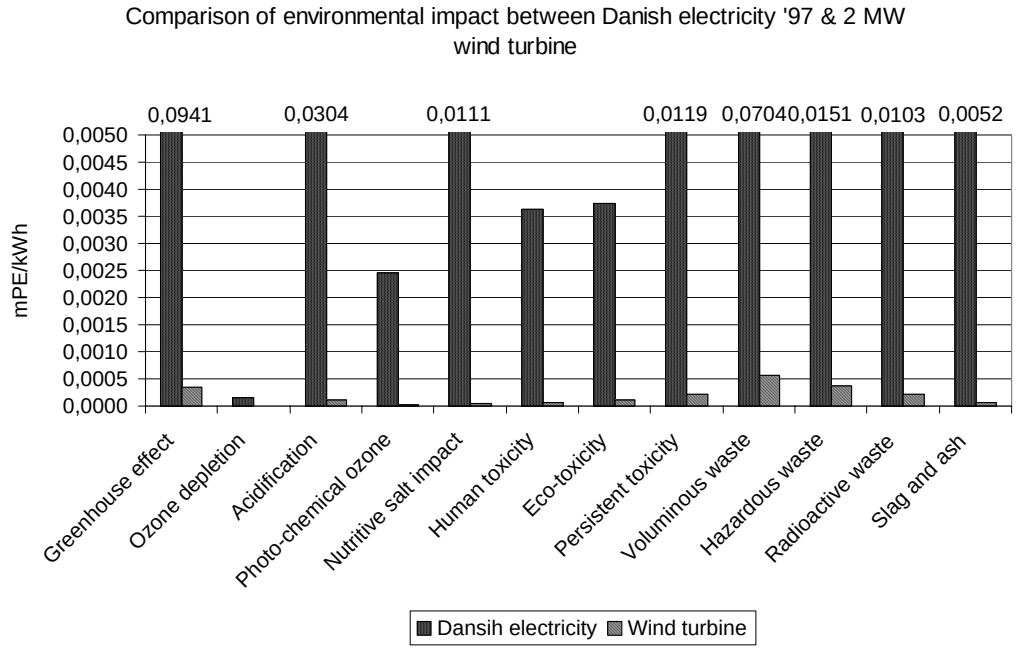

Figure 3

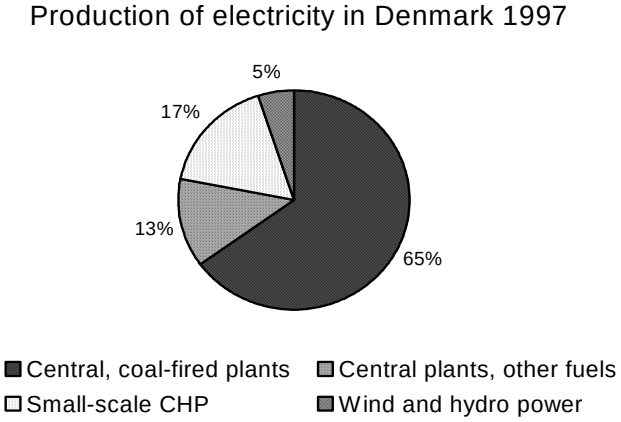

Figure 4

Table 1.

Resource	**Amount [g/kWh]**
Dammed water	119
Other water	23
Coal (pit)	0.77
Iron	0.40
Natural gas	0.27
Oil	0.18
Calciumcarbonate ($CaCO_3$)	0.11
Lignite	0.08
Petrol	0.04
Aluminium (Al)	0.01

6. CONCLUSION

One of the main conclusions of this LCA project is that the model for a wind turbine has been improved since the LCA for the Danish heat and electricity in 1997 was conducted. One of the main reasons for this improvement is the improved data available for this assessment.

A not very surprising conclusion is that the impact mainly originates from the production and disposal. It is found that the disposal scenario is very important to the environmental profile of the wind power.

The foundation/tower and the nacelle are found to give the greatest contributions to the most impact. The foundation and tower are the two heaviest components in a wind turbine and primarily made of steel. The nacelle contains quite a lot of high-strength steel which contributes considerably to the total impact from the wind turbine.

To continue this LCA work a new project is ongoing where the model will be even more refined and a comparison between a land-based and an offshore wind farm will be conducted. Furthermore the possibilities of using LCA results for environmental product optimisation and for Environmental Product Declarations will be investigated and tested.

The project reported in this paper has been conducted jointly by Tech-wise A/S and Vestas Wind Systems A/S and is supported by the PSO funds 1999.

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Livscyklusvurdering af dansk el og kraftvarme.
(Life Cycle Assessment of Danish Heat and Electricity)

Questionnaire regarding manufacturers and suppliers of equipment and the market for solar heating

Country: Poland

Filled out by:

Stanislaw Golebiowski, PhD,
Grzegorz Wisniewski
EC Baltic Renewable Energy Centre,
EC BREC/IBMER,
www.ibmer.waw.pl/ecbrec

Market

1. What is the estimated volume, in m^2 and USD, of the current market for solar heating equipment in your country?	av. 2000 sq. m in 2000 USD 720 000
2. What is the estimated growth rate of the current market for solar heating equipment?	10%
3. What is the most important market niche (for example heating of swimming pools, domestic hot water, hotel hot water, space heating, etc.)	Sanitary and domestic hot water, swimming pools
4. Does any of the manufacturers or suppliers have a well-known name that is closely associated with its solar heating products?	9 manufacturers, HEWALEX the biggest ONE (data below)
5. How is solar hetaing equipment generally offered to the end user: • From producer to end user?	Generally from producer to installer to end user. Very rarely directly to user

• From producer to retailer (e.g. suppliers of building materials) to end user? • From producer to installer (e.g. plumbers or suppliers of heating systems) to end user? • By the way of architects and/or consultants?	
6. Is the market dominated by domestic manufacturers or is imported equipment important? If possible, estimate this division in market shares.	Domestic manufacturers sell more products than importers because of the lower price The share of domestic is app. 80% of solar heaters market
7. What do you believe to be the main market barriers against increased introduction of solar heating ? (price, availability of equipment, performance of equipment, difficulties with building- and systems integration, little interest in spite of good performance, ...)	The main barrier is to high investment cost causing unprofitable IRR, PBT… factors in comparison with traditional heat sources. One of the solution for the several next year would be simple (easy to integrate) do it yourself solar heating systems. For prove technologies limited investment grants available for investors form ecological funds.
8. Which developments do you foresee that could lead to increased utilisation of solar heating in your country? (For example increased prices on fossil fuels, increased environmental awareness, government policy, drop in equipment unit costs etc.)	1. Continuous and even increase support from national local environmental funds. 2. Governmental policy affects on creation convenient legal regulations but mostly for green electricity and district heating. Temporarily reduction of VAT for solar equipment (now 22%), would be a real solution for the coming years to develop the market. 3. Training and promotion of RES by media.

Manufacturers and Suppliers:

1. Give the names of the three to five most important manufacturers or suppliers of solar heating equipment in your country.

Name: Hewalex Phone: +4832 2152979;2152987 Fax: e-mail:hewalex@hewalex.com.pl	Address: 43-512 Bestwinak ul. Witosa 14 a Poland
Name: Sunergy Phone:+4891 5610118 Fax: e-mail:	Address: Jeczydol 16 73-108 Kobylanka

Name:Aparel Phone: +4824 7223454; 7223472 Fax: e-mail: aparel@aparel.com.pl	Address: Topola Królewska 99-100 Leczyca Poland
Name: Emaru Phone: +4861 8628209; 8628237 Fax: e-mail:emarusolar@emarusolar.com.pl	Address: 60-301 Poznań ul. Jugosłowiańska 31 Poland
Name: Polska Ekologia Phone: +4822 7816342; 7625034 Fax: e-mail:poleko@home.pl	Address: 05-091 Ząbki ul. Lisa Kuli 6 Poland

2. If you can, please characterise these actors in terms of annual turn-over or sales, number of staff, growth rate, or other key figures.

Name:	Yearly sales: Number of staff: Growth rate: Subscribed capital: other:

3. Is solar heating equipment the core business of the most important suppliers, or is it only an "add-on" to other business, for example HVAC-services?

The solar heating systems is not so profitable business, so most manufacturers, installers, importers, plumbers deals his additional services with producing and installing traditional whole heating systems for buildings.

Other:

1. How many square metre of solar collector area is currently installed in your country? If possible, split on different applications.	About 15 th. sq. m of solar water systems About 6 th. sq. m of air solar systems, generally for drying Only same PV installations (eg. see lights)

2. Can you give some examples of "success stories" in the solar thermal business in your country?	In 1998 the Town Hospital in Gostynin installed 20 m^2 of solar colletors and is working in the bivalent system with heat pumps and electrical heaters. 1997 saw the installation of a 30 m^2 battery in the Cathedral Church in Przemysl. The battery is incorporated into the bivalent system with a heat pump and electrical heaters too. Another installation commissioned in 1997 is the solar system in a primary school in Duczki near Wołomin. The installation consists of two batteries: 16 m^2 and 24 m^2. At the beginning of 1998, a battery consisting of 70 m^2 of solar collectors was installed by a private investor near Poznań. Interestingly enough, all the collector panels have been adjusted to variable roof slopes. The purpose of the solar installation is to produce usable hot water, to heat water in the swimming pool and to aid central heating. In 2001 a big SHWs are under construction in the Redemptorist Convent in Tuchow (130 sq. m) and in minicipal sweeming pool in Tarnow (ca. 90 sq m.).
3. Has there been carried out an analysis of the potential for solar heating in your country. If so – when, and by who ?	The official document developed by the Ministry of Environment, adopted by Polish Council of Ministries (05.09.2000) and finally accepted by Polish Parliament (23.08.2001), entitled "National strategy of development of renewable energy in Poland" evaluates the realistic technical potential for solar energy app. 1340 PJ/year and set up a quantitative targets for heat production in solar collectors in 2010: 2,1 PJ/year for solar water type collectors and 0,2 PJ for solar air type collectors. All together 2,3 PJ in 2010 comparing to 0,02 PJ of app. current heat production. In 2000/2001 a study has been made by EC BREC (PL) and ESD (UK) with the use of SAFIRE model aiming at the development of RES scenarios for Poland. The results for solar collectors for 2010 are as follows: 337-641 MW installed capacity depending on the scenario (mostly environmental and energy policy assumption).

If you have any additional information and comments, please give them here.

REVIEW OF SOLID BIOFUELS

There are thousands of publications and articles describing the technical and market potentials of biomasses. Furthermore, there are plant specific stories, mainly success stories, telling the advantages of that particular plant.

When we think of the investments on the energy business, there are two decisive factors influencing on the commercial life cycle of the power plant: the price and the security of supply of the fuel. The technical lifetime of a typical heat or power plant is at least 20 years, preferably 25-30 years. It is not easy to negotiate a firm and fair fuel supply agreement, if the plant uses one fuel only.

Therefore in Finland, for instance, the heat and power plants are capable of using various fuels and their mixtures. In the Finnish case these fuels are wood and peat. Their mutual share varies depending on the outside temperature and the availability, not forgetting the price at the plant. This multi fuel concept seems to be the reasonable way to increase the share of biofuels.

Although peat is not officially classified as renewable biofuel, it is the essential fuel in order to increase the wood fuels, especially the green chips made from spruce dominated logging residues. The green chips contain alkalines, especially potassium, which causes corrodive deposits on the superheater tubes inside the boiler. Without going into details, this corrosion phenomenon can be avoided by using peat as an additional fuel mixed with green chips. Furthermore, with two fuels the plant has safer price stability and safer supply around the year.

The new boilers with fluidized bed combustion technique easily adapt variety of fuels. The old (dust) boilers can also burn biofuels, if the fuel meets the technical parameters of the boiler. These are usually the particle size and the moisture. There are good examples of the old coal power plants, which replace part of the coal with wood like sawdust or wood pellets. It is always cheaper to use and modify the existing capacity than to invest into a new capacity. This partly explains why the progress with the biofuels seems to be slow. The energy sector is rather conservative and therefore big jumps forwards cannot be expected. The bank and finance sector also trusts on the proven technology rather than unproven solutions and this may cause difficulties in financing new plants. This has led to the public subsidies of biomass derived fuels and their combustion plants.

I have compiled two tables where the current situation and the future trends in some European countries can be seen. These tables are based on research work conducted by the State Research Center of Finland, VTT. As we can see, the practice to promote biofuels varies country by country. The common denominator seems to be the investment aids and the promotion programs. The second table tries to sound the main development trends on those same countries including the European Union and some candidate countries. There is a large distribution of the trends and the main emphasis seems to be in the bioenergy market development. The table depicts the national interests and local conditions. It should be noted also that the bioenergy trade in Europe is approximately 1 Mtoe. This, of course, emphasizes the locality of the biofuels and their importance as a local supply source. Increasing the share of biofuels means the shift towards distributed energy systems as can also be seen at the table 2.

For your information I have attached two pictures. The first one shows the number of wood using heat and power plants in Finland. Their number is slightly over 140. It also gives information of so-called energy entrepreneurs or energy cooperatives, which have increased during the last 5 years from 10 up to 150. Those cooperatives are mainly private forest owners who make a contract with the local community to supply fuel wood to the community heating plant. The price of the wood fuel is bound to the price of the competitive fossil fuel, usually light or heavy fuel oil. The concept seems to work well when operating with heating plants ranging from 0,5 up to 15 MW. This picture also explains why I did not make the analysis on plant by plant basis.

The second picture is part of the work carried out at CEN Technical Committee 335, standardization of solid biofuels at the European level. The aim of the coming standard is to facilitate the trade of solid biofuels in the internal market. The picture shows the variety of wood and wood derived fuels currently found at the (Finnish) market. It also shows the need for the common terminology as well as the need for the classification and fuel specification.

The conclusion is that currently the biofuels are subsidized in most European countries. The forms of subsidies vary from investment aids to tax reliefs and everything in between. Ambitious promotion programs for biofuels have been established with more or less realistic targets. This development is likely to continue until the biofuels are competitive against the fossil fuels. Simultaneously, the efforts should be focused on the technical development as well because it gives the possibilities to a real price reduction and real competitiveness.

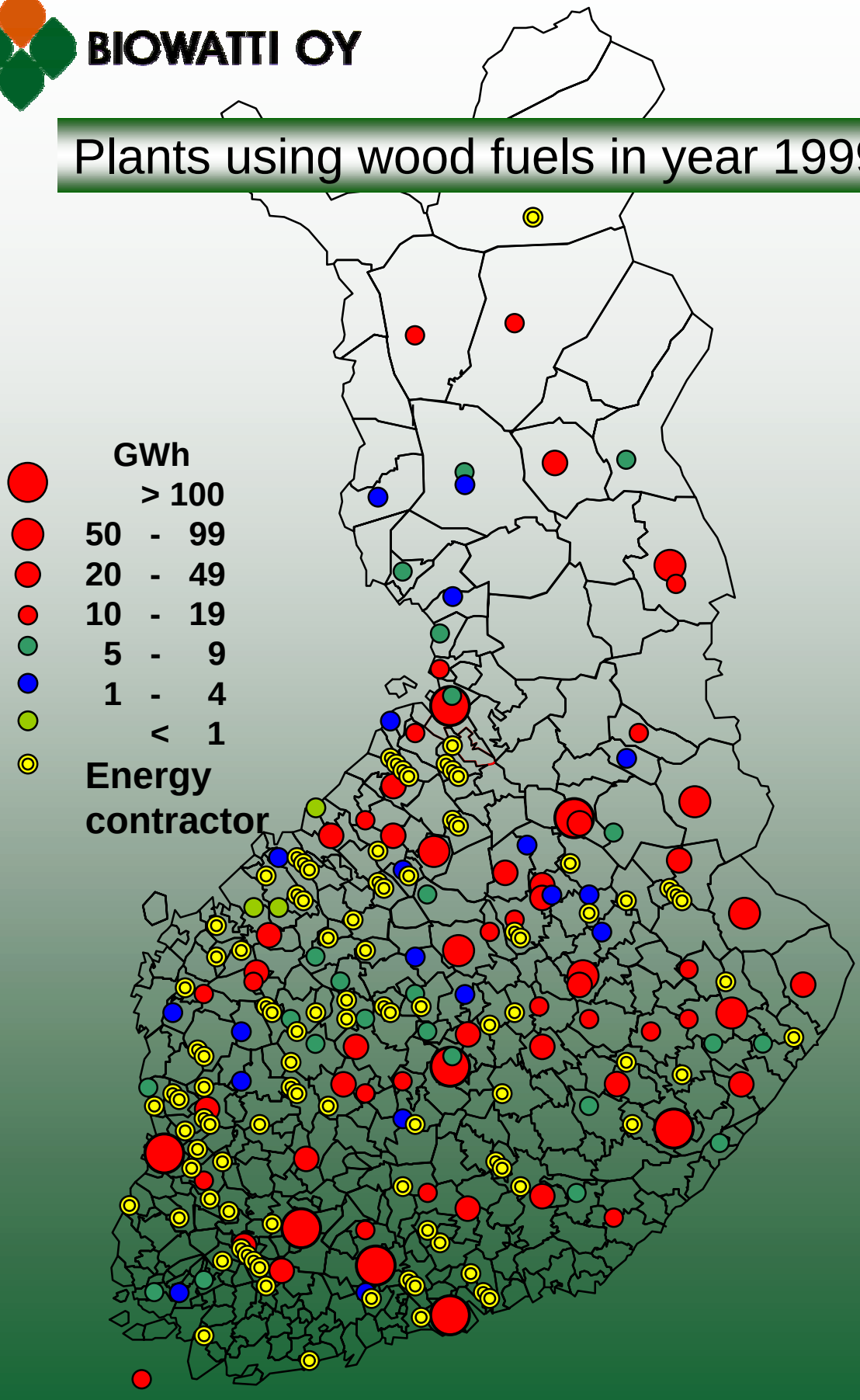
Together with the technical progress, the advantages (and disadvantages) of different biofuel mixes should be studied. As some examples show, proper mixing of local fuels may lead to an ideal solution both from technical and economical point of view.

References:

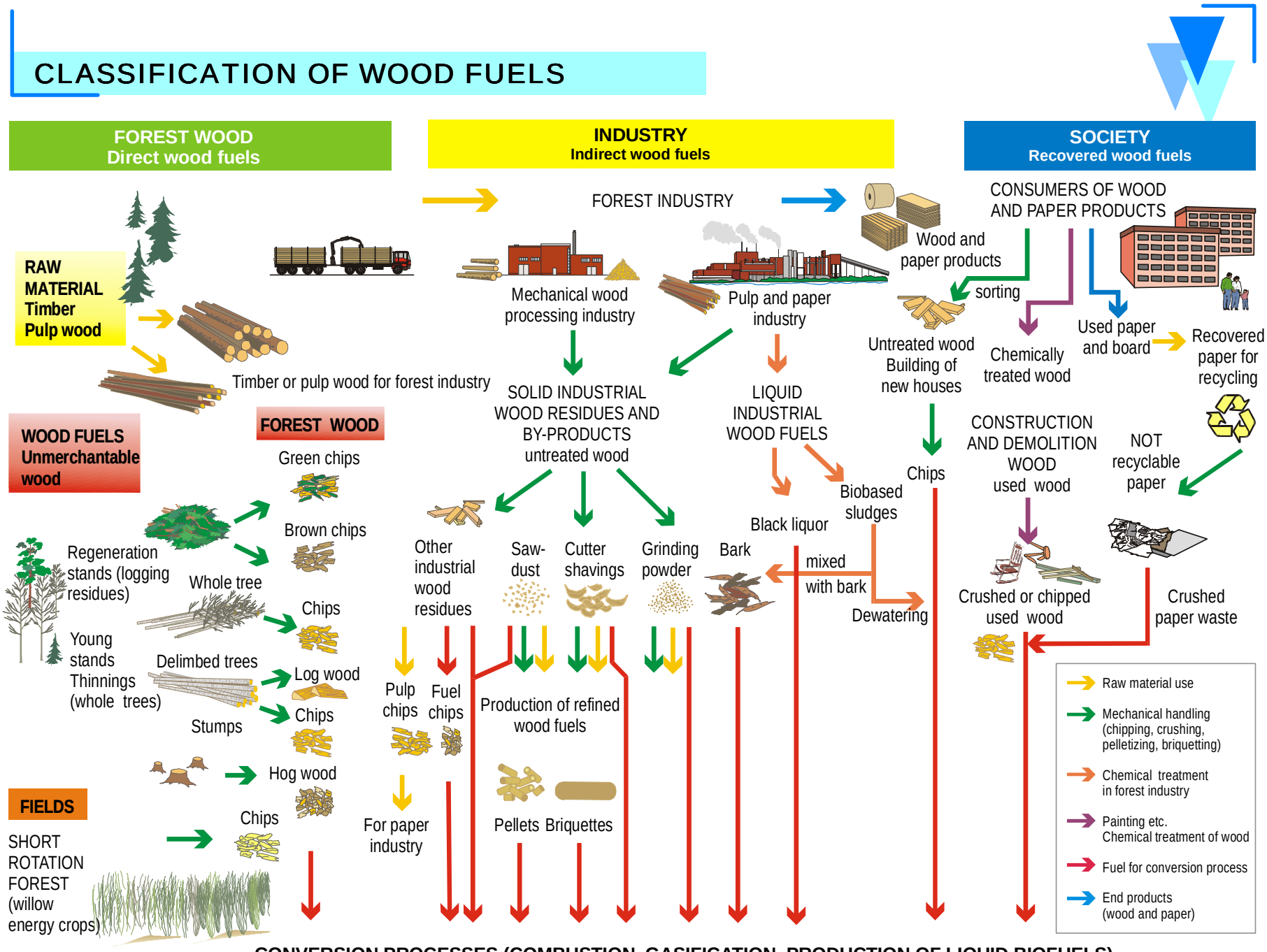
VTT Research Report, The status of the use, research and development of the wood energy in EU. (in Finnish). Author: Pirkko Vesterinen, Jyväskylä, October, 2001.

BIOWATTI OY

Plants using wood fuels in year 1999



CLASSIFICATION OF WOOD FUELS



CONVERSION PROCESSES (COMBUSTION, GASIFICATION, PRODUCTION OF LIQUID BIOFUELS)

VTT Energy E. Alakangas

Canadian Experience with Barriers to Development of Small and Micro Hydro Energy

Prepared by BC Hydro
with assistance of the Sheltair Group Resource Consultants

Introduction

In Canada, and the province of British Columbia (BC) in particular, micro and small hydroelectricity generators have been supplying power for many years. These facilities operate with small dams or other structures to divert water from smaller rivers, streams, and creeks to a generating station.

Hydroelectricity is currently one of the most important of the clean, economically feasible and renewable energy options. Hydro developments can avoid substantial volumes of greenhouse gases and other air emissions and thereby reduce energy production impacts on climate and air quality. Small or micro hydro facilities with limited or no water reservoirs often avoid the widespread biological effects large facilities can cause. Small-scale hydroelectric developments therefore have significant potential for contributing to our world's sustainable energy mix.

However, a number of barriers to small and micro-hydro development exist. This paper will identify some key barriers and provide examples of strategies aimed at overcoming them. For purposes of the paper, micro hydro developments are defined as those with a capacity of less than 2 MW, whereas small hydro facilities provide between 2 and 50 MW of power. They are similar in terms of impacts and operation, and for convenience we will refer to them together as "small-scale hydro". The paper draws mostly from experiences in British Columbia, Canada's most mountainous region, where a large number of small-scale hydro plants are installed and where the potential remains very large.

Context

The province of BC, on the west coast of Canada, is particularly well suited to small-scale hydro. The province experiences high levels of precipitation over mountainous terrain, resulting in an abundance of small rivers with high gradients that are suitable for hydro development.

There is a high level of environmental awareness of the general public, public agencies, and corporate energy sector in BC. Due to perceived or actual environmental impacts, the public tends to disfavour large hydroelectric facilities and thermal power projects. In contrast, the public perceives small-scale hydro as low impact projects that are more acceptable or even desirable.

The regulatory situation for electric power in BC is very complex. Multiple agencies from federal (i.e. national), provincial (i.e. state), and local jurisdictions are involved in the assessment, approval, and development process of micro- and small-hydro projects. The main electric utility, BC Hydro, generates, transmits, and sells electricity within a monopoly service area. It is owned by the government of the province and regulated by a utilities commission, a

provincial agency. The regulation of the energy sector is undergoing significant changes, as it has in other jurisdictions across North America and elsewhere in the world.

BC has a history of low cost and abundant hydroelectric power, mostly large-scale, comprising over 90% of its electrical generating capacity. The bulk of the remainder is provided by natural gas. A strong demand side management program (Power Smart) has been in place since 1989. However, with a growing population and economy in the province, there is a need to obtain new supplies. On the supply side, BC Hydro is seeking to meet 10% of these new electricity sources from 'green' projects. On the demand side, there is also a growing interest from individuals and organizations in purchasing green energy. Small-scale hydro is one of the renewable energy technologies (RETs)[1] most likely to provide a substantial share of this green energy target for new electrical generation.

Barriers to Micro- and Small-Hydro Development

No market exists without barriers to entry. Every entrepreneur wrestles to overcome barriers to his or her business model as an inherent part of the workings of competition. That's normal, and fair. But in some cases the barriers are created or made worse by the form of government policy shaping the market, and in other cases there is a public interest in bringing about a transformation (re-shaping) of the market. This paper attempts to distinguish and highlight such situations where they affect the development of small and micro hydro. They are the situations in which governments and industry players can take common action to improve the public good.

Each form of renewable energy faces its own set of barriers related to technology. The technology for small-scale hydro has been in commercial use for nearly a century, so new technology risks and barriers are almost non-existent. However, that does not mean small-scale hydro is free of technological limitations to its market position. Issues such as limited capacity and varying dependability (due to fluctuating water levels and blockages resulting from ice or floating debris) represent impediments, as they make it obligatory for end-users to have a backup energy source. But these limitations are normal competitive factors which do not require policy change or intervention.

The most significant barriers impeding the development of small-scale hydro are in fact shared with most other renewable technologies. Such barriers include a lack of coherent and comprehensive energy policies; poor economics in terms of high unit costs; high front-end capital requirements; lack of physical and institutional infrastructure; and insufficient public awareness.

In order to design a provincial-level program to stimulate RETs, the BC government recently surveyed a diverse range of stakeholders regarding opportunities and barriers[2]. Though their interests and experiences varied, a number of common themes emerged and important lessons were identified. The common barriers were summarized into three general categories:

- Information barriers;

[1] Renewable Energy Technologies (RETs) are defined as micro and small hydro, solar energy, wind energy, biogas recovery, wood residue combustion and other technologies that use hydrogen, compressed air or fuel cells to control, store and/or convert renewable energy.

[2] Sheltair Group Resource Consultants, 2001, for the BC Ministry of Employment and Investment

- Market and financing barriers; and
- Institutional and policy barriers.

Ultimately, all of the barriers affect RETs in one of two ways – either they prohibit the installation of a RET for a particular application, or they cause a reasonably economical RET application to become uneconomic.

Information barriers relate to the lack of information about RETs or the existence of confusing or incorrect information on their performance. Stakeholders affected by these barriers include independent power producers, energy consumers, utilities and retailers, permitting agencies, investors, and the civil service. Information barriers affect stakeholder decision-making in the marketplace by biasing decisions against the installation of economically or socially efficient RETs, such as micro- and small-scale hydro.

Market and financing barriers include access to the transmission grid and to the market in general, pricing, supply and demand characteristics, and obtaining project financing. In addition to obtaining an appropriate price for the sale of electricity, investors require long term pricing or other instruments to manage risk and uncertainty. Financial barriers also relate to taxation structures for energy suppliers, behaviour of investors, and issues surrounding market externalities such as environmental impacts. In addition, there is a gap between the demand for greener sources of electricity and the supply of companies and resources to meet this new need.

Institutional and policy barriers pertain to the market and regulatory structure, including energy regulations, utility culture, technical requirements, and procedures for connecting small-scale hydro installations to the electricity grid. Many of these barriers may exist because of an historical orientation of the electricity market toward large-scale centralized power supplies such as storage hydro or large natural gas projects. Thus, the policy and market structures (rules and standards) reflect that history and may disadvantage smaller-scale, distributed, RET supplies.

The three types of barriers often overlap and interact – for example, information barriers affect investor behaviour (a financing barrier). Similarly, transaction costs to connect the grid system will affect the financial performance of an investment.

These broad organizational categories were used to describe more specific barriers that apply to small-scale hydro projects in the three accompanying tables (Table 1 for Information Barriers; Table 2 for Market and Financing Barriers; and Table 3 for Institutional and Policy Barriers). The relevancy of the barriers for different stakeholders will change over different stages of project conception, assessment, approvals, and development. The barriers that are listed are primarily those faced by independent power producers. However, there are also barriers that are faced by consumers who want to purchase green power, yet are unable to access it.

Table 1: Information Barriers, Strategies, And Examples From BC To Micro-Hydro And Small Scale Hydro

BARRIERS AS SEEN BY RET PROPONENTS	STRATEGIES	EXAMPLES FROM BC AND CANADA
Lack of Understanding of the Energy Market, Energy Issues, and Benefits of Renewable Energy by Consumers • Many residential and commercial energy users are simply unaware of energy issues and the choices they have for purchasing electricity	Education and awareness raising Linking to educational components of Community Energy Planning and Greenhouse gas reduction initiatives	General awareness information on energy included in BC Hydro bills. General educational materials on energy and greenhouse gas emissions from Environment Canada, Natural Resources Canada, BC Hydro, etc.
Lack of Awareness of Available Renewable Energy Technologies, including micro-hydro and small scale hydro • Consumers may not be aware of cost-effective RET options	Education, Training and Knowledge Transfer Improved marketing by suppliers Technology Demonstrations	Technology Demonstration Example: Vancouver Island Green Energy Demonstration Project (BC Hydro). As part of a 20 MW demonstration project, approximately 6 to 8 MW of micro hydro energy will be developed on Vancouver Island
Lack of Information on Suppliers and Micro-hydro and small scale hydro industry • Industry is small and not well known • There is no industry association in Canada	Establishment of an industry association Improved marketing by suppliers	
Lack of Information on Micro-Hydro and Small Scale Hydro Resource Availability • Without information on the locations of optimal sites for installing micro-hydro and small-scale hydropower, proponents face the risk of underperformance.	Map and Atlas showing area of low, medium, and high potential for small hydro sites. The maps can be used to spatially show areas according to precipitation, gradient, and temperature	"Inventory of Undeveloped Opportunities at Potential Micro Hydro Sites in BC". The inventory identified over 500 small and micro hydro sites in BC. Location, flow, head, penstock length and diameter, power, energy and 'green' energy, cost, transmission distance, capacity factor, fish flow factor, and cost/kWh were all identified in order to assist potential developers. Energy Resources Map of British Columbia which includes a small hydro component (published by the provincial government, BC Gas and BC Hydro)
Incomplete Estimates of RET Costs and Benefits • Without information on system performance, cost of interconnection, and other factors, it is difficult for prospective investors to evaluate a business case for potential projects	Software Tools to Assess full financial performance of project	RETScreen International Small Hydro Project Model – an awareness, decision-support and capacity building tool developed by CANMET. The Model can be used world-wide to evaluate the energy production, life-cycle costs and greenhouse gas emissions reductions for small hydro projects.
Unclear Interconnection Requirements • There is a gap in technical standards for interconnection,	Simplified interconnection requirements and specifications	BC Hydro is developing a standardized interconnection contract and a micro hydro handbook outlining standards and procedures for developing micro hydro projects and the criteria for interconnecting to power distribution system.

Table 2: Market and Financing Barriers, Strategies, And Examples From BC To Micro-Hydro And Small Scale Hydro

BARRIERS AS SEEN BY RET PROPONENTS	POTENTIAL STRATEGIES	EXAMPLES FROM BC AND CANADA
Lack of demand for electricity from renewable energy sources • May be due to higher cost or lack of awareness about purchase of green power	Establish a renewable portfolio standard mandating that a certain percentage of power be generated through renewable energy resources	BC Hydro has a commitment to meet 10% of its new electricity needs from renewable energy sources by 2010
Lack of access to market and competition. • Energy markets in Canada are primarily dominated by public or private sector utilities serving a regulated monopoly market. Most RET proponents must enter into an agreement with the utility, and therefore can be effectively excluded from participation in the marketplace.	Ensure non-discriminatory electricity market access	
Overly complex or unclear interconnection requirements • Can add a time and cost delay to projects, particularly for smaller projects as costs are generally fixed for all sizes of generators	Standardized contracts for interconnections and fees proportional to size of installation.	BC Hydro has developed a standardized contract for interconnection requirements.
Obtaining an adequate price for supplying electricity • More renewable projects could be funded if they could fetch market prices rather than the price paid by a utility in a non-deregulated market.	Allow net billing where electricity users/providers receive a credit for the portion of electricity they feed into the electrical grid. Certified green power for consumers.	Already used in Manitoba, Toronto, and parts of rural Ontario
Uncertainty about the future price of electricity. • This can affect the financial performance of the project and ability to obtain financing for the project.	Firm and stable energy purchase price proportional to the scale of the system	
Uneven Playing Field for Competing Energy Supplies • Conventional energy supplies currently receive superior federal taxation treatments than RETs. Some of these differences have been alleviated in the late 1990s.	Eliminate subsidies to conventional energy sources Tax credits for renewable energy technologies	Canadian Renewable Energy Conservation Expense provides 100% of pre-development expenses to be written off. In addition, there is an accelerated capital cost allowance for renewable energy technology projects less than 50 MW in size.
Environmental and Social Externalities not accounted for in the rate structure. • Many of the environmental and social costs of supplying energy are borne by society at large and are not accounted in the current price.	Internalize environmental and social costs and benefits, which would make renewable energy technologies (which are generally more environmentally benign) more competitive with conventional supplies. Consider emissions trading to help internalize the environmental costs	

Lack of Access to Capital	Financial support programs Government funding for projects Revolving funds or project financing pool through low-interest loans or grants	
Lack of Consumer Choice • In most energy markets, consumers do not currently have the choice of the energy mix for their supply and are thus forced to purchase the mix provided by their electrical utility	Voluntary programs allowing consumers to choose their own energy mix for purchasing electricity. Deregulation of energy industry where consumers can purchase energy directly from suppliers.	Several electrical utilities (e.g. West Kootenay Power, ENMAX, EPCOR, and Toronto Hydro) offer consumers the choice of supply from various renewable energy sources,.

Table 3: Institutional and Policy Barriers, Strategies, And Examples From BC To Micro-Hydro And Small Scale Hydro

BARRIERS AS SEEN BY RET PROPONENTS	STRATEGIES	EXAMPLES FROM BC AND CANADA
Unclear government direction and lack of national and provincial leadership on renewable energy	Provincial energy strategy with policies on green energy production, including incentives and legislative changes	Generally, the federal and provincial government are supportive of green and renewable technologies. The BC Government is currently in the process of developing a new energy policy.
Complex federal and provincial regulatory environment and permitting process, which can be costly and lengthy	Streamlining, coordination and harmonization of federal and provincial regulations, impact assessments and approval processes.	
Lengthy and complicated provincial water licensing process.	Streamlining, coordination and harmonization of federal and provincial regulations, impact assessments and approval processes Fast-track smaller projects where there are no significant concerns about environmental impact and where there is less complexity involved.	The BC government is currently working to clear the backlog of water license applications and to streamline the licensing process.
No legal requirements and ongoing incentives for green energy	Encourage government purchases of renewable energy through green power purchasing agreements Government incentives for small hydro	
Lack of provincial government familiarity with renewable energy technologies and associated effects (excluding micro-hydro and small scale hydro)	Provision of information and technology demonstrations by industry and from other jurisdictions	With the exception of micro-hydro and small scale hydro, renewable energy technologies are new to the province. Therefore, lack of familiarity with the technologies and their effects is not surprising

Strategies for overcoming the barriers

Tables 1, 2, and 3 also present examples of a significant number of tools, resources, or programs that have been used in recent years in BC and Canada for overcoming the identified barriers. The key stakeholders who are able to influence and reduce barriers are primarily federal/national governments, provincial/state governments, provincial/state electricity regulatory agencies, and the energy utilities.

Government strategies to overcome barriers

Table 4 outlines the strategies currently used to promote renewable energy technologies in BC, with examples pertaining directly to small-scale hydroelectric projects. The table shows that in Canada, the federal government is quite active in most areas, including research and development, information and technical assistance, financial assistance, market transformation (procurement), fiscal and taxation reform, and regulatory reform. Conversely, the provincial governments in Canada have till recently been noticeably absent from many of these activities. Indeed, in BC the most common complaint of prospective renewable energy providers has been the "policy vacuum" in government.

Table 4: Current Renewable Energy Technology Promotion Programs in BC

Stakeholder	**Research & Development**	**Information and Technical Assistance**	**Financial Assistance**	**Market Transformation / Procurement Policy**	**Fiscal and Taxation Reforms**	**Regulatory Reforms**
Government Of Canada	Renewable Energy Technologies Program (RETP) Development of Interconnection guidelines	Renewable Energy in Remote Communities Program (RERC)	Renewable Energy Deployment Initiative (REDI)	Power Procurement Policy (10% of energy used by federal agencies)	CRCE Class 43.1 Capital Cost Allowance (Depreciation)	Climate Change Strategy 2000
BC Provincial Government					Provincial Sales Tax rebate for RET purchases	
BC Utilities	Mapping of Hydro Potential			10% of new electricity to be supplied by renewable energy sources Standardised Contracts	Not Applicable	Not Applicable

This highlights one of the most important steps - arguably even a *critical* step - for governments (including energy market regulatory agencies) to take. To overcome barriers, they need to develop a policy *focus* on the public interest in renewable energy. Until this is recognized, producers and consumers will face significant barriers in multiple, disaggregated, redundant, and even contradictory approval processes and requirements of all the relevant jurisdictions and agencies. Many existing processes were designed to protect the public interest in large, complex projects brought forward by large established companies, and may be inappropriate for small-

scale hydro and other small renewable projects. The relevant agencies and jurisdictions need to develop as simple and unified a process as possible, without, of course, compromising legitimate environmental and other standards which should apply to renewable energy entrepreneurs as much as others.

In a current paper, Berry and Jaccard[3]: identify four broad policy options used by governments to stimulate development of renewables such as small-scale hydro:

- Policies to increase the cost of non-renewable energy, such as subsidy reduction, pollution-based taxes, pollution technology regulation, or caps on emissions.
- Direct financial support to renewables, such as capital grants, premium prices, tax incentives, or favourable loans.
- Indirect support of renewables, such as demonstration projects, resource inventories and maps, training, R&D support.
- Policies to enhance market share for renewables, such as voluntary agreements with producers, mandatory renewable portfolio standards (RPS), or providing "green" tariffs (i.e. product choices) for consumers.

The current trend is for renewable portfolio standards to overtake direct financial measures in supporting renewables in North America. According to Berry and Jaccard[4], this is because the RPS minimizes direct government involvement and ensures the attainment of policy targets, while simultaneously maintaining cost competition among renewable producers. Under this policy, the province or state plays a key role by requiring the energy market to deliver a minimum amount of electricity from specific fuels and/or technologies. This policy fosters the increased production of electricity from energy sources that may have a higher cost but is desirable from a social and environmental perspective.

However, other observers[5] note that at least some RPS mechanisms appear to discriminate against production methods in a manner prohibited by international trade obligations in GATT, WTO, and the North American Free Trade Agreement. A key step by governments, and other stakeholders, will be to work together to design RPS policies so that they can withstand trade challenges.

Energy utility strategies to overcome barriers

While government is obviously in the most powerful position to shape or reshape the market for renewable energy, energy utilities can also take significant actions to reduce barriers. Several examples are provided in the detailed tables.

One of the most significant is to reduce, as much as possible, the complexity and uncertainty associated with negotiations of energy purchase and interconnection contracts. BC Hydro, for example, has developed standard contracts for interconnections to make the rules clear. Hydro has also standardized and made objectively measurable many elements in its energy purchase contracts that previously were subject to negotiation. Prospective entrepreneurs with renewable

[3] Berry and Jaccard, 2001
[4] Berry and Jaccard, 2001
[5] Horlick, Schuchhardt and Mann, 2001

projects now know with greater certainty, and sooner, how profitable their project is likely to be, which significantly improves their viablility as assessed by investors and lenders.

BC Hydro has also supported the development of small-scale hydro through a number of other initiatives. The key initiative is BC Hydro's commitment to acquire 10% of its new electricity supply from green sources (in effect, a voluntary RPS by the utility). As part of this commitment, Hydro will fund 20MW of green energy demonstration projects on Vancouver Island (a service area facing capacity constraints). Where the renewable technology is new to BC (wind and ocean) Hydro will joint venture with IPPs; however this is not necessary for the planned 6 to 8 MW of micro hydro.

In support of this, BC Hydro is working actively with the IPP industry association to eliminate information barriers impeding market entry. Hydro developed and published a resource map (An Inventory of Undeveloped Opportunities at Potential Micro Hydro Sites in BC). The utility is also working with the federal and provincial regulatory agencies to streamline and harmonize regulatory requirements, and is developing a micro-hydro handbook outlining those regulatory requirements. Furthermore, Hydro is hosting workshops to train stakeholders on both the regulatory and competitive purchasing processes. These barrier-reducing actions have turned a formerly adversarial relationship into one of cautious partnership and cooperation, and increasing market success for renewables.

Conclusions

Micro- and small-scale hydro are mature technologies with a well-developed engineering and design knowledge base, and do not require research and development support. However, Independent Power Producers and other stakeholders do face a number of significant information, market and financing barriers that prevent small-scale hydro and other renewables from fully penetrating the electricity generating market.

A broad range of strategies is available to help overcome these barriers. Many of these strategies are already underway and being used successfully in B.C. and Canada to establish small-scale hydro projects. Deregulation considerations and increased consumer demand for ‘green’ energy are pushing utilities and governments to become more involved in renewable energy technologies. The success of these initiatives relies on the strength and commitment of the utilities and the regulators, and the nature of their partnership. A survey of RETs in other jurisdictions[6] indicates that the highest level of renewable energy penetration occurs in jurisdictions with a fully integrated suite of policies. The primary lesson to be learned is that the commitment to renewable energy, coupled with cooperation amongst all involved, are required for a sustainable energy future.

[6] Sheltair Group Resource Consultants, 2001

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Questionnaire regarding manufacturers and suppliers of equipment and the market for solar heating

Country: Norway

Filled out by: John Rekstad, SolarNor AS

Market

1. What is the estimated volume, in m^2 and USD, of the current market for solar heating equipment in your country?	2000 m^2/year $ 400.000 /year
2. What is the estimated growth rate of the current market for solar heating equipment?	10 %
3. What is the most important market niche (for example heating of swimming pools, domestic hot water, hotel hot water, space heating, etc.)	Combined heating systems for residential buildings, Large DHW-systems for institutions and commercial buildings
4. Does any of the manufacturers or suppliers have a well-known name that is closely associated with its solar heating products?	One manufacturer: SolarNor AS
5. How is solar hetaing equipment generally offered to the end user: • From producer to end user? • From producer to retailer (e.g. suppliers of building materials) to end user?	Small projects are offered through installer companies (plumbing companies). Larger projects: either direct to end user og to building company

• From producer to installer (e.g. plumbers or suppliers of heating systems) to end user? • By the way of architects and/or consultants?	
6. Is the market dominated by domestic manufacturers or is imported equipment important? If possible, estimate this division in market shares.	domestic products dominate
7. What do you believe to be the main market barriers against increased introduction of solar heating ? (price, availability of equipment, performance of equipment, difficulties with building- and systems integration, little interest in spite of good performance, ...)	Structure of B&C sector Lack of competence among installers and advisors. High temperature in the market prohibits change of technology.
8. Which developments do you foresee that could lead to increased utilisation of solar heating in your country? (For example increased prices on fossil fuels, increased environmental awareness, government policy, drop in equipment unit costs etc.)	The market will grow under the present frame conditions. The speed of the growth will be dependent on incentives in terms of policy, price of other energies etc.

Manufacturers and Suppliers:

1. Give the names of the three to five most important manufacturers or suppliers of solar heating equipment in your country.

Name: Adress Phone: Fax: e-mail:	SolarNor AS PBox 352, 1323 Høvik, Norway 67 81 53 90 67 81 53 85 solarnor@solarnor.com
Name: Phone: Fax: e-mail:	:
Name: Phone: Fax: e-mail:	Address:

2. If you can, please characterise these actors in terms of annual turn-over or sales, number of staff, growth rate, or other key figures.

Name: SolarNor AS	Yearly sales: 10 mill. NOK Number of staff: 16 Growth rate: 100 % Subscribed capital: other:
	Yearly sales: Number of staff: Growth rate: Subscribed capital: other:

3. Is solar heating equipment the core business of the most important suppliers, or is it only an "add-on" to other business, for example HVAC-services?

Other:

1. How many square metre of solar collector area is currently installed in your country? If possible, split on different applications.	ca. 6000 m^2
2. Can you give som examples of "success stories" in the solar thermal business in your country?	Some projects have been evaluated among the best in Europe.
3. Has there been carried out an analysis of the potential for solar heating in your country. If so – when, and by who?	Various

If you have any additional information and comments, please give them here.

ANNEX 3 – COUNTRY INFORMATION

CONTENTS

COUNTRY INFORMATION - DENMARK

Søren Varming
Techwise A/S, DENMARK

Questionnaire on renewable reference projects

1. National or your company specific renewable development conditions

- Renewables with significant energy supply today – what made them succeed in your own country/company?

The table gives an overview of the development in the use of renewable energies in Denmark over the last 20 years. Waste incineration, straw and wind energy are the dominating RES.

Production of Renewable Energy etc

Direct Energy Content [TJ]	**1980**	**1988**	**1990**	**1997**	**1998**	**1999**
Actual Production						
Renewable Energy etc	**25,844**	**47,765**	**50,856**	**73,774**	**76,646**	**80,972**
Solar Energy	50	61	100	280	300	317
Wind Power	38	1,050	2,197	6,963	10,152	10,906
Hydro Power	123	118	101	69	98	115
Geotermal Energy	-	-	48	50	54	54
Straw	4,840	11,258	12,481	13,344	13,353	13,706
Wood Chips	-	1,604	1,724	2,704	3,038	2,649
Fire Wood	6,071	7,814	7,019	9,603	8,339	8,339
Wood Pellets	-	355	1,575	2,279	2,420	2,368
Wood Waste	3,648	6,383	6,183	6,004	6,231	7,128
Biogas	184	354	752	2,394	2,670	2,656
Waste Combustion	10,584	14,418	15,471	26,746	26,535	29,103
Fish Oil	-	1,860	744	14	14	27
Heat Pumps	306	2,488	2,462	3,323	3,443	3,604

Significant government intervention through taxes, subsidies and agreements with industry has been the major driver. A strong involvement of non-utility organisations has been part of the success ie in the introduction of wind power. Of the total production of windturbines in 2000 only 10% were utility owned.

- Most important Government actions to promote renewable energies (direct subsidies, environment taxation, R&D support, legislation, regulations, business development, etc.)

There has been a large portfolio of government interventions to promote RES. Feed-in laws and guarantied (high) prices has been the key, but also strong support for R&D and taxes has been involved.

- Degree of liberalisation in the energy markets in reference (role of utilities, free access for investors to engage in renewable energy projects etc.)

Non-utility involvement in RES has been strongly promoted. For long periods incentives for non-utility generation has received higher subsidies than utility owned. A regulation with green certificates and an obligation for consumers to buy a certain minimum amount of certificates as share of total electricity consumption.

- Indication of price level of electricity and petroleum products at end users (household, industry)

Electricity price for private consumers

A total of approximately 1,5 DKK pr kWh or 0,2 Euro/kWh

A breakdown of the costs

Basic charge:	0,14	DKK/kWh
Grid tariffs:	0,16	DKK/kWh
Commercial power:	0,10	
"Green power"	0,20	
Energy tax	0,51	
Distribution tax	0,04	
CO2-tax	0,10	
Total	1,25	DKK/kWh
VAT 25%	0,31	
To pay	1,56	

- Most important renewable energy resource to meet energy demand, as seen by your national government and or company

Wind energy is expected to be the fastest growing renewable energy form in Denmark for the next decades. At present the installed capacity is around 2500 MW producing approximately 13% of the electricity consumption. For comparison the installed capacity of conventional power stations is around 8000 MW.

In the coming years a significant development in offshore windfarms is expected. At present 5 projects with a total of 750 MW is in the planning process. For the longer term (2030) up to 4000 MW offshore wind is foreseen.

- National capacity to develop domestic industry in the renewable area (competence, industry base, existing infrastructure, capital etc.) in your own country or in any other country you/your company is familiar with.

In the wind area Denmark has been very successful in developing a local industry with several of the worlds largest producers of windturbines being Danish. In this fall a step decline has been seen in value of the shares in the windturbine manufactures. The reason is questions whether they will be able to keep growing or larger companies (Siemens, ABB, etc) will take over the global market.

- To what degree are environmental benefits of using renewable energy important in the debate?

There is a strong support for the need for CO2-reductions in the Danish public. A growing concern on the visual impacts from windturbines is limiting the onshore development and stimulating offshore windfarms.

- Most important short- and medium-term developments expected to take place in the renewable industry under consideration, globally and/or in your country (climate change related mechanisms like Joint Implementation etc., Government policy, new technologies…)

Concern has been raised over the change of regulatory regime from fixed prices for RES to "market based" pricing through green certificates. In generel the internationalisation of the energy policy (at least in EU) will change the framework. A question could be raised about the willingness to pay for investments abroad (European green certificates market, JI, CDM) and by foreign companies.

COUNTRY INFORMATION - HONG KONG, CHINA

Richard Entwistle, CLP Research Institute, Hong Kong, China

Questionnaire on renewable reference projects

Replies follow your original questions to facilitate analysis and comparisons. Answers are for the Hong Kong territory (part 1) and our company (part 2). We are completing a review of Hong Kong and China at the moment and I hope to pass extracts of this work to all committee members as soon as possible. Originally planned to complete this review before now, but have been unable to do so. (My own volunteered task.)

1. National or your company specific renewable development conditions

Give your own opinion on what is the most important factor to develop renewable energy production and use in your country or by your company. Comment on the following aspects if relevant:

- **Renewables with significant energy supply today – what made them succeed in your own country/company?**

To date, the only renewable energy source tapped significantly in Hong Kong has been landfill gas. Three main operating landfills plus several older closed landfills generate over 7 MW of landfill site power needs. One site is connected to the CLP Power electricity supply network exporting less than 1 MW of 'free power' in return for grid connection. CLP Power is the larger of two electric utilities and supplies Kowloon and the New Territories of Hong Kong. All landfills are in CLP Power supply territory. The second, and smaller Hong Kong utility (Hong Kong Electric) supplies power to Hong Kong Island and Lamma Island, where no landfills exist.

With a potential for over 30 MW of landfill gas generation, there are increasing demands for CLP Power to adopt or facilitate landfill gas generation as surplus landfill gas is simply flared off. CLP subsidiaries are currently reviewing these opportunities.

Wind power (particularly off-shore) is considered to be feasible and substantial in Hong Kong (could supply over 5% of total annual demand). To date, no turbines of any real size are installed in Hong Kong, but CLP Research will commission a small 3kW turbine before end October (see case study). HK remote observatory weather stations and some private householders do have some very small wind turbines – some encouraged by the Friends of the Earth NGO. This year has seen both Hong Kong electric utilities commence wind power resource studies. Within the next two years we should see some serious wind turbine installation talk locally. With government support for wind turbine siting (whether on- or off-shore) some sizable wind power installations should materialise.

Solar power has not gone beyond research & development activities, or small-scale private implementations. However, with increasing environmental awareness of both the Government and public, significant applications for solar power are appearing. A number of new buildings to be completed from 2002 onwards will include building-integrated PV (BIPV) designs. CLP Power initiated discussions with the Hong Kong government on grid connection policies to meet these demands but to date there has not been much progress. The government appears to be taking its lead from consultants employed to advise on renewable energy (see last item).

- **Most important Government actions to promote renewable energies (direct subsidies, environment taxation, R&D support, legislation, regulations, business development, etc.)**

To date, encouragements for renewable energy have been through limited R&D support only. A number of small university projects have been funded by various government schemes. The universities initiated these projects. Earlier this year, a CLP Research 48kW solar power project (see case study) was funded by the government Innovation & Technology Fund. However, another project for 200kW of residential solar power did not get funded.

It is expected that other forms of support, together with added R&D support specific to renewables, will follow from the current renewable energy study being done by the government (see last item).

- **Degree of liberalisation in the energy markets in reference (role of utilities, free access for investors to engage in renewable energy projects etc.)**

The Hong Kong electricity market has operated under a regulated scheme of control for over 30 years. This scheme does not include incentives for power companies to provide grid access to, or to buy power from, or to invest in renewable energy sources. Some potential renewables players in the community see grid connection and third party power sales as key hurdles for renewable energy development in Hong Kong. CLP Power has however taken the initiative in opening up discussions with government on this topic. (As mentioned above.)

- **Indication of price level of electricity and petroleum products at end users (household, industry)**

Continued pressure on energy tariffs from government and public is eroding utilities ability to raise prices. Future pressure from Mainland China suppliers to deliver lower priced electricity may exacerbate this, although the Hong Kong government is well aware of the environmental impacts of 'cheaper' mainland electricity. The government will likely only allow 'clean energy' sources to compete in Hong Kong. Therefore, the Hong Kong government, CLP Research, and the Hong Kong gas utility are actively researching other distributed energy products like fuel cell cogen plants.

- **Most important renewable energy resource to meet energy demand, as seen by your national government and or company**

Renewable energy is not considered as a major contributor, and cannot supply Hong Kong's needs unless such energy is imported from Mainland China. Such an import could take several decades given China's own demands and time to establish renewable resources. With both Hong Kong utilities moving to gas fired plant (CLP Power since the mid 90's), and the eventual retirement of coal-fired plants, it is possible that a substantial electricity supply in future will come from Mainland China with local wind, solar thermal/BIPV, waste-to-energy, and other power schemes providing clean power locally.

- **National capacity to develop domestic industry in the renewable area (competence, industry base, existing infrastructure, capital etc.) in your own country or in any other country you/your company is familiar with.**

The potential exists in Hong Kong, despite current lack of renewable energy developments. A number of small local enterprises, driven by young energetic professionals, have been established for renewable energy development. Given the increasing local awareness of environmental issues and renewables, there is a fair chance that Hong Kong's domestic industry could develop. The Hong Kong government would likely support this with appropriate industrial and innovation funding.

- **To what degree are environmental benefits of using renewable energy important in the debate?**

Very important. Probably the main drive for renewable energy in the foreseeable future. The power sector is seen as the largest source of CO2, with a greenhouse gas policy under development by the HK government. Public concerns for roadside level pollution, albeit not directly related, is helping to encourage local discussion of solar and wind power. The local media are increasingly chasing for environmental and renewable energy stories.

- **Most important short- and medium-term developments expected to take place in the renewable industry under consideration, globally and/or in your country (climate change related mechanisms like Joint Implementation etc., Government policy, new technologies…)**

The Hong Kong Government initiated a 'Study on the Potential Applications of Renewable Energy in Hong Kong' in November 2000. This 32-month study includes a thorough review of all practical renewable energy technologies and some PV demonstration installations in both electric utility supply territories. This study will likely drive much of the short- and medium-term developments.

In a preliminary workshop in July, consultants presented findings of their early discussions with the community. Barriers to renewable energy implementation in Hong Kong were presented as typical for other parts of the world: technical, political, economic, structural and a general lack of awareness. With the study being done in a collaborative style, its suggested approaches for addressing barriers will ensure all players work together to map out Hong Kong's renewable energy future. The study is also looking for new incentives to realise Hong Kong's renewable energy potential. (I can supply the extensive 'wordy' presentations delivered at this workshop if needed.)

In parallel with the above study, the Government will develop an energy policy to continue its control of power generation emissions. Related studies are in hand to examine emissions trading. Further, the regulatory scheme of control for the two power companies is due for renewal in 2008. For an interim scheme review in 2003, the government have requested both electric utilities to present their view of an appropriate future scheme.

It is expected that significant renewable technology implementations will follow from all these initiatives.

2. Case studies

Case study 1: Hong Kong Schools Solar Power Project: A Building-Integrated Photovoltaics project for a new primary school. A 48kW BIPV system together with a building energy management system. A Hong Kong schools solar education program will accompany the main work.

Project is a university-industry collaboration program 50% funded by the Hong Kong government Innovation & Technology Fund. See the University of Hong Kong project website for details at:

www1.arch.hku.hk/research/schoolsBIPV/

R&D phase	Was the R&D work primarily done by the industry, academic or government institutions?	The University of Hong Kong (HKU) architecture department have been studying PV applications since 1996. A small PV installation on HKU campus funded by the Hong Kong Electric company was set up to study PV operation and grid connection needs. Scale of this PV work was limited, and a more representative real world project was sought. CLP Research developed the HK Schools project with HKU to satisfy joint needs.
	How long was the R&D phase?	About two years working with company and other players to gain support for a real-world PV application.
Business development	At what stage was a business plan developed?	Not a business development, but a full proposal and implementation plan was developed before project start. This was necessary for 50% government funding application.
	Presence of local/national market	This is a reference project for future school designs. Collaborating with government architects on project to help change standard design approaches.
	Presence of existing infrastructure	None.
	Were any market niches identified?	Yes. Much interest in PV being shown by property developers. CLP Research acting to help establish CLP Group as a future systems provider.
	Description of entrepreneur/business?	Intention is to encourage other CLP Group subsidiaries to take up these

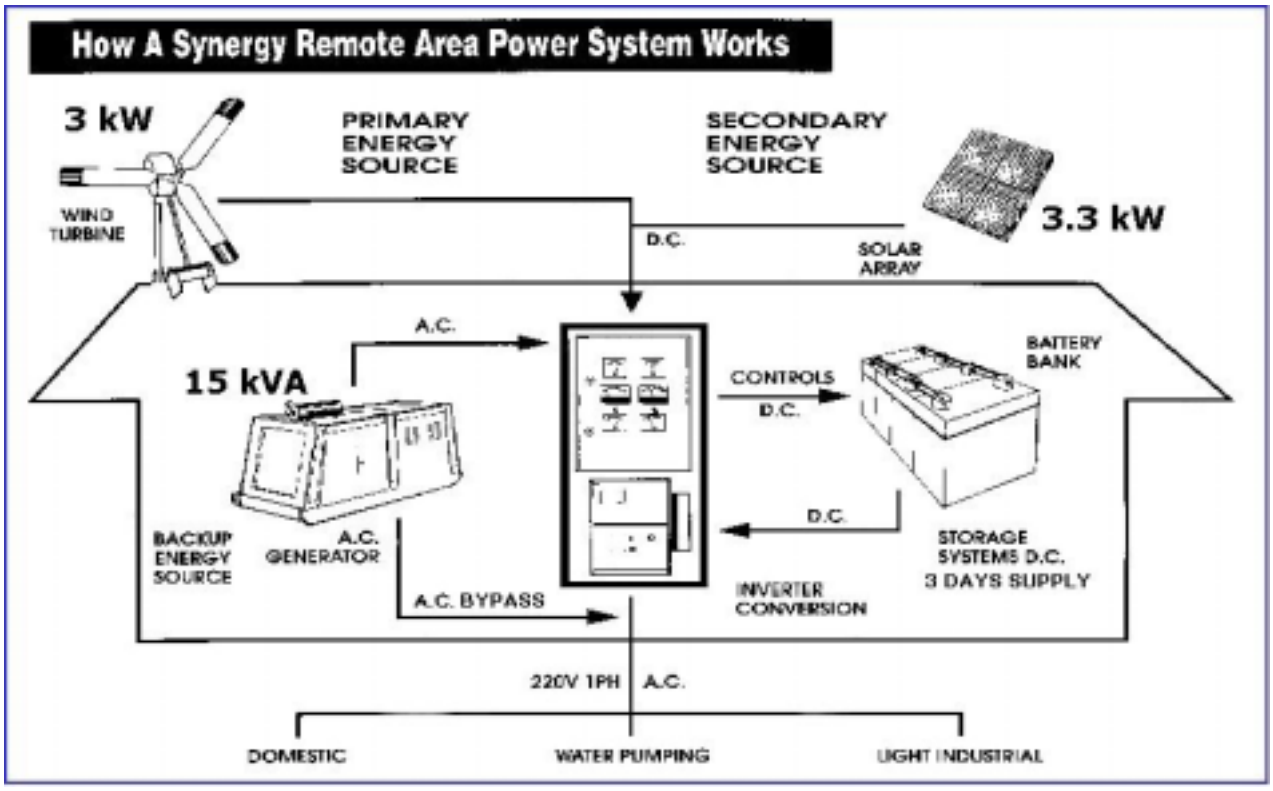
		opportunities from CLP Research.
	At what stage(s) were investors entering the project	Not required for this project but establishing CLP as a PV player would encourage future partnerships or investments.
	Role of NGOs or other actors outside industry	Important role for green groups to help canvas government and others support. Green groups themselves are looking to utilities to initiate applications of renewable technologies. Win-win.
Market conditions	Consequences of energy market liberalisation	No liberalisation likely for several years but market changes seen as necessary by many players (inc government) and others to encourage renewable applications.
	Consequences of emerging climate change regulations	Increasingly important due to local governments and NGO interest. Some NGOs actively pushing for emissions trading and now being studied by government.
	Public financial support	Not likely. Although when grid connection procedures have been agreed, there will be increased interest in PV applications for both government and private developments. Public awareness will follow and possibly some support.
Information	Presence of reference projects	None at present. Several smaller systems will be implemented within the next two years coincident with this particular project.
	Were small-scale advantages highlighted in presentation?	Yes. This project aims to help standardise future BIPV applications.
	Were environmental NGOs and institutions an ally?	Yes. NGOs have increasing influence with government.
	Were environmental consequences documented?	Yes. Reduced CO2 and energy conservation touted as key benefits.
Other	Any other relevant observations	Many players now buying into project. Lots of interest being generated.

Case study 2: A hybrid wind-solar-diesel rural electrification power system is being installed on a Hong Kong outlying island. The system will demonstrate and monitor renewable technologies, contribute to education programs for community awareness, and promote similar systems for China and the Southeast Asian countries.

The system will feed a new two-storey school building. Equipment comprises a 3kw wind turbine, a 3.3kW solar panel array, a 150 kVA backup diesel generator, a three day battery energy storage, all controlled by a hybrid electronic control system. See system diagram at end.

R&D phase	Was the R&D work primarily done by the industry, academic or government institutions?	CLP Research completed feasibility study only. Limited R&D done as hybrid system design is proven and operating in the region.
	How long was the R&D phase?	CLP Research intends to carry out R&D work for about 24 months on system to assess wind and solar resources for Hong Kong. Universities invited to collaborate, and several projects may run concurrently. This is the first such renewable energy system in Hong Kong.
Business development	At what stage was a business plan developed?	Not yet done. Using this project as demonstration site. A business plan for a second installation in Hong Kong (on commercial terms) will be prepared from 9/01 to 12/01.
	Presence of local/national market	Many remote islands off the coast of China, with several large islands just outside of Hong Kong waters. Other opportunities in China's remote regions, and most Southeast Asian countries.
	Presence of existing infrastructure	None. System feeds a newly built school and dormitory building.
	Were any market niches identified?	Yes. As discussed earlier, a demo reference system for remote power or rural electrification applications.
	Description of entrepreneur/business?	Intention is to encourage other CLP Group subsidiaries to take up these opportunities from CLP Research.
	At what stage(s) were investors entering the project	Wholly funded by CLP Group for time being.
	Role of NGOs or other actors outside industry	Green groups involved from start and intend to apply similar systems to a Friends of the Earth project.
Market conditions	Consequences of energy market liberalisation	System is designed as off-grid and intended for remote area or rural electrification applications. Energy

		market liberalisation not a factor.
	Consequences of emerging climate change regulations	Hybrid system designed to help electrify remote communities. Should satisfy emerging climate change regulations.
	Public financial support	Will involve public during system promotion and education programs to follow. No financial support needed, although would expect other groups to fund their own systems.
Information	Presence of reference projects	This is intended to be a reference project for China and South-East Asia. Other systems are not easily accessible.
	Were small-scale advantages highlighted in presentation?	Certainly. Original motivation for delivering this system was in response to a charitable request.
	Were environmental NGOs and institutions an ally?	Certainly. Important allies.
	Were environmental consequences documented?	Will be documented in future as part of monitoring research programs.
Other	Any other relevant observations	System is generating much interest from government and others.



COUNTRY INFORMATION - ISRAEL

Michael Lax
ORMAT Industries, Ltd., Israel

QUESTIONNAIRE ON RENEWABLE REFERENCE PROJECTS

Type of Projects: Geothermal Power Generation, Small Industrial Waste Heat Utilization

Company: ORMAT Industries Ltd,

RENEWABLE DEVELOPMENT CONDITIONS

General

ORMAT designs and manufactures innovative, environmentally benign power units operating primarily from renewable energy resources such as geothermal energy or unused industrial heat streams. Over the last 35 years renewable energy promotion has proved to be a core success for ORMAT. Some 700 MW of ORMAT renewable power plants were installed worldwide, in 14 countries, from the U.S. to New Zealand, from Iceland to the Philippines, both in developing and developed countries.

Main Key for Success

Need for energy; consciousness of the need for diversification of energy resources; existence of unused indigenous energy resources; ability for fair competition in the energy market; favorable legislation for implementation of renewable projects.

Most Important Government Actions to Promote Renewables

Preparation of favorable legislation for renewable project implementation. Government may be helpful in the geothermal business by providing guarantees to the developers with regard to the purchase of electricity by the national utility and the purchase price (guarantor to the PPA). The investments in R&D are less important, and may also be covered by the private sector.

Degree of Liberalization of the Energy Markets

- The "laissez-faire" policy maximizing the supply of cheap fossil resources exacerbates several problems the world will be forced to solve in the future. Firstly, but not the most

urgent, the growing depletion of those resources; secondly, the negative ecological impact of their utilization; and thirdly the "unfair" market competition of those resources with alternative, renewable resources, thus influencing the pace of their development.

- The trend of market liberalization also initiated ***merchant power plants***. The governments should recognize that a power sector based on merchant power plants, dispatched according to competitive bidding is not compatible with the development of renewable energy power plants, which cannot be dispatched to accommodate fluctuating demand, because the up-front investment in fuel must be recovered on a continuous basis. The new, more sensitive approach should synchronize the options for the sake of global energy sustainability.

Indication of Price Level

Recently the cost of renewable energy power generation (most of the resources) has become competitive with conventional fuels. However, the competition should be fair, by including the externalities in renewables and refraining from fossil fuel subsidies.

Most Important Renewable Energy Resource

This depends on the country concerned. The existence of indigenous renewable resources is, of course, a precondition.

Importance of Environmental Benefits

These are very important. The positive influence of renewable power generation on the environment is one of the key promoters of renewable projects, although not the only one. "Diversification of resources" also plays a part.

Most Important Developments for the Future

- climate change related mechanisms
- Government legislation or regulatory initiatives, such as "renewable energy set-asides" (RPS – Renewable Portfolio Standards – in the U.S., U.K. Renewable Obligation, etc.)
- Export Credit Agencies promoting ***fast-track*** renewable project implementation
- The rich countries should support access to renewables by the rural poor

CASE STUDIES

a. <u>R&D Phase</u>

A steadily continuing process. In order to be competitive, the proprietary technology needs to be updated on a continuous basis.

b. Business Development

Niches were identified; implementation was based on successful private-public cooperation. This enabled the involvement of private investors.

c. Market Conditions

Legislation or regulatory steps were needed to enable fair competition with the energy markets

d. Information

The reference of projects was very crucial to new project implementation; the positive environmental impact of renewable projects is a promoter.

THE ACTUAL STATUS OF RENEWABLES IN JAPAN

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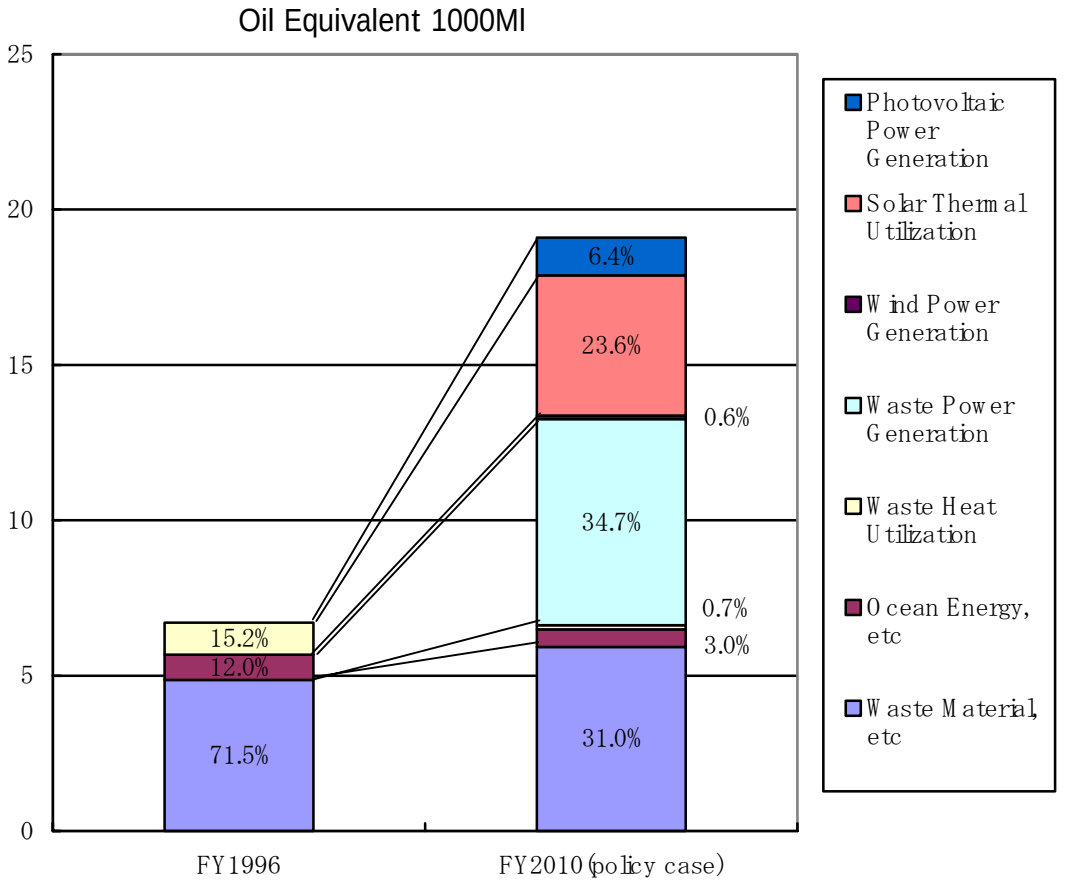
SOCIAL AND PUBLIC SYSTEMS DEPARTMENT
MITSUBISHI RESEARCHI INSTITUTE
Tokyo, JAPAN

株式会社三菱総合研究所

Outlook of Renewable Energy
—The Policy for Renewables—

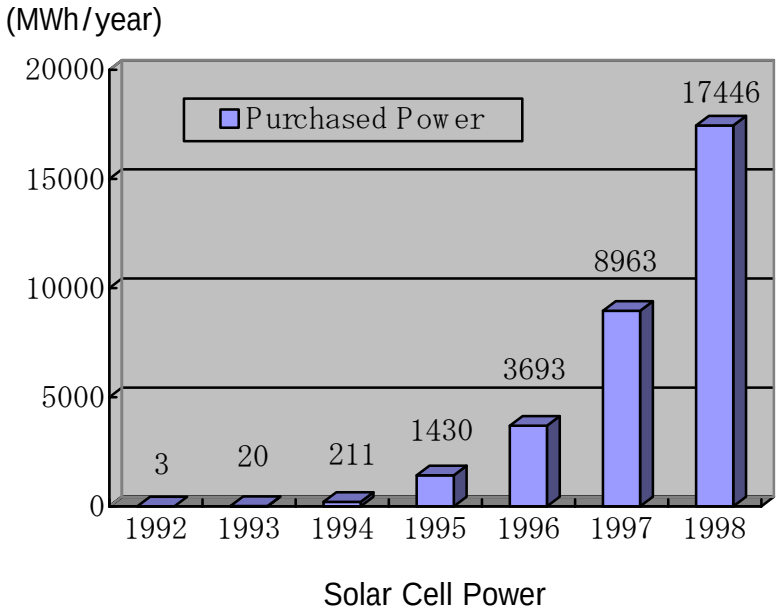
Outlook for FY2010

Renewables \ FY	1990	1996	2010	
			Base case	Policy case
Photovoltaic Power	9MW	55MW	230MW	5000MW
Generation	(2Ml)	(14Ml)	(60Ml)	(1220Ml)
Solar Thermal Utilization	1260Ml	1040Ml	1090Ml	4500Ml
Wind Power Generation	3MW	14MW	40MW	300MW
	(1Ml)	(6Ml)	(20Ml)	(120Ml)
Waste Power Generation	480MW	890MW	2130MW	5000MW
	(440Ml)	(820Ml)	(2820Ml)	(6620Ml)
Waste Heat Utilization	37Ml	44Ml	120Ml	140Ml
Ocean Energy, etc.	18Ml	33Ml	90Ml	580Ml
Waste Material, etc.	5030Ml	4900Ml	5170Ml	5920Ml
Total	6790Ml	6850Ml	9400Ml	19100Ml

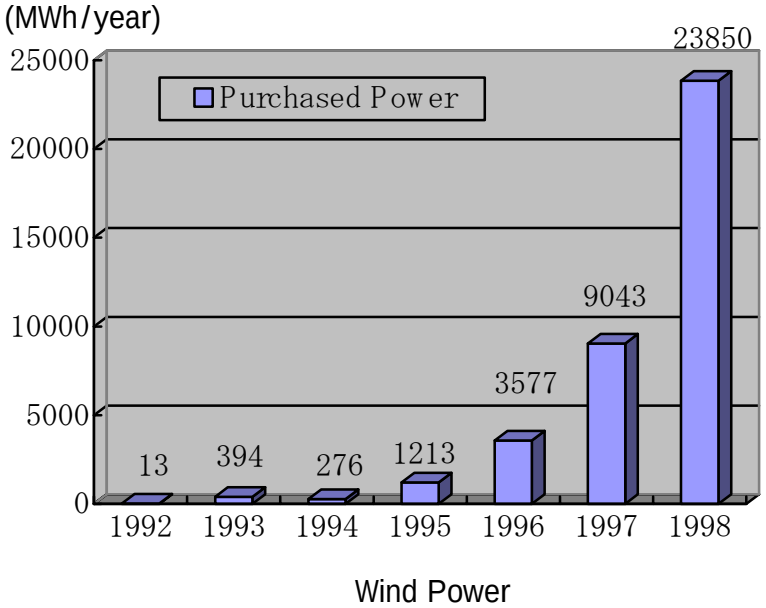


Power Generation by Renewable Energy in Japan

The power utility companies have a duty to purchase renewable power ! : Wind and Solar
Amount of purchased power is greatly increased. At last, activity of using renewable energy started !



Solar Cell Power



Wind Power

Renewables Market in Japan (1)

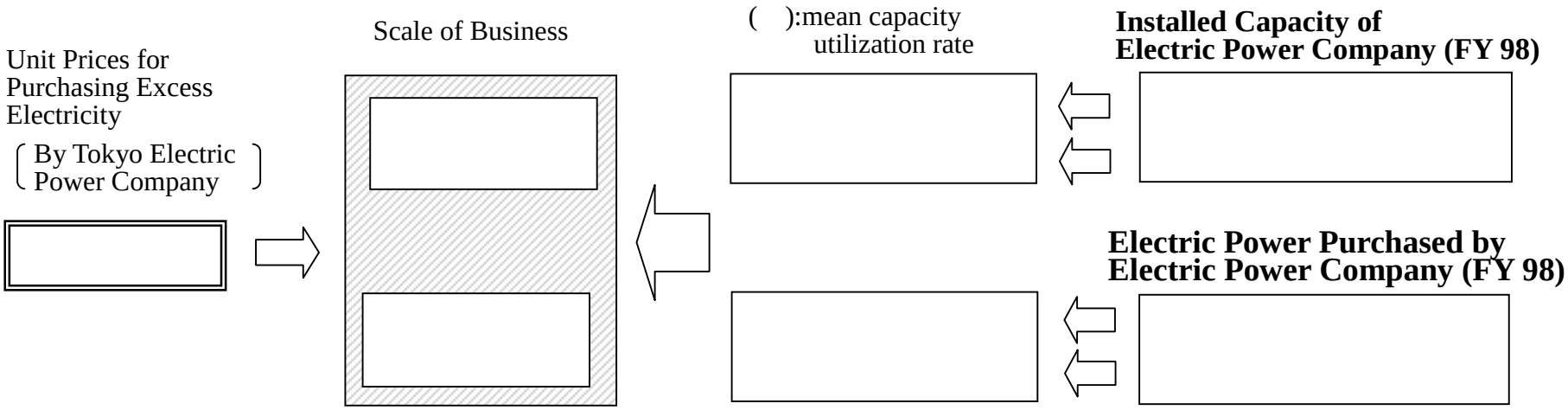
1. Operation for Business Use

Electric power companies (=utility) operate renewables for business, and also purchase renewable energy.

Market Scale is 4.2 billion Yen (=35M$)

● Installed capacity

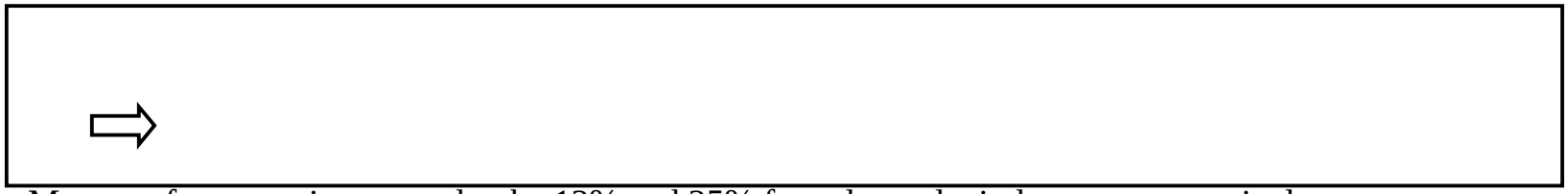
FY 1996		Target (by Japanese Policy)
Solar Power Generation	55MW	5,000MW
Wind Power Generation	14MW	300MW



Total 4.2 billion Yen

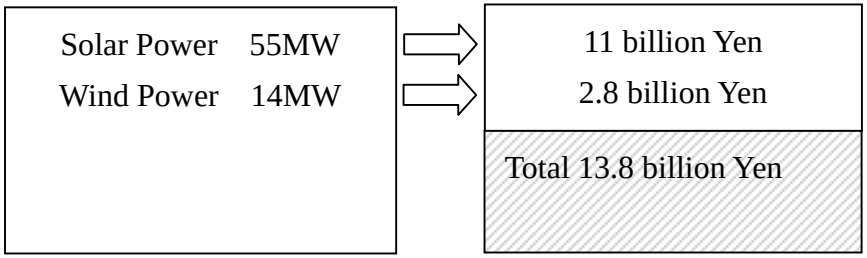
Renewables Market in Japan (2)

2. Operation for Self－Use

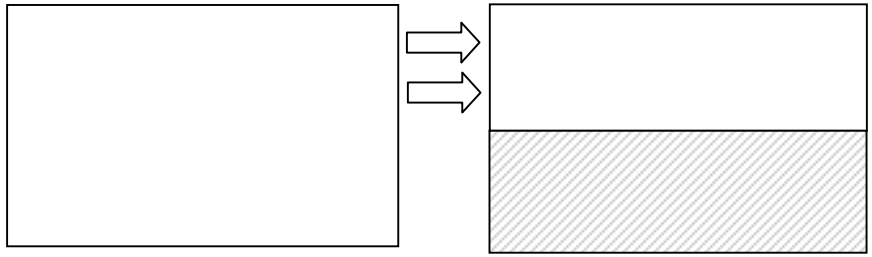


Mean performance is assumed to be 12% and 25% for solar and wind power, respectively.

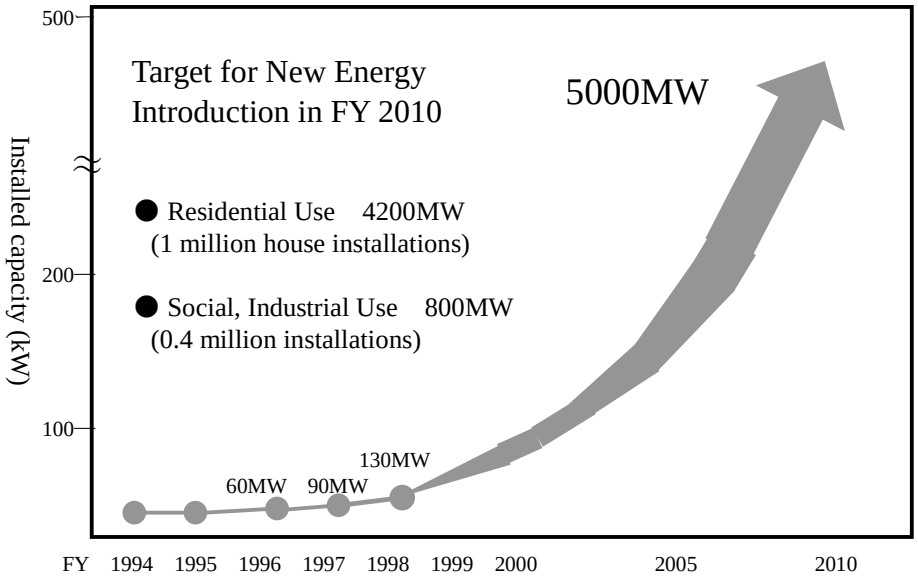
● FY 1996



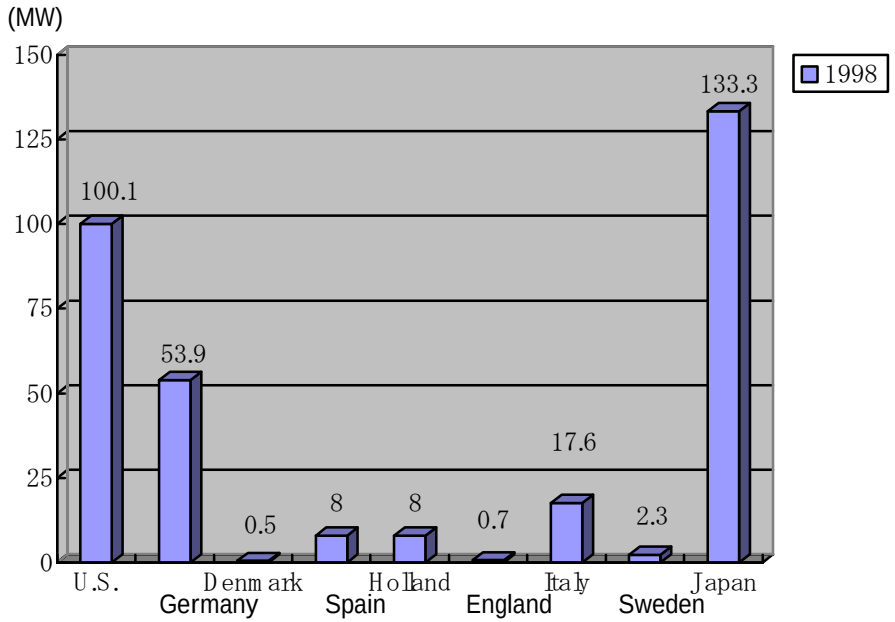
● FY 2010 (Target)



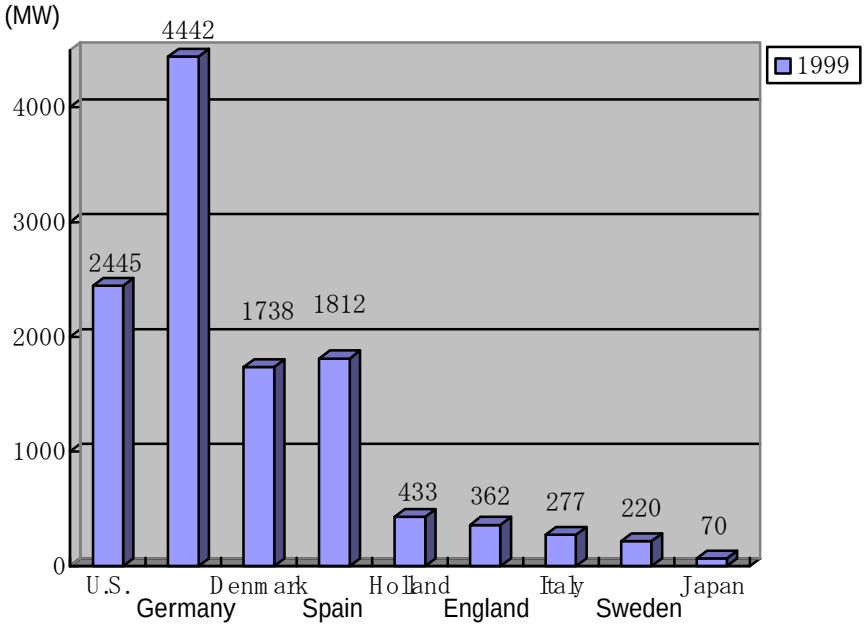
The Outlook of Solar Power



Japanese Situation of Wind and Solar

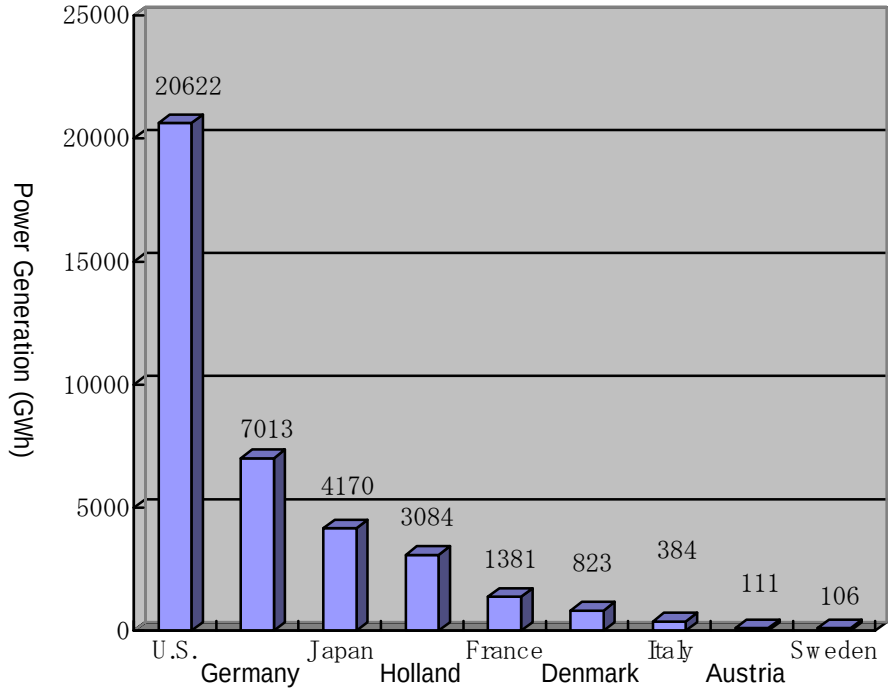


Solar Power



Wind Power

The Waste Power Genaration



(Source : Energy Balances of OECD Countries (1999Edition)

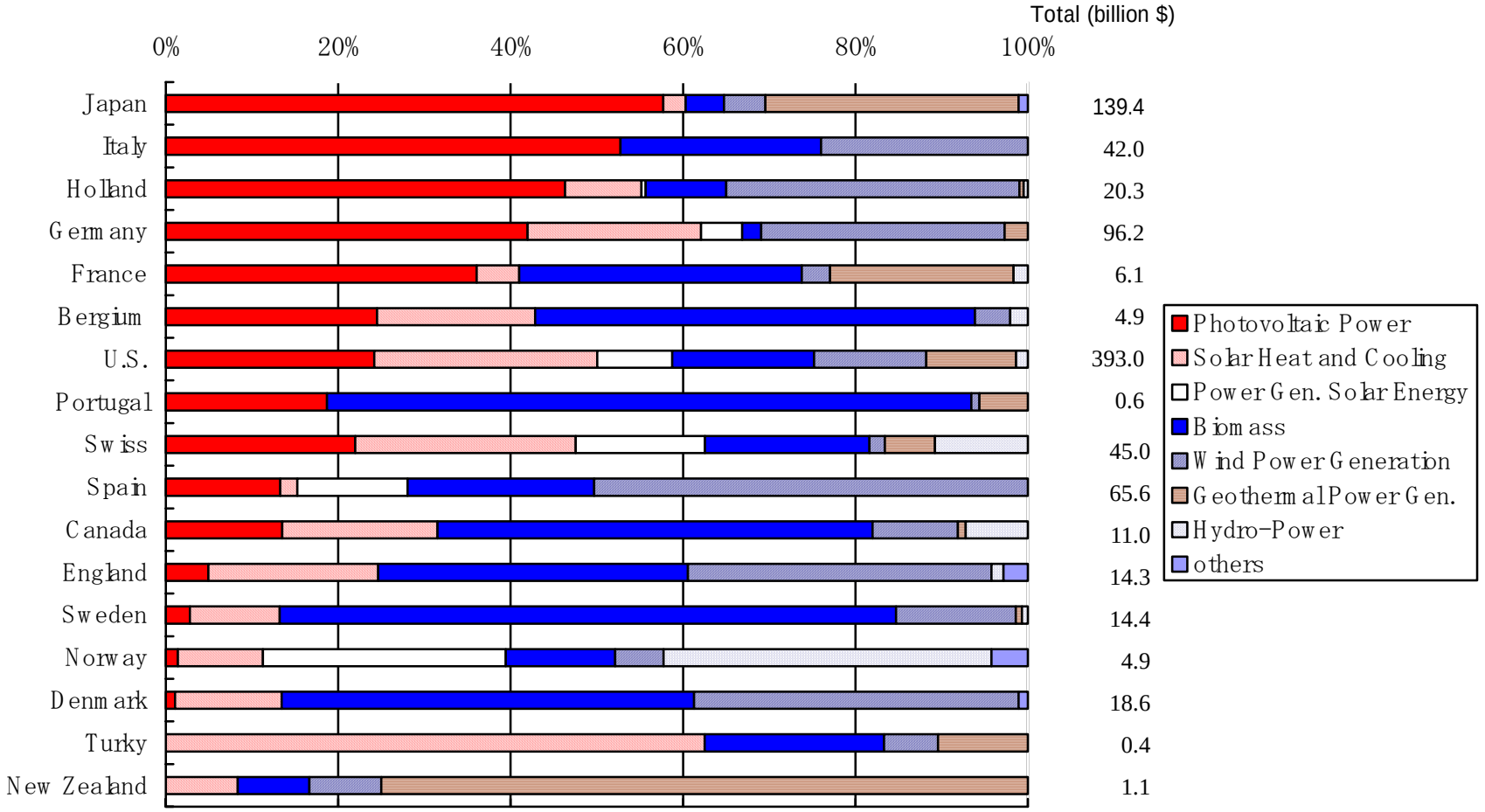
Installed Capacity (x10MW)

	FY1998	FY2010 (Target)	
Non-industrial waste	78.6	Base case →	2130MW
Industrial waste	14.7	Policy case →	5000MW
Total	93.3		

Electric Energy (x10^5MWh)

	FY94	FY95	FY96	FY97	FY98
Non-industrial waste	24	30.0	33.2	37.7	41.6
Industrial waste	3	3.3	4.1	4.0	5.4
Total	27	33.3	37.3	41.7	47.0

R&D Budget and Its Allocation for Renewables
－Government Budget－



(Reference : IEA Energy Technology R&D Statistics, 1974-1995, IEA/OECD 1997)

Many problems still remain in Japan for Renewables !

Point 1 : Combined Heat and Power Policy is Poor.

Installed capacity Target in 2010 is about 5GW, which is 1/10 of U.S. target.

⇨ Installed capacity is almost “Zero”!

Heat Supply infrastructure is “Zero”!

Point 2 : Renewables Need Wide Space.

⇨ Japanese town is congested !

No place to construct renewables near cities.

Point 3 : The History of Economic Development..

⇨ Large scale power plant was needed.

Mass production and consumption supported Japanese economy.

Concept of values must be changed !

Point 4 : Why Renewables ?

⇨ Different understanding and different needs.

Governmental policy is important, especially for Japan.

Different situation, different way of distribution.

Most Important Point : What is the most important thing for us, mankind, in the long term ?

We need to have long term vision and strategy for our future society. That is our urgent task !

Questionnaire on renewable reference projects in Norway

1. National or your company specific renewable development conditions

Give your own opinion on what is the most important factor to develop renewable energy production and use in your country or by your company. Comment on the following aspects if relevant:

Renewables with significant energy supply today – what made them succeed in Norway?

USE OF RES IN NORWAY

The dominant renewable energy sources in Norway are large-scale hydropower and biomass, and their position is based on a long history. Wind power, solar energy and expanded use of heat pumps and refined biomass products face a number of challenges in entering the market.

Energy production in Norway TWh/year	
Bioenergy	12.5
Waste	1.5
Heat pumps	4.5 -5
Solar	0.0015
Wind	0.038
Geothermal	0
Hydro power	122
Oil	1.75E06
Gas	5.41E05

About half of the total final consumption of energy in Norway comes from hydropower. The use of wood and black liquor makes up about five per cent. District heating makes up scarcely 1 per cent of the total energy consumption. Rich access to hydropower as a source of clean and inexpensive energy is one of the main reasons why Norway has not made more of an effort to develop other renewable energy potential.

Hydropower: Hydropower development is closely linked to Norway's industrial development during the first half of the 20th century. The largest hydropower development projects were carried out between 1970 and 1985, when installed capacity increased by 10 730 MW, or an average of 4.1 per cent per year. Towards the end of the 1980s,the rate of hydropower development dropped. There has been little development of production capacity in the 1990s.

Over the last twenty years, there has been a marked transition from the use of oil products to electricity for heating purposes.

Large-scale hydropower presently accounts for more than 99% of the electricity production in Norway.

Bio energy: Bio energy is the most important contributor to current new renewable energy supply in Norway. The total recorded consumption of biomass in 2000 was 16 TWh, of which the wood processing industry used 7 TWh.

Wind energy: In spite of Norway's large wind power potential, only 13 MW of wind energy generation has been installed so far. The Norwegian Water Resources and Energy Directorate (NVE), a directorate under the Ministry of Petroleum and Energy, has granted concession to a number of new wind parks.

Heat pumps: Heat pumps have become popular in recent years, 30000 heat pumps were installed by the end of 2000, and heat pumps are now the fourth largest contributor to heat supply with 4.5 – 5.0 TWh per year.

District heating: There are 30 district heating plants in Norway. Preliminary estimates indicate a gross production of 2.0 TWh in 2000. About half of the net supply was produced in waste incineration plants. District heating amounts to 2 % of the energy used for heating purposes.

Indication of price level of electricity and petroleum products at end users (household, industry)

Cost is a critical factor in the development of renewable energy in Norway, where it must compete with fairly low electricity prices. Total price for electric energy, VAT and grid rent taxes included, was 0.597 NOK/kWh (7.46 eurocents/kWh) in the 1st quarter 2001. The taxes constituted 48.6 per cent of the price of electric energy for households.

As the electricity supply system in Norway is almost entirely based on hydropower, the generation and hence the spot prices depend on the annual hydro inflow. In a year with normal hydro inflow, the current generation capacity is about 118 TWh and actually about 6 TWh less than the consumption last year. So in normal or dry years, Norway must import energy from its neighbouring countries. In wet years however, there may be a surplus generation for export. As a consequence, quite dramatic variations in the spot prices are observed, ranging from an average of 0.10 NOK/kWh last year to 0.25 NOK/kWh in 1996. In the years to come, similar variation in prices must be expected, though the average level is anticipated to rise. At rather conservative assumptions, and excluding the effect of possible CO_2 taxes or quotas, the average price for year 2010 is estimated to be around 0.18 NOK/kWh.

Even though the energy cost of renewables in some cases is lower than conventional technology, decision-makers tend to choose the conventional systems. The reasons could be lack of knowledge, high investment costs, buildings without water-borne heat distribution systems or higher risks because these are new technologies.

Degree of liberalisation in the energy markets in reference (role of utilities, free access for investors to engage in renewable energy projects etc.)

The Norwegian Energy Act of 1990 liberalised the electricity sector and opened up this market to competition. At the spot market contracts are traded daily for physical delivery in the next 24-hour period, and the price is fixed by the balance between bids and offers from all market participants. Development of new markets paying a premium for "green energy" may of course change this to the better for wind energy.

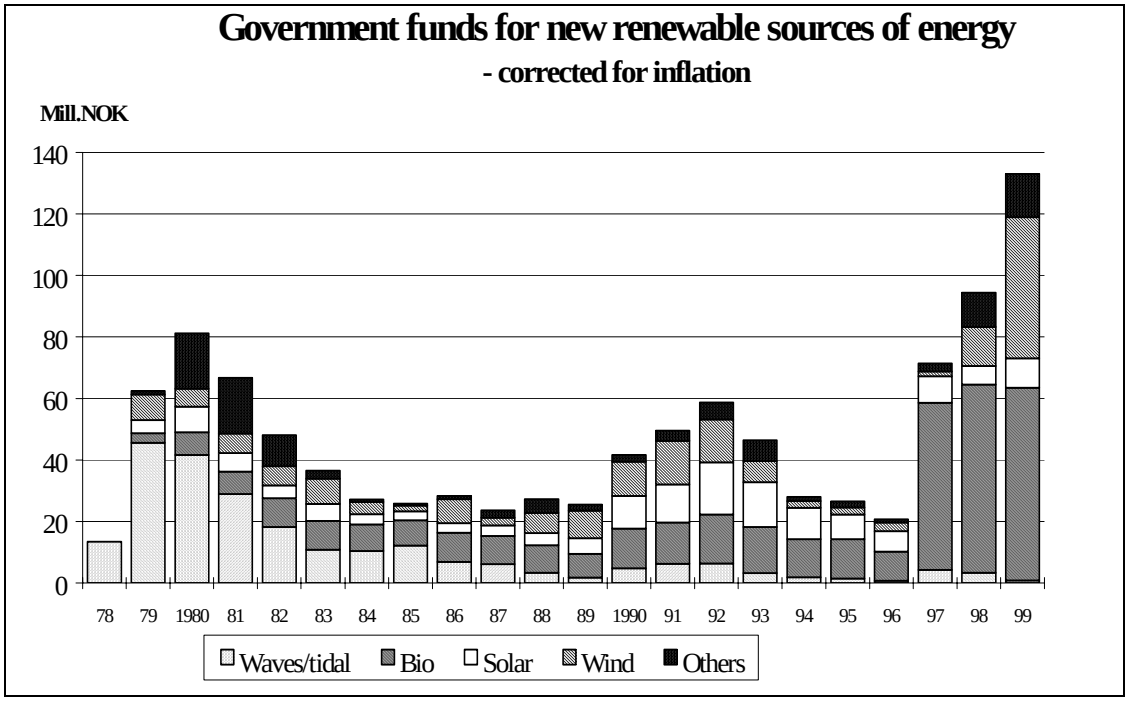
The roles of the utilities have changed. New investors can supply energy to the market and compete with more conventional utilities.

To what degree are environmental benefits of using renewable energy important in the debate?

The question of man driven climate change is a frequently discussed topic. Severe weather (storms, heavy snowfalls, floods etc) increase the interest in the population.

The Norwegian government has the intention to fulfil its KP obligations, keeping the greenhouse gas emissions (GHG) at 1% above the 1990 level by year 2008. Renewables are obvious candidates, but are often still considered an issue for the future. The government favours at the same time cross border solutions such as JI, CDM and ET in order to reduce cost.

Most important Government actions to promote renewables



Targets set by the Government

By the year 2010

- Water-borne heat produced from renewable energy sources should increase by 4 TWh compared to 1998
- 3 TWh wind power by 2010

The objective is to secure the energy supply and to reduce the harmful emission caused by our consumption of fossil energy. This has been the first attempt to set definite targets, and reflects an increased confidence that renewables can be commercially introduced in the market. It is, however, generally agreed that there is a need for governmental initiatives and support mechanisms.

R&D - RES

The NYTEK programme focuses on research and development aimed at efficient, renewable energy technologies, covering development efforts up to and including the field testing of a prototype. The programme will focus on areas that feature commercial opportunities for products made by Norwegian companies.

DIRECT SUBSIDIES

Wind Power: Cost of energy from wind farms is estimated to range between 0,25 and 0,35 NOK/kWh when applying today's technology and prices, 20 years depreciation time and 7% discount rate. Comparing this with the estimated spot market price of 0,18 NOK/kWh, it is evident that support is required to make the wind farms economic. Currently, governmental support to wind power in Norway consists of a 25 % investment grant, roughly corresponding to 0,06 NOK/kWh, and a production support of about 0,06 NOK/kWh, equivalent to half the electricity fees. This indicates that wind farms with cost of energy less than 0,30 NOK/kWh are economic viable in Norway.

Heat Production from RES: As from 1997 investment support has been granted to heat production facilities. The objective has been to increase the utilisation of renewable energy, heat pumps and waste heat for heating purposes. In 2001, the total budget was 90 million NOK.

TAXES

RES: New renewables are exempted investment tax (7 %).

Electricity: Electricity consumption, except in manufacturing industries and mining and quarrying, is subject to an electricity tax, which in 2001 is NOK 0.113 per kWh. All consumers in northern Troms and Finnmark are exempt from the tax.

CO_2: As the first country in the World, Norway introduced CO_2 tax on the use of petroleum products.

REGULATIONS

Water-borne heating systems**:** About 25 % (30 TWh) of the electricity is used for heating purposes, and the Government wishes to release as much as possible of this electricity to other purposes. New Government buildings larger than $1000m^2$ are obliged to install water-borne heating systems.

District heating: The Energy Act regulates district heating. District heating plants in areas where all households are obliged to connect to the district heating system, can not charge more than the price of an equivalent amount of electricity.

OTHER

The Norwegian Water Resources and Energy Directorate is responsible for administration of governmental efforts in the field of Renewables and rational use of energy. Information programmes and introduction of new energy technologies are important measures.

National capacity to develop domestic industry in the renewable area (competence, industry base, existing infrastructure, capital etc.) in your own country or in any other country you/your company is familiar with.

Norway has a long history of industry development in the energy sector. The Norwegian hydropower industry is more than a century old. Later, the petroleum supply industry has developed the expertise needed for petroleum extraction, refining and transport. In addition, the authorities have built up expertise in statutory regulation and management of hydroelectric and petroleum resources.

Examples of new development:

- Several companies form million industry for PV purposes.

- New combustion technologies have enabled small-scale waste incineration plants to fulfil comply with the most advanced emission standards.

Most important renewable energy resource to meet energy demand, as seen by your national government and or company

Biomass: In terms of energy the total annual growth of biomass in Norway corresponds to approximately 250 TWh (400 TWh including aquatic biomass. Based on conservative estimates, it has been calculated that the bio energy usage could be increased from 12 TWh/year today up to approximately 30 TWh/year in the course of the next 10 years.

Wind power: The Norwegian wind power resources are relatively large. Along the coast from Lindesnes in the south to Kirkenes in the north there is a considerable number of locations with sufficient wind and favourable topographical conditions. On the other hand, costs of infrastructure like roads and grid connections represent limitations. According to a report describing the wind power potential in OECD countries, the technical potential for wind power in Norway is estimated to 76 TWh/year.

Heat pumps: An estimate from early 1990s indicates a potential of 30 TWh in 2020.

Most important short- and medium-term developments expected to take place in the renewable industry under consideration, globally and/or in your country (climate change related mechanisms like Joint Implementation etc., Government policy, new technologies…)

- Increased demand of electricity leads to need of new electricity developments.
- Domestic use of gas for power production and industrial purposes restricts further use of fossil fuels. Due to their contribution to GHGE, natural gas has become major political issues. In this setting the introduction of new renewable energy technologies are gaining increased acceptance and popularity
- Kyoto mechanisms (the Government recently published a White Paper on Climate)
- Increased focus on local energy planning to stimulate the development of new renewables projects
- Increased electricity price

2. Case studies

Waste incineration technology - Energos ASA

A new energy recovery plant for household waste, located in Averøy, Northwest Norway, shows that municipal waste can be incinerated, achieving a good rate of energy recovery and low emissions even when the fuel contains wet organic fractions. The plant was established in 1999 and is based on technology developed over the last 15 years and now offered by Energos ASA.

R&D phase	Was the R&D work primarily done by the industry, academic or government institutions?	Primarily by SINTEF, one of Europe's largest independent research organisations. SINTEF worked in close collaboration with the Norwegian University of Science and Technology (NTNU). Industry was also involved. The Norwegian Research Council supported the work.
	How long was the R&D phase?	About 10 years
Business development	At what stage was a business plan developed?	The researchers established a company to commercialise the technology in 1995.
	Presence of local/national market	Technologies available in the market were large-scale, and not well suited to Norwegian waste sector, which is dominated by small municipal waste companies. Increasing waste volumes were of growing concern.
	Presence of existing infrastructure	Apart from Oslo and Trondheim, larger distribution systems for heat from central heating plants had not been established, and is still a barrier to the introduction of this technology.
	Were any market niches identified?	In processing industry, biofuels, electricity and oil are used for the production of steam and hot water. In this sector, energy plants, based on waste fuel have a market. The company identified this as a niche.
	Description of entrepreneur/business?	Energos ASA is a Norwegian company that plans, supplies and operates high technology, environmentally sound energy recovery plants for waste. This is the company's main business.
	At what stage(s) were investors entering the project	Planning phase of pilot project
	Role of NGOs or other actors outside industry	NGOs have actively been lobbying for renewable energy. However,

		waste incineration has not been seen as entirely positive. Waste incineration tends to be more accepted now.
Market conditions	Consequences of energy market liberalisation	Has made it simpler for investors outside the energy sector to develop energy projects.
	Consequences of emerging climate change regulations	They are expected to favour the technology and market opportunities in the same way as bio energy projects. The technology is also well suited for export and Joint Implementation projects.
	Public financial support	The plant does not receive any form of public funds at present. But the technology development has benefited form R&D funds and support for pilot projects The buyers of the technology may receive public support to individual projects and hence increase the demand for Energos' products.
Information	Presence of reference projects	A reference project, the waste incineration plant at Ranheim, was established in 1997.
	Were small-scale advantages highlighted in presentation?	Yes
	Were environmental NGOs and institutions an ally?	Working both ways.
	Were environmental consequences documented?	Report on emissions from pilot plant
Other	Any other relevant observations	Profitability for incineration plants is achieved because the fuel (waste) has negative value.

Name: **Christian Grorud**

Company: **KanEnergi AS**

Date: **5th September 2001**

COUNTRY INFORMATION - SENEGAL

Louis SECK
Direction de l'Energie (Sénégal)

Questionnaire on renewable reference projects in Senegal

National or your company specific renewable development conditions

Give your own opinion on what is the most important factor to develop renewable energy production and use in your country or by your company. Comment on the following aspects if relevant:

- Renewables with significant energy supply today - what made them succeed in your own country/company?

L'adaptabilité au contexte du monde rural sénégalais et la performance du service rendu

- Most important Government actions to promote renewable energies (direct subsidies, environment taxation, R&D support, legislation, regulations, business development, etc.)
- **Direct subsidies, legislation actions, business development**
- Degree of liberalisation in the energy markets in reference (role of utilities, free access for investors to engage in renewable energy projects etc.)
- **Free access for investors to engage in renewable energy projects**
- Indication of price level of electricity and petroleum products at end users (household, industry)
- **Electricity:**
- **- usages domestiques: entre 114,84 et 59,19 francs CFA/KWh ;**
- **- usage professionnels : entre 119,49 et 73,9 francs CFA/KWh ;**
- **- éclairage public : 82,56 francs CFA/KWh ;**
- **- moyenne tension : entre 55,88 et 80, 63 francs CFA/KWh ;**
- **haute tension : entre 36,48 et 46,55 francs CFA/KWh ;**
- **gaz oil : 39372 francs CFA/ Hectolitre ;**
- **-essence super: 52700 francs CFA/ Hectolitre;**
- **diesel oil :2395148 francs CFA/ Tonnes ;**
- **fuel oil 380 CSTG6: 122108 francs CFA / Tonne.**
- Most important renewable energy resource to meet energy demand, as seen by your national government and or company
- **Solar energy**
- National capacity to develop domestic industry in the renewable area (competence, industry base, existing infrastructure, capital etc.) in your own country or in any other country you/your company is familiar with.
- **Competence, industry base, existing infrastructures**
- To what degree are environmental benefits of using renewable energy important in the debate?
- **Preservation of environment by avoiding CO2 emission**

- Most important short- and medium-term developments expected to take place in the renewable industry under consideration, globally and/or in your country (climate change related mechanisms like Joint Implementation etc., Government policy, new technologies…)
- **Government policy, new technologies, renewable industries, utilising renewables in promoting rural electrification, climate change.**

Case studies

Select one or more examples of renewable projects, which could help visualise the development of renewable projects in your country. If questions are irrelevant, please give relevant information.

R&D phase	Was the R&D work primarily done by the industry, academic or government institutions?
	How long was the R&D phase?
Business development	At what stage was a business plan developed?
	Presence of local/national market
	Presence of existing infrastructure
	Were any market niches identified?
	Description of entrepreneur/business?
	At what stage(s) were investors entering the project
	Role of NGOs or other actors outside industry
Market conditions	Consequences of energy market liberalisation
	Consequences of emerging climate change regulations
	Public financial support
Information	Presence of reference projects
	Were small-scale advantages highlighted in presentation?
	Were environmental NGOs and institutions an ally?
	Were environmental consequences documented?
Other	Any other relevant observations

COUNTRY INFORMATION - SLOVENIA

Franko Nemac
ApE - Energy Restructuring Agency, Ljubljana, Slovenia

Questionnaire on renewable reference projects

1. National or your company specific renewable development conditions

Renewables with significant energy supply today
The large share of primary energy supply from renewables is primary due to the hydro power plants production (mostly large ones, above 10 MW of installed power) and traditional exploitation of wood biomass. In Slovenia we have according to the official data (Resolution on strategy of supply and rational use of energy, 1996) about 764,6 MW of installed and operating hydro power plants (HPP), among them 64,2 MW of small HPP (up to 10 MW of installed power).

RES Production	Areas	MW	GWh/year	ktep
Electricity	Hydraulic (>10MW)	700.4	3197	274.9
	Minihydraulic (< 10MW)	64.2	236	20.3
	Biomass	5.8	23.2**	2.0
	Wind	-	-	-
	Photovoltaic*	0,05	-	-
	Others	-	-	-
Total Electricity		770.45	3,456.2	297.2
Heat	Biomass	360	1,440**	123.8
	Solar thermal	100,000 m^2	28	2.4
	Geothermal	103	400	34.4
	Others	-	-	-
Total Heat		463	1,868	160.6
Total		1,233.45	5,324.2	457.8

Source: The Resolution on the Strategy of Energy Use and Supply of Slovenia
*not connected to the grid
** 4,000 h/y

One of the renewable energy sources with significant energy supply today is also biomass. The current share of biomass in primary energy supply is 4.4% (11.2 PJ), but this is due to use the biomass in individual boilers in household and industry for heat supply. Much of this appliances a old and they would need an adequate replacement. The Government of Slovenia has set a target to substantially increase the share of all RES within the primary energy balance by the year 2010. Beside increasing the efficiency of the existing boilers, this goal is envisioned to be reached by increasing the use of biomass for district heating either in heat-only or co-generation plants. According to the recent estimations a programme for CO_2 abatement could be launched, which gives RES and especially to biomass in energy production one of the leading roles.

Other exploitation of renewable energy is also solar thermal production of heat for hot water supply in households and the use of geothermal energy for balneorecreative purposes in spas.

Government actions to promote RE

The Government of Slovenia has systematically supported renewable energy programs and investment projects since 1991 through its public competition program. The support was given through a number of instruments, through soft loans, interest rate subsidies and grants. The Government budget for renewable energy sources for the period 1991-1998 accounted for 11 million ECU. For the implementation of the National Energy Program (NEP), the establishment of a long-term financing mechanism to support energy efficiency and renewable energy projects has been proposed, using the funds collected through the CO_2-tax.

The Government of Slovenia laid down its energy policy objectives and main priorities for the development of the energy system in its Resolution on the Strategy of Energy use and Supply of Slovenia (ReSROE), which was adopted by the Parliament in January 1996. The long-term strategic energy orientations for Slovenia should be the increase of energy efficiency in all sectors and the substantial increase of the RES share in primary energy production.

Degree of liberalisation

According to the Energy low the inner market of electricity was opened on April 15, 2001. The electricity so became the market good for 8,000 eligible consumers, which have the connecting power more than 41 kW at one place. These consumers are mainly industrial, service and distribution companies. They can buy electricity at open market or get the bilateral contracts for the purchased electricity. For the non-eligible consumers the tariff system will remain in power and the prices will be set by the government. This is theory.

In practice the liberalisation of the inner market goes its own way. The government didn’t do nothing on this field till April. On the meeting held on April12, 2001, it has adopted last measures which defines the operation of free electricity market. Among others it has also defined the network costs, the rules for operation of the electricity exchange and extended the contracts with the big consumers for six months (the piece was set as before April 15, 2001). This was done to protect the consumers in the transition period till the balance between demand and supply on the market is established. Eligible consumers can choose the electricity supplier and also can change it with one month notice. To fasten the competition on the internal market the new opening date for foreign suppliers was set and now it is foreseen for January 1, 2001.

There are still some acts to be adopted by the government, which are important for the marketing part and they are arranging the relations between the supplier and the purchaser. Important is also the question of the bad investments, which has to be resolved before the Slovenian producers enters the international open market and which have influence on the operation of the market. To high burdens from this investments will push the prices up and the competitiveness of the producers will be

reduced. There has to be adopted also the act on energy permits, which will define how new investors are going to obtain the permits for operation of the new plants.

Currently the co-ordination between all actors involved in the operation of the electricity market (Ministry for spatial planning and environment, Energy agency as market operator and ELES as system operator) is going on. The co-ordination is needed to control the execution of adopted acts and to resolve the unclear situations, questions from customers and distributors.

Price level

Electricity

For the electricity apply the prices according to the tariff system (11.11.2000).

Sale's group	Tariff grade	Season	Connect -ion fee	Calc. power monthly	Active Power SIT/kWh				Reactive Power SIT/kVArh	
					PT	HT	LT	One-tariff measuring		
			SIT/m	SIT/kW					HT	LT
Sale on 110 kV	three-tariff measuring	VS		3252,51	9,22	8,19	5,12		2,69	1,58
		SS		2602,01	7,36	6,54	4,09		2,14	1,26
		NS		2168,34	6,14	5,46	3,41		1,76	1,05
Sale on 1-35 kV	I. grade three-tariff measuring	VS		2896,54	10,01	8,90	5,56		2,64	1,55
		SS		2482,75	8,57	7,62	4,76		2,26	1,33
		NS		2068,96	7,15	6,35	3,97		1,89	1,11
	I. grade two-tariff measuring	VS		2896,54		9,45	5,56		2,64	1,55
		SS		2482,75		8,09	4,76		2,26	1,33
		NS		2068,96		6,75	3,97		1,89	1,11
	II. grade two-tariff measuring	VS		2241,40		11,83	6,96		2,64	1,55
		SS		1921,20		10,13	5,96		2,26	1,33
		NS		1601,00		8,45	4,97		1,89	1,11
Household sale	I. grade		424,24					14,56		
	II. grade		954,52			17,32	10,19	14,56		
	III. grade			161,67		17,32	10,19	14,56		
Other sale on low voltage	I. grade	VS		1894,01		13,31	7,83		3,45	2,03
		NS		1456,93		10,23	6,02		2,65	1,56
	II. grade			202,98		19,60	11,53		3,16	1,86
	II. grade with two seasons	VS		168,90		25,94	15,26			
		NS		168,06		16,22	9,54			
	Public lighting							13,87		

Tariffs are without 19% VAT!

Abbreviations and explanations:

HS - high season on high and middle voltage: in months January, February and December

MS - middle season on high and middle voltage: in months March, April, October and November

LS - low season on high and middle voltage: in months May, June, July, August and September

HS - high season on low voltage - Other sale I. grade: in months January, February, March, October, November and December

LS - low season on low voltage - Other sale I. grade: in months April, May, June, July, August and September

HS - high season on low voltage - Other sale II. grade: in months January, February and December

LS - low season on low voltage - Other sale II. grade: in months March, April, May, June, July, August, September, October and November

PT - Peek daily tariffs for customers on high voltage during working days from Monday till Friday, as follows:

- during HS 6 hours daily,
- during MS 5 hours daily,
- during LS 4 hours daily.

Hours of PT are defined for each year by the supplier.

HT - high daily tariffs on working days from Monday till Saturday between 6. and 13. o'clock and between 16. and 22. o'clock; in period, when summer time is in use between 7. and 14. o'clock and between 17. and 23. o'clock, except hours, which are on high voltage defined as hours of PT.

LT - low daily tariffs on working days from Monday till Saturday between 13. and 16. o'clock and between 22. and 6. o'clock; in period, when summer time is in use between 14. and 17. o'clock and between 23. and 7. o'clock. Low tariff is applied for the whole Sunday.

Tariff for buying from qualified producers up to 10 MW power is 14,54 SIT/kWh high (HT) and 8,55 SIT/kWh low tariff (LT).

Petroleum products

The prices (without 19% VAT) for fuels are presented in the table below:

Extra light fuel oil	Euro Diesel	Euro Super 95
SIT/l	SIT/l	SIT/l
76,891 min 75,924*	129,244	144,706

*special offers and sale conditions

Liquid petrol gas (LPG)

The price for LPG varies for different consumers and they are (without 19% VAT):

Propane for tank owners and tank renter (price with transport)	SIT/l
a. payment with 4 checks or order	69.24
b. cash or advance payment	67.23
Mix for tank owners and tank renter (price with transport)	
a. payment with 4 checks or order	63.87
b. cash or advance payment	57.56
Propane for users with accounting system for consumed gas with gas meter	253.78
LPG from steel containers	
Households	190.00
For the forklifts drive	213.50

Natural gas (NG)

The price for NG varies for different consumers and they are (without 19% VAT, CO_2 tax and excises):

Wide consumption	**Small use**	**Household tariff**	**Central heating**
a. for supplied quantities	130,31 SIT/Sm^3	68,33 SIT/Sm^3	68,33 SIT/Sm^3
b. for connection power	a	9181,67 SIT/year	755,41 SIT/kW/year
Other consumption	**Small use**	**Basic tariff**	**Heating of business places**
a. for supplied quantities	130,31 SIT/Sm^3	79,37 SIT/Sm^3	79,37 SIT/Sm^3
b. for connection power	a	23417,45 SIT/year	460,36 SIT/kW/year
Contractual sale	**All**		
a. for supplied quantities	60,69 SIT/Sm3		
b. for connection power	835,62 SIT/kW/year		

District heating

Price setting for heat supply (for district heating) is left to the municipalities, but they must previously obtain an opinion from the Agency for energy.

Most important RES to meet energy demand

In the long-term, RES are the most important primary energy source in Slovenia. According to the share of RES in primary energy balance and production of electricity, Slovenia is situated among developed European countries and it has a good starting point for the successful development of RES. Beside the refurbishment of existing hydro power plants and construction of the new hydro power chain on Sava river, the biggest potential is expected from exploitation of biomass for heat and power production and use of wind. Considerable development potential and increase is possible also for other RES. The real development is extremely dependent on the long-term governmental support programme.

National capacity to develop industry

National capacity to develop domestic industry in the renewable area is good. In Slovenia we already have some producers in the renewable area. They are mostly operating on the field of solar thermal equipment and exploitation of biomass. On the other hand, the equipment of manufacturers from Slovenia like form other CEEC and EEC is generally considered as not the most modern one, and the producers often try to collaborate with manufacturers from developed countries (EU, USA, or Japan) in order to reach high quality standard. Such links have already been established in a number of cases.

Environmental benefits of using RE

The environmental benefits of the using renewable energy are not so important as the location of the plant site. Nobody likes to have the plant of any kind in his neighbourhood. Lately, strong pressure is made by the ecologists on the SHPP because of some bad cases (location in protected area etc.), which were made in the past. The consequences – negative public opinion etc. – are now on all SHPP projects. The same is also happening at the exploitation of wind potential, where it is hard – almost impossible – to obtain the necessary permits to build such a plant. On the other hand the people are very interested to install solar systems for hot water supply, new individual biomass fired boilers etc.

The reduction of CO_2 emissions, as a consequence of broader use of RE, is important argument in government discussions on assuring a long-term financial support for RE development.

Short- and medium-term developments

Renewable energy sources, in general, are considered as an important future primary energy source in Slovenia. Considering the fact that about 70% of Slovenia's total primary energy consumption is imported, the renewable energies - beside their obvious environmental and social benefits - are considered as an important national strategic reserve. The priorities are, as laid down in the ReSROE, to increase the share of renewable energy sources in energy production and to enhance the combined heat and power production. Among RES the largest potential is expected from biomass, regarding the fact that over 54% of the Slovenian territory is covered by the forests and that there are significant wood processing industry in the country. Increasing the use of biomass together with substitution of the old boilers will have a specific emphasis.

2. Case studies

Biomass district heating system in Gornji Grad

R&D phase	Was the R&D work primarily done by the industry, academic or government institutions?	The equipment and know how were well known, but the R & D activities were primarily done by the consulting agencies.
	How long was the R&D phase?	From the firs idea till the start of the works (obtaining plans, permits etc.) passed few (2-3) years.
Business development	At what stage was a business plan developed?	First were made pre-feasibility and feasibility studies. On this basis was prepared investment program in order to receive financial grants and loans. After that was established company ENGO, owner and operator of the plant and started the construction works.
	Presence of local/national market	Yes. The market for energy is local (local heat consumers, factory Smreka was the biggest).
	Presence of existing infrastructure	The plant was built on the land of Municipality, near the factory Smreka, the main consumer and fuel supplier. Existed fuel silo has been used.
	Were any market niches identified?	Yes. Some fuel suppliers emerged, among them also the farmer(s) that has bought a wood chipper to prepare the chips in the forest.
	Description of entrepreneur/business?	The company ENGO was established by the municipality (75%) and Smreka (25%).
	At what stage(s) were investors entering the project	Before the actual building phase. In earlier phase the municipality has been the actor.
	Role of NGOs or other actors outside industry	They did create favourable atmosphere about the use of renewable energy.
Market conditions	Consequences of energy market liberalisation	None.
	Consequences of emerging climate change regulations	None.
	Public financial support	This was the first pilot project in Slovenia, thus it received about 50% of public financial support.
Information	Presence of reference projects	Yes. A lot of (300-500) similar systems in Austria.
	Were small-scale advantages	Yes

	highlighted in presentation?	
	Were environmental NGOs and institutions an ally?	Yes
	Were environmental consequences documented?	Partly yes. The project is not concluded, yet. The second phase of the network has to be built.
Other	Any other relevant observations	-

COUNTRY INFORMATION - THAILAND

Boonrod Sajjakulnukit and Amnuay Thongsathitya
Department of Energy Development and Promotion, Thailand

Questionnaire on renewable reference projects

1. National or your company specific renewable development conditions

Give your own opinion on what is the most important factor to develop renewable energy production and use in your country or by your company. Comment on the following aspects if relevant:

- **Renewables with significant energy supply today – what made them succeed in your own country/company?**

  Biomass energy is the most significant energy supply in Thailand today. This is because of its abundant availability and low relative prices.

- **Most important Government actions to promote renewable energies (direct subsidies, environment taxation, R&D support, legislation, regulations, business development, etc.)**

  Direct subsidies are the most important Government actions to promote renewable energies.

- **Degree of liberalisation in the energy markets in reference (role of utilities, free access for investors to engage in renewable energy projects etc.)**

  A significant program of private sector participation has already been undertaken in the Thai energy sector, primarily based on extensive use of Independent Power Producers (IPPs) and facilitation of privately owned distributed generation facilities under the Small Power Producer (SPP) program. An ongoing SPP scheme has been set to support renewable energy SPPs with a target of 300 MW. Private sector involved must have gone through the bidding process. Bidding prices above the by back tariffs set by EGAT will be supported in the form of incentive payments from the ENCON (Energy Conservation and Promotion) Fund.

- **Indication of price level of electricity and petroleum products at end users (household, industry)**

  The electricity tariff structure of each consumer category can be summarized as follows:

  - Residential
    - The tariff is in the form of progressive rates.
    - Small residential consumers receive subsidization, i.e. the tariff level is at 28% of the marginal costs.
    - The tariff for large residential consumers almost reflects the actual generation and distribution costs, being partly subsidized, i.e. the tariff level is at 80% of the marginal costs.
  - Small General Services

    - The tariff structure is similar to that of large residential consumers due to similar load patterns.

- Medium and Large General Services, and Specific Business Services
    - The tariffs vary according to the voltage levels (69 kV, 11-33 kV, < 11 kV).
    - For Medium General Services whose consumption does not exceed 355,000 kWh/month, the two-part tariff is applied, i.e. the tariff will be divided into the demand charge and the energy charge. If the consumption is over 250,000 kWh/month, the TOU rate can be an alternative.
    - For Large General Services, i.e. those whose consumption is over 2 MW or over 355,000 kWh/month, either the Time of Day rate or the Time of Use rate is applied.
    - For Specific Business Services (hotels to accommodate tourism), the two-part tariff is applied; the TOU rate will be an alternative if the consumption is over 250,000 kWh/month.
- Government Institutions and Non-Profit Organizations
    - The tariff comprises only the minimum demand charge and the energy charge according to the voltage levels. If the consumption is over 250,000 kWh/month, the TOU rate will be applied.
- Agricultural Pumping Service
    - The flat rate tariff of 1.1516 Baht/kWh is applied with no variation according to the voltage levels.

Average tariffs for each customer category compared with based marginal cost are shown in Table below.

Customer Category	Average Tariff (Baht/kWh)		Difference (%)
	Marginal Cost Based	Existing Tariff	
Residential	2.31	2.27	2.03
Small General Services	2.47	2.68	-7.56
Medium General Services	1.94	2.03	-4.13
Large General Services	1.90	2.20	-13.58
Specific Business Services	1.78	2.03	-11.92
Government Institutions	2.31	2.20	5.42
Agricultural Pumping Service	2.37	1.73	37.12
Street Lighting	1.83	0.00	-
Total	2.08	2.22	-6.31

The government has abolished determination of ex-refinery/import & wholesale prices to allow full deregulation of gasoline, kerosene, diesel and fuel since 19 August 1991. Each private company involved therefore sets other petroleum products retail prices, except LPG.

- **Most important renewable energy resource to meet energy demand, as seen by your national government and or company.**

Biomass is seen as the most important renewable energy source to meet energy demand both as present and the short- and medium- terms in future.

- **National capacity to develop domestic industry in the renewable area (competence, industry base, existing infrastructure, capital etc.) in your own country or in any other country you/your company is familiar with.**

Renewable energy has been integrated into educational curriculum starting from to graduate levels. However, development in domestic industry is still limited according to a small market and difficult to make money environment.

- **To what degree are environmental benefits of using renewable energy important in the debate?**

Environmental benefits of using renewable energy are realized and accepted by a large part of population and communities. However, high investment cost of RETs seems to be the major barrier for their widespread applications.

- **Most important short- and medium-term developments expected to take place in the renewable industry under consideration, globally and/or in your country (climate change related mechanisms like Joint Implementation etc., Government policy, new technologies…)**

In Thailand, most important developments are expected to be from government policy. More stringent environmental regulations and incentives to support RE applications are seen to be the two major driving forces in the short- and medium- terms. CDM that will be applicable for developing countries is believed to be one of positives mechanisms. However, it is still not clear and hard to assess at present.

2. Case studies

Select one or more examples of renewable projects, which could help visualise the development of renewable projects in your country. If questions are irrelevant, please give relevant information.

R&D phase	Was the R&D work primarily done by the industry, academic or government institutions?	R&D work is mainly done by universities with financial support from government agencies.
	How long was the R&D phase?	Normally 1-2 years.
Business development	At what stage was a business plan developed?	Before a dissemination and promotion plan is performed.
	Presence of local/national market	Yes for solar and biomass technologies.
	Presence of existing infrastructure	The existing infrastructure in Thailand for RE acceleration is relatively good compared to other countries in the region.
	Were any market niches identified?	Yes
	Description of entrepreneur/business?	A combination of local construction and assembling companies for small RE projects. A consortium with foreign partners for RE SPP type projects.
	At what stage(s) were investors entering the project	When a considerable demand for RE is confirmed.
	Role of NGOs or other actors outside industry	NGOs are really enthusiasm and supportive for RE programmes especially community base programmes in the rural.
Market conditions	Consequences of energy market liberalisation	Much more opportunity for RETs to Compete with conventional energy technologies under supports from the government.
	Consequences of emerging climate change regulations	Still not clear at this stage.
	Public financial support	ENCON Fund can be used to support up to 50 % of the initial investment for small-scale RE projects.
Information	Presence of reference projects	Demonstration of biogas projects in pig farms.
	Were small-scale advantages highlighted in presentation?	Yes
	Were environmental NGOs and institutions an ally?	Yes, for most NGOs and for some extents.
	Were environmental consequences documented?	Yes
Other	Any other relevant observations	

COUNTRY INFORMATION - TURKEY

Bülent Gada
Foreign Relations Department, Turkey

Questionnaire on renewable reference projects

1. National or your company specific renewable development conditions

- **Renewables with significant energy supply today – what made them succeed in your own country/company?**

Predominant renewable energy supply in Turkey is hydropower, which in 1998 provided 38% of electricity production.

The other contributions from renewables are geothermal, solar and wind energies except from the non-commercial utilization of traditional biomass.

The most common utilization of solar energy is flat plate solar collectors for domestic water heating. Considering the installed collector area, Turkey is one of the leading countries with 7.5 million m² in 2000. The most significant reason is the simplicity of the technology, which makes it possible to manufacture the systems in a local level. Local production also makes the prices affordable and the systems available for people. One indirect reason is the abundant solar radiation potential of the country especially in the southern regions.

Wind electricity has developed in recent years. In the year 2000, the installed capacity was 18.9 MW. The main reason was the comparatively attractive prices offered to the investors by the Build-Operate-Transfer model and autoproducer tower, constructions works etc. and also short installation period of wind energy systems have positive impact.

Geothermal is utilized both as electricity production and as heating. The main reason may be that the municipalities have recognized that geothermal heating is a cheap and environmentally friendly solution for central heating.

- Most important Government actions to promote renewable energies (direct subsidies, environment taxation, R&D support, legislation, regulations, business development, etc.)

For the wind electricity, the legislation enabling the BOT and autoproducer models together with the relatively attractive buying prices encouraged the wind energy investors.

- **Degree of liberalisation in the energy markets in reference (role of utilities, free access for investors to engage in renewable energy projects etc.)**

Recently a new electricity market law has been issued to promote the competition in the electricity market. With this law, free market access is forseen for all kind of energy sources.

- **Indication of price level of electricity and petroleum products at end users (household, industry)**

Petroleum market has already been liberalised. For electricity, the tariff differs depending on the end-use sector (industry, commercial, residential) and on the regions with development priority.

- **Most important renewable energy resource to meet energy demand, as seen by your national government and or company**

Demand for renewable energy in Turkey consists largely of hydro electricity and biomass heat energy. In the longer term the major sources of non-hydro renewable energy in Turkey are expected to be geothermal, solar heat and wind electricity.

- **National capacity to develop domestic industry in the renewable area (competence, industry base, existing infrastructure, capital etc.) in your own country or in any other country you/your company is familiar with.**

Turkey has industrial capability for manufacturing and installation of the most renewable energy equipment and systems. Capital shortage is the biggest barrier on the development.
Turkey is usually familiar with the European technology on renewable energy.

- **To what degree are environmental benefits of using renewable energy important in the debate?**

Environmental concern has been taking in the consideration in energy sector recently.

- **Most important short- and medium-term developments expected to take place in the renewable industry under consideration, globally and/or in your country (climate change related mechanisms like Joint Implementation etc., Government policy, new technologies…)**

Ministry of Environment has been trying to develop GHG reduction scenarios would aid Turkey in evaluating and choosing among the possible approaches for addressing UNFCCC. There are lists of options that Turkey can consider for mitigating the environmental impact of rapidly increasing energy usage. One of them is "inter_fuel_subsitition" which means substituting of renewables for fossil fuels.

2. Case studies

Evaluation of Wind Energy Potential in Turkey

The aim of the wind energy research and development studies of EIE - a governmental energy resources survey organization - is to determine wind energy potential of Turkey and follow the available technology on wind energy in the world and to carry out research studies. The broader objective is to encourage the utilisation of the wind energy technologies within the country considering the need for maintaining secure and competitive energy supplies and for protecting the environment by increasing the utilization of renewable sources.

As a first step to the wind energy potential determination, EIE evaluated the historical wind energy data measured by the Meteorological Office between 1970-1980 and published the results in a report in 1983. According to these evaluations, some regions were found rich in wind energy.

However, since these historical measurements were not sufficient for the energy generation purposes, EIE has initiated a new wind energy potential measurement **as a second phase**. For this purpose, starting from 1990, microprocessor controlled wind monitoring systems have been installed in the different locations over the country. Since then, Wind Energy Division of EIE has been carrying on on-site wind measurements for potential evaluation and identifying the candidate sites for wind energy conversion systems.

According to data collected, some regions such as Aegean Coast and Marmara Coast of Turkey are found, most suitable for the utilization of wind energy. These results have encouraged private firms to attempt wind power plant installation.

As third phase, investors started to collect their own measurements in their project area for at least 1 year. After this period, the feasibility reports prepared for new wind power plants were submitted to the Ministry of Energy and Natural Resources by the investors. After completing all official procedures, the WPP's were installed.

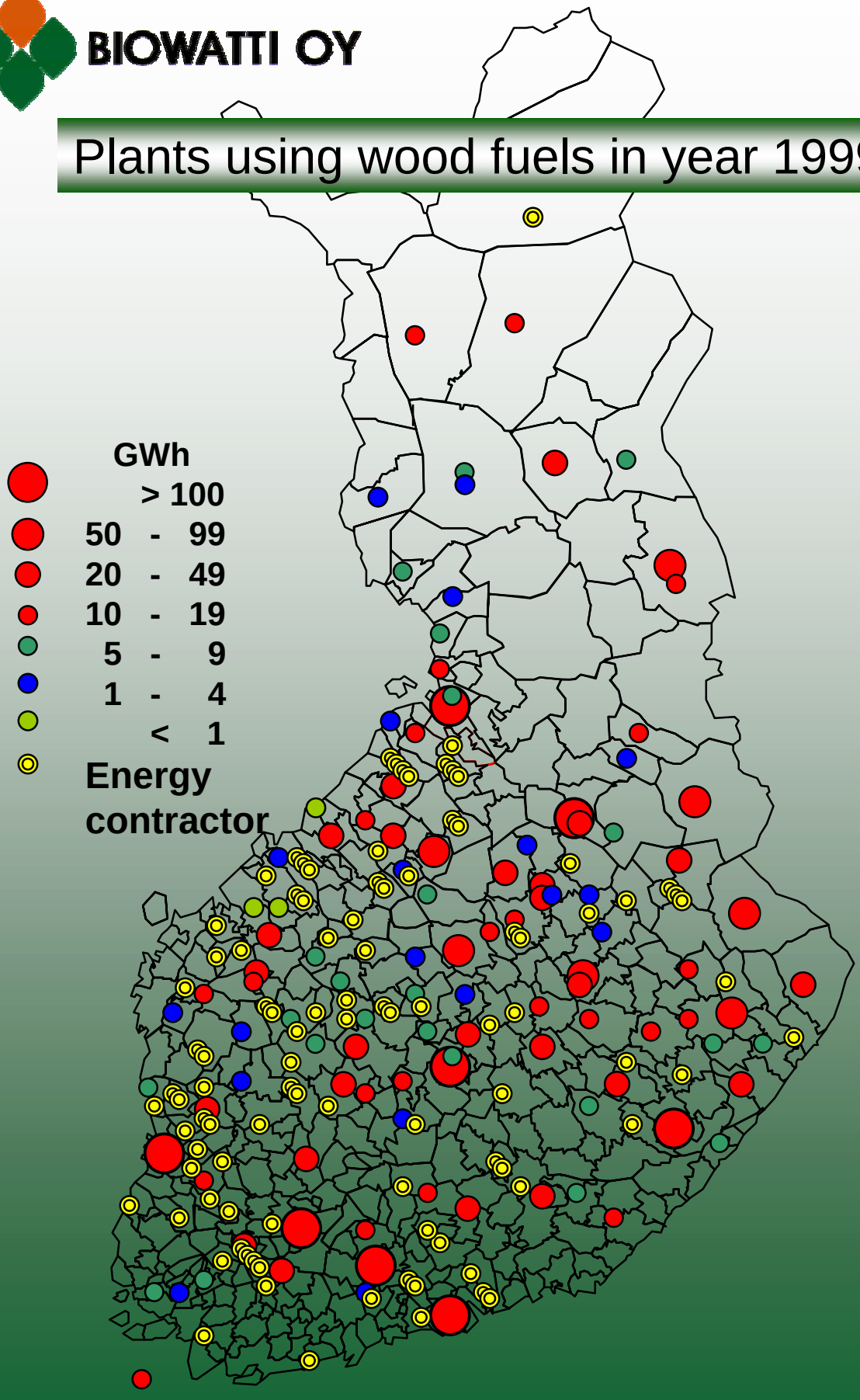
Today, about totally 20 MW of wind plants have been operating in Turkey. These are given in the table below. Apart from these, nearly 700 MW projects are under evaluation at the different stages.

As for the technology transfer for the tubular tower of WPP's in Turkey were realised by Çimtaş Co. from Enercon Co during the installation process of the Bozcaada WPP.

WPP	Capacity	Location	Investor Company	Date
Delta Plastik	1.5 MW Auto Producer (3x500kW Enercon turb.)	Alaçati-Çeşme	Demirer Holding	February 21, 1998
ARES WPP	7.2 MW, BOT (12 x 500 kW Vestas turbine)	Alaçati-Çeşme	Güçbirliği Joint Venture Group	November 28, 1998
Bozcaaada WPP	10.2 MW, BOT (17x 600 kW Enercon turb.)	Bozcaada - Çanakkale	Demirer Holding & Enercon co. Joint Venture	June 25, 2000

BIOWATTI OY

Plants using wood fuels in year 1999



ANNEX 4

Annex A – <u>British Petroleum's Green Glossary</u> (Excerpts)

Activities Implemented Jointly, or AIJ

The pilot phase for joint implementation (JI), as defined in Article 4.2(a) of the FCCC, that allows for project activity among developed countries (and their companies) and between developed and developing countries (and their companies). AIJ is intended to allow Parties to gain experience in jointly implemented project activities. There is no crediting for AIJ activity during the pilot phase. (See also 'Joint Implementation' and 'Clean Development Mechanism'.) A decision remains to be taken on the future of AIJ projects and how they may relate to the Kyoto Mechanisms.

Additionality

According to the Kyoto Protocol Articles on Joint Implementation and the Clean Development Mechanism, emissions reduction units (ERUs & CERs) will be awarded to project-based activities provided that the projects achieve reductions that are 'additional to those that otherwise would occur.' The issue is subject to further clarification by Parties. Some now make the distinction between different types of additionality criteria: Environmental additionality - credits are allocated to projects purely on the level of greenhouse gas (GHG) reductions or limitations achieved; Financial additionality - the funding for the project would need to be additional to existing ODA commitments from governments and GEF;

2: Investment additionality - in this approach to defining whether a project would qualify for credits, investors would need to demonstrate that the credits generated significantly improve the financial and/or commercial viability of the project activity; Technological additionality - the technology used for the project activity shall be the best available for the circumstances of the host Party.

Ad Hoc Group on the Berlin Mandate, or AGBM

Working group established by the first meeting of the Conference of the Parties (COP-1) to develop a process aimed at strengthening developed countries 'commitments to greenhouse gas reductions in the post-2000 period through the adoption of a protocol or other legal instrument. The AGBM convened for the last time at COP-3 in Kyoto.

Adverse Effects/Impacts

Adverse effects or impacts, refers to the potential negative effects of climate change as well as the impact of the implementation of response measures. Such effects or impacts include sea level rise, change in precipitation or other weather patterns, and reduced demand for fossil fuels or

other energy intensive products. Impacts of climate change can be positive as well as negative. (See also 'Articles 4.8 &4.9'.)

Afforestation

The act or process of establishing a forest on land that has not been forested in recent history.

Alliance of Small Island States, (AOSIS)

The Alliance of Small Island States is a coalition of small island and low-lying coastal countries that share similar development challenges and concerns about the environment, especially their vulnerability to the adverse effects of global climate change. It functions primarily as an ad hoc lobby and negotiating voice for Small Island Developing States (SIDS) within the United Nations system. AOSIS has a membership of 43 States and observers, drawn from all oceans and regions of the world: Africa, Caribbean, Indian Ocean, Mediterranean, Pacific and South China Sea. AOSIS functions on the basis of consultation and consensus. The Alliance does not have a formal charter, and there is no regular budget, nor a secretariat.(AOSIS' own definition). AOSIS and other UN regional groupings are informally defined and their structure and definition can change.

Alternative Energy

Energy derived from non-fossil fuel sources.

Ancillary Benefits (IPCC definition)

The ancillary or side effects of policies aimed exclusively at climate change mitigation. Such policies have an impact not only on GHG emissions, but also on resource use efficiency (i.e. reduction in emissions of local and regional air pollutants associated with fossil fuel use) and on issues such as transportation, agriculture, and-use practices, employment and fuel security. Sometimes these benefits are referred to as 'ancillary impacts', to reflect the fact that in some cases the side effects may be negative. From the perspective of policies directed at abating local air pollution, GHG mitigation may in some cases also be considered to be an ancillary benefit, but these relationships are not considered in this assessment. (See also 'Co-benefits'.)

Annex I Countries

Annex I to the Climate Convention (UNFCCC) lists all the countries in the Organization of Economic Cooperation and Development (OECD) in 1990, plus countries with economies in transition, Central and Eastern Europe (excluding the former Yugoslavia and Albania). By default the other countries are referred to as Non-Annex I countries. Under Article 4.2 (a & b) of the Convention, Annex I countries commit themselves specifically to the aim of returning individually or jointly to their 1990 levels of GHG emissions by the year 2000.

Annex II Countries

Annex II to the Climate Convention lists all countries in the OECD in 1990. Under Article 4.2(g) of the Convention, these countries are expected to provide financial resources to assist developing countries comply with their obligations such as preparing national reports. Annex II countries are also expected to promote the transfer of environmentally sound technologies to developing countries.

Annex B Countries

Annex B in the Kyoto Protocol lists those developed countries that have agreed to a commitment to control their greenhouse gas emissions in the period 2008–12, including those in the OECD, Central and Eastern Europe and the Russian Federation. Not quite the same as Annex I, which also includes Turkey, and Belarus, while Annex B includes Croatia, Monaco, Liechtenstein and Slovenia.

Anthropogenic Emissions

Emissions of greenhouse gases associated with human activities. These include burning of fossil fuels for energy, deforestation, land-use changes and emissions of other GHGs.

'Anyway' Tonnes

The emissions reductions achieved from projects that would have occurred anyway (irrespective of a country's policies to control GHG emissions). Some have argued that projects which are profitable would have been implemented anyway and, therefore, are not additional and should not qualify for credits under the CDM or JI.

ARD Activities

Afforestation, Reforestation, Deforestation (see separate definitions).These are the three land-use change and forestry activities which are included in Article 3.3 of the Kyoto Protocol. Net changes resulting from these activities are allowed to be used by the Parties in meeting their GHG obligations under the Protocol in the first commitment period (they are required in the second commitment period).They are often referred to together as ARD. ARD Activities are the focus of Ch.4 of the IPCC Special Report on LULUCF.

Articles 4.8 & 4.9

Adverse impacts of climate change, the impact of measures taken to respond to climate change, and compensation for these impacts is referred to in Articles 4.8 & 4.9 of the Convention. This issue is also addressed under Article 3.14 of the Kyoto Protocol. In the negotiations, discussion of article 4.8 is of particular concern to small island countries and those non-Annex I countries whose economies are highly dependent on exporting fossil fuels. Article 4.9 refers specifically to the special situations of least developed countries.

Articles 5, 7 & 8

Issues surrounding the preparation (methodologies), communication and review of national inventories are addressed in Articles 5, 7 & 8 respectively. The main aspects of the discussions of these articles include establishing appropriate methods (or consequences for not having methods), how to account for sinks (LULUCF), how adjustments would be made to national inventories and monitoring of a country ’s progress against its Kyoto commitment.

Assigned Amounts

Under the Kyoto Protocol, the total amount of greenhouse gas emissions that each developed country has agreed that its emissions will not exceed in the first commitment period (2008–12) is the assigned amount. This is calculated by multiplying its total greenhouse gas emissions in 1990 by 5 (for the five-year commitment period) and then by the percentage it agreed to as listed in Annex B of the Protocol (e.g.,92 per cent for the EU, 93 per cent for the USA).Units of the assigned amounts are referred to as either PAAs (Parts of the Assigned Amount) or AAUs (Assigned Amount Units).

Atmosphere

The envelope of gases surrounding the earth and bound to it by the earth’s gravitational attraction. The atmosphere is divided into layers: the troposphere (from ground level to between 8 – 17 km); the stratosphere (up to 50km); the mesosphere (50 – 90 km); and the thermosphere which forms the transition zone to outer space. Mixing between layers is extremely slow.

Banking

Parties to the Kyoto Protocol may save excess emissions allowances or credits from the first commitment period for use in subsequent commitment periods (post-2012).

Baseline
A projected level of future emissions against which reductions by project activities could be determined, or the emissions that would occur without policy intervention.

Berlin Mandate

Decision of the Parties reached at the first session of the Conference of the Parties to the FCCC (COP-1) in 1995 in Berlin. Governments agreed that the commitments in the Convention were inadequate, and further agreed to begin a negotiating process to prepare a protocol or other legal instrument to strengthen these commitments in the post-2000 period.

Biofuel

A fuel produced from dry organic matter or combustible oils produced by plants. Examples of

biofuel include alcohols (from fermented sugar), black liquor from the paper manufacturing process, wood and soybean oil.

Biomass

The total dry organic matter or stored energy content of living organisms. Biomass can be used for fuel directly by burning it (e.g., wood), indirectly by fermentation to an alcohol (e.g., sugar) or extraction of combustible oils (e.g., soybeans).

Borrowing

The Kyoto Protocol does not permit borrowing emissions credits or units from future commitment periods (i.e., from the periods after 2012) to satisfy obligations in the first commitment period (2008–12). On the other hand, carrying forward excess credits is allowed. (See also 'Banking.')

BTU Tax

Energy tax levied at a rate based on the BTU (British Thermal Unit) energy content of a fuel.

Bubble

Article 4 of the Kyoto Protocol allows a group of countries to meet their target listed in Annex B jointly by aggregating their total emissions under one 'bubble' and sharing the burden depending on each individual country's circumstances and agreement within the bubble. The 15 nations that comprise the EU have agreed to aggregate and share their emissions commitments under one bubble for the first commitment period. Some countries in the EU have taken on greater cuts than the 8 per cent in the Kyoto Protocol (e.g.UK – 12.5 per cent and Germany – 20 per cent), thus enabling others under the EU bubble to increase their emissions during the first commitment period.

Buenos Aires Plan of Action

The Plan of Action agreed by governments at COP-4 held in Buenos Aires (November, 1998). The Plan of Action states the aim to resolve, by COP-6, a list of outstanding issues concerning the FCCC and the Kyoto Protocol, principally on the Kyoto Mechanisms and compliance. The development and transfer of technology, compensation for adverse effects (of climate change itself and mitigation policies), and the status of projects under the Activities Implemented Jointly (AIJ) pilot program are also included in the Plan of Action and require resolution by COP-6. It is sometimes referred to as the BAPA.

Capacity Building

A process of constructive interaction between developing countries and the private sector to help them develop the capability and skills needed to achieve environmentally sound forms of economic development. The process makes use of the private sector's modern technologies and

management systems, in combination with a competent workforce and appropriate laws and regulations. Under current negotiations, capacity building should assist developing countries to build, develop, strengthen, enhance and improve their capabilities to achieve the objective of the Convention and their participation in the Kyoto Protocol process.

Carbon Cycle

The natural processes that govern the exchange of carbon (in the form of CO_2, carbonates and organic compounds etc.) among the atmosphere, ocean and terrestrial systems. Major components include photosynthesis, respiration and decay between atmospheric and terrestrial systems (approximately 100 billion tonnes/year (gigatons); thermodynamic invasion and evasion between the ocean and atmosphere, operation of the carbon pump and mixing in the deep ocean (approx. 90 billion tonnes/year). Deforestation and fossil fuel burning releases approximately 7 Gt into the atmosphere annually. The total carbon in the reservoirs is approximately 2000 Gt in land biota, soil and detritus, 730 Gt in the atmosphere and 38,000 Gt in the oceans. (Figures from IPCC Third Assessment Report 2001.) Over still longer periods, the geological processes of outgassing, volcanism, sedimentation and weathering are also important.

Carbon Dioxide, or CO_2

A naturally occurring gas, it is also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the earth's temperature. It is the reference gas against which other GHGs are indexed and therefore has a 'Global Warming Potential' (see below) of 1. Carbon dioxide constitutes approximately 0.036 per cent of the atmosphere. The mass ratio of carbon to carbon dioxide is 12/44.

Carbon Dioxide Fertilization

Enhancement of plant growth or yield as a result of an increase in the atmospheric concentration of CO_2. Depending on their mechanism of photosynthesis, only certain types of plants are sensitive to CO_2 fertilization. Examples are all trees, nearly all plants of cold climates, and most agricultural crops, including wheat and rice, but excluding maize and sugar cane.

Carbon Intensity

Carbon dioxide emissions per unit of energy or economic output.

Carbon Sequestration

The long-term storage of carbon or carbon dioxide in the forests, soils, ocean, or underground in depleted oil and gas reservoirs, coal seams and saline aquifers. Examples include: the separation and disposal of CO_2 from flue gases or processing fossil fuels to produce H_2 and carbon rich fractions; and the direct removal of CO_2 from the atmosphere through land-use change, afforestation, reforestation, ocean fertilization, and agricultural practices to enhance soil carbon.

Carbon Sinks

Natural or man-made systems that absorb carbon dioxide from the atmosphere and store them. Trees, plants and the oceans all absorb CO_2 and, therefore, are carbon sinks.

Carbon Tax

A tax placed on carbon emissions. It is similar to a BTU tax, except that the tax rate is based on the fuel's carbon content.

CDM Reference Manual

The CDM Reference Manual is to be a compendium of information for all interested in participating in CDM projects. There are two main proposals for the Manual. The first is that it should provide detailed guidance on baseline methodologies, monitoring requirements, additionality criteria, approval processes, etc. The second is that it only lists decisions made by the Executive Board. Both proposals see the Reference Manual as a 'living document' revised and updated on a regular basis by the Executive Board.

Certified Emission Reduction Unit, or CER

A CER represents a specified amount of greenhouse gas emissions reduction achieved through a Clean Development Mechanism project.

Clean Development Mechanism, or CDM

Defined in Article 12 of the Kyoto Protocol, CDM projects undertaken in developing countries are intended to meet two objectives: (1) to address the sustainable development needs of the host country; and (2) to generate emissions credits that can be used to satisfy commitments on Annex 1 Parties and thus increase flexibility in where government Parties meet their reduction commitments. Projects that limit or reduce greenhouse gas emissions can earn the investor (government or industry) credits if approved by the CDM Executive Board. A share of the proceeds from the project activities is to be used to cover administration costs, and to create an adaptation fund which will assist developing countries that are particularly vulnerable to the adverse effects from climate change to take action to adapt.

Climate Change (UNFCCC definition)

A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability over comparable time periods.

Climate Feedbacks

Interaction between greenhouse gases and important climate mechanisms, such as vegetation, water vapor, ice cover, clouds, and the ocean. Such interactions can increase, decrease, or neutralize the warming produced by increased concentrations of greenhouse gases.

Climate Models

Large and complex computer programs used to mathematically simulate global climate. They are based on mathematical equations that seek to represent the physical processes that govern the earth-atmosphere system. (See 'General Circulation Models'.)

Climate Sensitivity

Theoretical change in earth's average surface air temperature for a given change in greenhouse gas concentration or other forcing mechanism. Does not refer to changes in any other climate properties.

Climate Surprises

Climate surprises, also referred to as rapid non-linear climate change, are supposedly large, unexpected and relatively sudden changes in the climate system. These could include events such as the shutting down of the North Atlantic Oscillation or the rapid release of sedimentary methane hydrates triggering even greater changes in climate. The IPCC concluded that it is very unlikely that these events would occur in the next 100 years (IPCC Third Assessment Report 2001).

Climate System

The totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions.

Co-benefits (IPCC definition)

The benefits of policies that are implemented for various reasons at the same time — including climate change mitigation — acknowledging that most policies designed to address GHG mitigation also have other, often at least equally important rationales, e.g. related to objectives of development, sustainability and equity. The term co-impact is also used in a more generic sense to cover both positive and negative side of the benefits. (See also 'Ancillary Benefits '.)

Cogeneration
The use of waste heat from steam and or electricity generation, such as exhaust from gas turbines, for either industrial purposes or district heating.

Combined Cycle

Electricity generation where the waste heat of a gas-turbine generator is used to heat water in a boiler to drive a steam-turbine generator, thereby increasing efficiency.

Commitment Period

To allow Parties some flexibility in when they meet their GHG emissions reduction obligations under the Kyoto Protocol, the reduction target is applied to a 5-year period, known as the commitment period. The first commitment period will be 2008–12.Terms governing the nature of the second and subsequent periods are subject to future negotiation. The Kyoto Protocol calls for negotiations concerning the second period to commence by 2005.

Commitment Period Reserve

To prevent Annex B Parties from overselling allocations from their Assigned Amount, some have proposed that a portion of the Assigned Amounts in their national registries should be kept in reserve during the commitment period. Known as the Commitment Period Reserve, this portion could be a fixed percentage of the Assigned Amount or variable, depending on projected or recent emissions.

Compliance

Article 18 of the Kyoto Protocol relates to sanctions for non-compliance. Discussion of this article relates to the structure of a compliance committee, financial or other penalties for non-compliance, and whether non-compliance can only be assessed against Annex B emissions targets or other aspects of the Protocol or Convention. Any binding consequences for non-compliance can only be adopted by an amendment to the Protocol (amendments can be proposed by any Party to the Protocol, but require ratification by three-quarters of the Parties to the Protocol).

Conference of the Parties, or COP

The supreme body of the UNFCCC, comprised of countries that have ratified or acceded to the Framework Convention on Climate Change. The first session of the COP (COP-1) was held in Berlin in 1995; COP-2 in Geneva, 1996; COP-3 in Kyoto,1997; and COP-4 in Buenos Aires. COP-5 will be held in Bonn. (See also ‘COP/MOP ’and ‘Meeting of Parties’.)

Contact Group

SBI and SBSTA delegate the responsibility for negotiating draft text on specific issues, such as the Kyoto Mechanisms or compliance, to individual contact groups. Representatives of all Parties are able to participate in the contact group meetings. Such meetings are often closed to observers.

Contraction and Convergence

Some have promoted the idea of 'contraction and convergence' as a long-term strategy for managing global GHG emissions. Contraction refers to a global cap which would be set on worldwide emissions, together with an overall reduction trajectory for the century ahead. Emissions entitlements would be allocated on a per capita basis under the global cap and trading would be permitted. Emissions entitlements would converge over time towards equal per capita emission rights for all countries, so that total emissions allowances to countries are proportional to population. Proponents of the system of contraction and convergence argue that it is equitable (being based on population) and that it would be truly global, involving the participation of all countries.

COP/MOP

The Conference of Parties of the FCCC will serve as the 'MOP' (Meeting Of Parties, the supreme body of the Kyoto Protocol) but only Parties to the Kyoto Protocol may participate in deliberations and make decisions. Until the Protocol enters into force, the MOP cannot meet.

Credit for Early Action

Some governments have suggested giving credit for action taken before 2008. The intent would be to stimulate investment in GHG abatement projects in developed countries in the years prior to 2008. Under the Kyoto Protocol, Annex B governments cannot receive credits towards their emissions obligations for actions aimed at reducing GHG emissions prior to the first commitment period (2008–12), except under the Clean Development Mechanism (i.e. in developing countries only). Governments may choose to give domestic credits prior to the first commitment period.

Dangerous GHG Concentration

The ultimate objective of the Climate Change Convention is the stabilization of atmospheric GHG concentrations at a level that would prevent dangerous human interference with the climate system. To date, dangerous remains undefined, and no official body has taken or been assigned responsibility to provide a definition. For now the IPCC has concluded that defining dangerous is a political decision. The Third Assessment Report is evaluating the potential impacts of different GHG concentration scenarios ranging between 450 and 750 ppmv CO_2. For each CO_2 stabilization scenario, including different pathways to stabilization, the IPCC will evaluate the range of costs and benefits of climate change, in terms of sea level rise, water stress, biodiversity, social and economic impacts, possibilities for adaptation, technological change, policies and measures among others. Any political decision over what constitutes a dangerous GHG concentration would have major implications for the emissions control policies for all countries, as it would ultimately set an absolute level of emissions globally.

Deforestation

The removal of forest stands by cutting and burning to provide land for agricultural purposes, residential or industrial building sites, roads, etc., or by harvesting the trees for building materials or fuel.

Demand-side Management

Policies and programs designed to reduce consumer demand for electricity and other energy sources. It helps to reduce the need for constructing new power facilities.

Demonstrable Progress

Paragraph 2 of Article 3 of the Kyoto Protocol states that 'Each Party included in Annex I shall, by 2005, have made demonstrable progress in achieving its commitments under this Protocol.' There is no consensus on the meaning of the term 'progress' (for example, is it an actual reduction in GHG emissions by 2005 or the adoption of policies and measures which will enable a Party to meet its Kyoto Commitment by 2012?), nor how it will be demonstrated.

Desertification

The progressive destruction or degradation of vegetative cover, especially in arid or semi-arid regions bordering existing deserts. Overgrazing of rangelands, large scale cutting of forests and woodlands, drought, burning of extensive areas and climate changes all serve to destroy or degrade the vegetation cover.

Early Crediting

Article 12 on the Clean Development Mechanism indicates that early crediting will be given for CDM projects undertaken between 2000 and 2008. These credits can be used to assist in achieving compliance in the first commitment period.

Earth Summit, or UN Conference on Environment and Development (UNCED)

The Earth Summit was held in 1992 in Rio de Janeiro at which the climate treaty, or UN Framework Convention on Climate Change (UNFCCC), was signed by more than 150 countries. (See 'Rio+10')

Eligibility

Discussion of eligibility relates firstly to the requirements for Annex I Parties to be eligible to participate in the use of the three Kyoto Mechanisms and secondly to whether a project would be eligible to qualify for credit under the CDM. In the first case, it has been proposed that Parties would only be eligible to participate in the Kyoto Mechanisms if they meet certain requirements. These could include: being in compliance with commitments under Articles 5 & 7 and submitting the last available national inventory report; having a national system for the

estimation of GHG emissions; and having ratified the Protocol. In the second case, eligibility in the CDM refers to the type of technology or project that would qualify for credit. This may depend on the sustainable development criteria of the host country, the size of the project and the type of technology used e.g. nuclear, fossil fuel or renewable (see 'Positive and Negative Lists').

Emissions (UNFCCC definition)

The release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time.

Emissions Cap

A mandated restraint, in a scheduled time frame, that puts a 'ceiling' on the total amount of anthropogenic greenhouse gas (GHG) emissions that can be released into the atmosphere. The Kyoto Protocol mandates caps on the GHG emissions released by Annex B, or developed, countries.

Emissions Reduction Unit, or ERU

The ERU represents a specified amount of greenhouse gas emissions reductions achieved through a Joint Implementation project or as the unit of trade in green-house gas emissions trading systems.

Emissions Trading

A market-based approach to achieving environmental objectives that allows those reducing GHG emissions below what is required to use or trade the excess reductions to offset emissions at another source inside or outside the country. In general, trading can occur at the domestic, international and intra-company levels. Article 17 of the Kyoto Protocol, allows Annex B countries to exchange emissions obligations. Negotiations will determine the extent to which firms and others may be allowed to participate. International emissions trading constitutes one of the Kyoto Mechanisms, designed to provide Annex B countries cost-effective flexibility in reducing emissions to achieve their agreed commitments.

Environmental Integrity Group

A small negotiating bloc consisting of Switzerland, Mexico and South Korea. This group seeks to maintain 'environmental integrity' during the negotiations which, for them, means minimizing the trade of hot air and the use of sinks to meet Annex B commitments.

Executive Board (EB)

Article 12 of the Kyoto Protocol calls for the establishment of an Executive Board to supervise the CDM. The Executive Board could be subject to the authority and guidance of the COP/MOP. It could be responsible for the following: accrediting operational entities; maintaining the CDM Reference Manual; developing and maintaining information on CDM project activities which

should be publicly available; reviewing the geographical distribution of CDM projects; recommending what types of projects should be included or excluded from the CDM; levying a share from the proceeds of CDM projects; and issuing the CERs generated by CDM projects. The composition of the EB is under negotiation. The President's Paper at COP-6 Part I, proposed that the CDM Executive Board would be comprised of 16 members — 3 each from the 5 UN Regional Groups plus 1 from the SIDS. Decisions will be adopted by three-quarters of those present; if consensus cannot be achieved, this prevents either developed or developing countries alone from controlling the Executive Board.

Forest

Key to the identification of Kyoto lands is a definition of forest that is consistent for all Parties. This definition is critical to the accounting of sources and sinks under the Kyoto Protocol (Articles 3.3 & 3.4).There are many definitions of forest, based on land-use status (administrative/cultural records) or a minimum threshold of canopy cover and/or tree height. None, however, were specifically designed for carbon accounting as required under the Protocol. This definition and the implications of using different definitions are addressed in detail in Chapter 3 of the IPCC Special Report on LULUCF.

Fossil Fuels

Carbon-based fuels formed in the ground over very long periods, including coal, oil and natural gas.

Fuel Cell

An electrochemical device, like a battery, that combines hydrogen and oxygen to produce electricity, heat and water. The source of hydrogen can be either pure hydrogen or a number of other fuels (such as methanol or other hydrocarbons) which are first converted to hydrogen and CO_2.

Fungibility

Fungibility refers to the possibility that one unit/product, or a unit of a currency, can be exchanged for, or replaced by another. The negotiations on fungibility relate to whether emissions units are freely exchangeable i.e. whether an ERU is exactly equivalent to an AAU/PAA or CER.

General Circulation Models, or GCMs

Large and complex computer programs that attempt to mathematically simulate global climate. They are based on mathematical equations that seek to represent the physical processes that govern the earth-atmosphere system. (See 'Climate Models'.)

Global Environment Facility, or GEF

A joint funding programmed established by developed countries to meet their obligations under various international environmental treaties. GEF serves as the interim financial mechanism for the UNFCCC, in particular to cover the cost of reporting by non-Annex I countries. It provides funds to complement traditional development assistance by covering the additional or 'agreed incremental costs' incurred by non-Annex I countries, when a national, regional or global development project also targets global environmental objectives such as those which address biodiversity.

Global Warming

The view that the earth's temperature is being increased, in part due to emissions of greenhouse gases associated with human activities such as burning fossil fuels, biomass burning, cement manufacture, cow and sheep rearing, deforestation and other land-use changes.

Global Warming Potential, or GWP

A time dependent index used to compare the radiative forcing, on a mass basis, of an impulse of a specific greenhouse gas relative to that of CO_2. Gases included in the Kyoto Protocol are weighted in the first commitment period according to their GWP over a 100-year time horizon as published in the 1995 Second Assessment Report of the IPCC. In that report, a kilogram of methane, for example has a radiative force of about 21 times greater than that of a kilogram of CO_2.The GWP of CO_2 is defined as 1, thus methane has a GWP of 21 over the 100-year time horizon.

Grandfathering

A method used to allocate emissions credits to companies or other legal entities based on their emissions levels at a certain point in the past (such as 1990).Those companies which have reduced their emissions since that point in the past (e.g. through efficiency gains or by shutting down operations) could potentially be rewarded under this process of allocation. Companies established after the baseline date (and therefore having zero emissions at that time) would not receive any emissions credits if this method of allocation is used alone. Alternative emissions credit allocation methods include auctioning which would be similar to emissions taxation, and free allocation based on negotiation.

Greenhouse Effect

The trapping of heat by naturally occurring heat-retaining atmospheric gases (water vapor, carbon dioxide, nitrous oxide, methane and ozone) that keeps the earth about 30°C (60°F) warmer than if these gases did not exist.

Greenhouse Gases, or GHGs

Gases in the earth's atmosphere that absorb and re-emit infra-red radiation. These gases occur through both natural and human-influenced processes. The major GHG is water vapor. Other primary GHGs include carbon dioxide, nitrous oxide, methane, ozone and CFCs.

Group of 77 and China (G77/China)

Originally 77, now more than 130 developing countries that act as a major negotiating bloc. The G77 and China are also referred to as non-Annex I countries in the context of the UNFCCC.

Heat-Island Effect

Localized warming produced in cities due to the density of infrastructure, such as pavement, buildings and roads that retain heat. This effect can influence temperature readings obtained from nearby weather stations.

Hot Air

A few countries, notably Russia and the Ukraine, have emissions allocations under the Kyoto Protocol that appear to be well in excess of their anticipated emissions in the first commitment period (as a result of economic downturn since the baseline year of 1990). The potentially excess allocation is referred to as hot air. Under the Kyoto Protocol it could be traded with other Parties.

Hydrofluorocarbons, or HFCs

Among the six greenhouse gases to be controlled in the Kyoto Protocol 'basket of gases '.They are produced commercially as a substitute for Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs). HFCs are largely used in refrigeration and insulating foam. Their Global Warming Potentials range from 140 to 11,700 times that of CO_2 ,depending on the HFC. See Global Warming Potential.

Impact Models

Computer programs used to estimate the impact of a specific climate change on natural, social or economic systems.

Intergovernmental Organization, or IGO

Organizations constituted of governments. Examples include The World Bank, the Organization of Economic Cooperation and Development (OECD), the International Civil Aviation Organization (ICAO).The Convention allows accreditation of these IGOs to attend the negotiating sessions.

Intergovernmental Panel on Climate Change, or IPCC

Panel established in 1988 by governments under the auspices of the World Meteorological Organization and the UN Environment Program. It prepares assessments, reports and guidelines

on: the science of climate change and its potential environmental, economic and social impacts; technological developments; possible national and international responses to climate change; and cross-cutting issues. It provides advice to the UNFCCC's Conference of the Parties. It is currently organized into 3 Working Groups which address: I) Science; II) Impacts, Adaptation and Vulnerability; and III) Mitigation. There is also a Working Group to address GHG Inventories.

International Energy Agency, or IEA

Paris-based organization formed in 1973, it now has a membership of 25 countries (OECD members). The IEA's original purpose was to manage future oil supply shortfalls. They have also agreed to share energy information, to coordinate their energy policies and to cooperate in the development of energy programs. Today the core mission of the IEA remains unchanged, but it has extended its activities to include providing energy statistics and other information and analysis worldwide, as well as reporting regularly on the energy policies of its Member States and those of selected non-Members.

Inventories

Countries are required to submit regularly an inventory of their GHG emissions. The IPCC has provided guidance on how to estimate and report on anthropogenic GHG emissions and removals, using a standardized tabular reporting format for six major sectors: energy; industrial processes; solvents and other product use; agriculture; land-use change and forestry; and waste. In addition to a sector-by-sector approach of summing carbon dioxide emissions from fossil fuel combustion, the IPCC requires that, as a check, a top-down approach be used to calculate emissions based on national fuel consumption data. A range of companies and associations are also preparing GHG inventories and the methodologies to calculate them. A number of factors need to be considered when designing a corporate GHG inventory including: emissions factors versus direct measurements; boundary definition around operations; the inclusion of emissions from contractors; and materiality. Certain sources of emissions, such as bunker fuels, are intentionally excluded from inventories for now.

Joint Implementation, or JI

Jointly implemented projects that limit or reduce emissions or enhance sinks are permitted among developed countries under Article 6 of the Kyoto Protocol. JI activity is also permitted in Article 4.2(a) of the FCCC, between all Parties. As defined in the Kyoto Protocol JI would allow developed countries, or companies from those countries, to cooperate on projects to reduce greenhouse gas emissions and share the emissions reduction units (ERUs). As JI occurs between Annex B countries (who have emissions caps), no new emissions units are generated (unlike the case with projects under the Clean Development Mechanism).JI can be viewed as an investment for ERUs swap. See also 'Activities Implemented Jointly'.

Kyoto Basket

Under the Kyoto Protocol, Parties have committed to control emissions of a 'basket' of six

GHGs. This ‘basket’ includes carbon dioxide, methane, nitrous oxide, HFCs, PFCs and SF 6 .The arrangement gives the flexibility which would enable a Party to increase emissions. 25 of any gas in the ‘basket’ provided commensurate reductions were made in another gas in the ‘basket’.

Kyoto Lands

The Kyoto Protocol describes land use, land-use change and forestry activities that require or allow the net GHG emissions from sinks to be accounted for by Parties in meeting their emission reduction commitments. The lands on which these activities take place are designated as Kyoto lands (as defined in the IPCC draft report on LULUCF).

Kyoto Mechanisms

(formerly known as Flexibility Mechanisms) Procedures that allow Annex 1 Parties to meet their commitments under the Kyoto Protocol based on actions outside their own borders. As potentially market-based mechanisms they have the potential to reduce the economic impacts of greenhouse gas emission-reduction requirements. They include Joint Implementation (Article 6), the Clean Development Mechanisms (Article 12) and Emissions Trading (Article 17).

Kyoto Protocol

The Protocol, drafted during the Berlin Mandate process, that, on entry into force, would require countries listed in its Annex B (developed nations) to meet differentiated reduction targets for their emissions of a ‘basket’ of greenhouse gases (see ‘Kyoto Basket’) relative to 1990 levels by 2008–12. It was adopted by all Parties to the Climate Convention in Kyoto, Japan, in December 1997.

Least Developed Countries, or LDCs

An informal group of countries defined using a number of parameters including per capita GDP. Under current proposals, Least Developed Countries and Small Island Developing States would gain special consideration for adaptation and Convention funding, technology transfer, capacity building and the CDM.

Liability

Liability relates to the consequences falling on parties involved in a transaction that were the result of overselling of some party’s Assigned Amount. A number of options have been proposed, for example: the (over) seller is liable and would pay the penalty for noncompliance; the buyer is liable and the trade would be unwound, returning the AAUs to the overseller; or other hybrid options where liability is shared.

Methane, or CH_4

One of the basket of six greenhouse gases to be controlled under the Kyoto Protocol, it has a relatively short atmospheric lifetime of 10 ± 2 years. Primary sources of methane are landfills, coal mines, paddy fields, natural gas systems and livestock. The SAR (1995) estimate of the Global Warming Potential of methane is 21, over a 100-year time horizon. See 'Global Warming Potential'.

Methane Recovery

Method by which methane emissions from, for example, coal mines or waste sites, are captured and then re-used either through cost-effective management methods or through power generation.

Meeting Of the Parties (to the Kyoto Protocol) or MOP

Supreme body of the Kyoto Protocol, which can only convene after the Protocol enters into force. Only the MOP can make amendments to the Protocol.

Montreal Protocol

International agreement under UNEP which entered into force in January 1989 to phase out the use of ozone-depleting compounds such as CFCs, halons, methyl chloroform, carbon tetrachloride, HCFCs and methyl bromide.

National Action Plans

Plans submitted to the Conference of the Parties (COP) by all Parties outlining the steps that they have adopted to limit their anthropogenic GHG emissions. Countries must submit these plans as a condition of participating in the UN Framework Convention on Climate Change and, subsequently, must communicate their progress to the COP regularly. The National Action Plans form part of the National Communications which include the national inventory of greenhouse gas (GHG) sources and sinks.

Nitrous Oxide, or N2O

One of the basket of six greenhouse gases to be controlled under the Kyoto Protocol, it is generated by burning fossil fuels and the manufacture of fertilizer. It has a Global Warming Potential of 310 over a 100-year time horizon. (See 'Global Warming Potential'.)

Non-Annex I Parties

The countries that have ratified or acceded to the UNFCCC that are not included in Annex I of the Convention.

Non-Annex B Parties

The countries that are not included in the Annex B list of developed nations in the Kyoto Protocol.

Non-Governmental Organization Observer, or NGO

NGOs can include registered non-profit organizations and associations from business and industry, environmental groups, cities and municipalities, academics, and social and activist organizations. Under the UN, NGOs must be accredited to observe its activities and, to do so, they must meet certain qualifications. IPIECA has UN ECOSOC Category II Non-Governmental Organization consultative status.

No Regrets

Actions which result in greenhouse gas limitations and abatement, and which also make good environmental and economic sense in their own right.

North/South

Following the end of the cold war, it has been suggested that the most important geopolitical axis is now between the North, or developed countries, and the South, or developing countries. At the UNFCCC negotiations developing countries coordinate under the banner of the G77 + China, which includes a number of sub-groups such as AOSIS, the African Group and the group of Latin American countries.

Ozone

Ozone (O_3) is a greenhouse gas. In the troposphere, or lower part of the atmosphere, O_3 can be a constituent of smogs. It is created naturally and also by reactions in the atmosphere involving gases resulting from human activities, including NO_x ,or nitrogen oxides, from motor vehicles and power plants. The Montreal Protocol seeks to control chemicals which destroy ozone in the stratosphere (upper part of the atmosphere) where ozone absorbs ultra-violet radiation.

Perfluorocarbons, or PFCs

One of the basket of the six greenhouse gases to be controlled under the Kyoto Protocol. They are a by-product of aluminum smelting. They also are the replacement for CFCs in manufacturing semiconductors. The Global Warming Potential of PFCs ranges from 6,500–9,200 over a 100-year time horizon. See ‘Global Warming Potential’.

Policies and Measures, or PAMs

In UNFCCC parlance, policies are actions that can be taken and/or mandated by a government —often in conjunction with business and industry within its own country, as well as with other countries — to accelerate the application and use of successful measures to curb greenhouse gas

(GHG) emissions. Measures are technologies, processes and practices used to implement policies, which, if employed, would reduce GHG emissions below anticipated future levels. Examples might include carbon or other energy taxes, standardized fuel efficiency standards for automobiles, etc. 'Common and coordinated' or 'harmonized' policies would refer to those adopted jointly by Parties. (This could be by region, such as the EU, or by countries comprising a given classification, for example, all Annex I nations.)

Positive & Negative Lists

Some countries have argued that listing the types of projects that would qualify for CDM credit would simplify the decision making process for potential project participants and could facilitate a prompt start to the CDM. It has been proposed that the lists of projects could either be negative i.e., exclude specific technologies (e.g. nuclear or large scale hydro) or be positive i.e. include specific technologies or activities such as renewable energy or energy efficiency projects.

Precautionary Principle

From the UN Framework Convention on Climate Change (Article 3): Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost.

'Primary Market' & 'Secondary Market' Trading

In commodities and financial exchanges, buyers and sellers who trade directly with each other constitute the 'primary market', while buying and selling through the exchange facilities represent the 'secondary market.'

Public Participation

Article 12 of the Kyoto Protocol does not mention public (or NGO) participation in the CDM project approval process, but many countries have proposed that it be part of the process. The criteria for, and the timing of, public participation (i.e. whether public consultation should occur prior to project approval and then again prior to the issuance of credits) is a concern for some governments. Some have argued that while public participation is necessary, there are existing structures for this process during project planning such as the EIA procedures, and that the CDM should operate within these existing structures.

QELROs, or Quantified Emissions Limitations and Reductions Objectives

The greenhouse gas emissions reduction commitments made by developed countries listed in Annex B of the Protocol. (See also 'Targets and Timetables'.)

Radiative Forcing

A change in the balance between incoming solar radiation and outgoing infra-red and short-wave radiation. Without any radiative forcing, solar radiation absorbed by the earth would continue to be approximately equal to the infra-red radiation emitted from the earth. The addition of greenhouse gases absorbs an increased fraction of the infra-red radiation in the atmosphere, re-radiating it and creating a warming influence.

Reforestation

The act or process of re-establishing a forest on land that had been deforested in relatively recent history.

Reservoir

A component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored (UNFCCC definition).The oceans, soils and forests are all carbon reservoirs.

Rio+10

Rio+10 will be a special meeting of the UN General Assembly in 2002 to highlight the tenth anniversary of the Rio Summit. The agenda for this meeting is under development. Unlike the Rio Summit, it is unlikely that the Governments will negotiate new conventions. The meeting will be held in South Africa.

Second Assessment Report, or SAR

Published by the IPCC in 1995 the SAR provided a comprehensive overview of the state of knowledge on climate change at that time. It contains the widely cited statement 'the balance of evidence suggests that there is a discernible human influence on global climate'. The IPCC 's Third Assessment Report is expected to be finalized in 2001.

Secretariat of the UN Framework Convention on Climate Change

United Nations administrative and clerical staff assigned the responsibility of conducting the affairs of the UNFCCC. In 1996 the Secretariat moved from Geneva, Switzerland to Bonn, Germany.

Small Island Developing States, or SIDS

Small Island Developing States is a subset of AOSIS in that it includes only developing country islands (AOSIS also includes some low-lying countries).This group is considered to be especially vulnerable to the impacts of climate change. Under current proposals, Small Island Developing States and LDCs would gain special consideration for adaptation/convention

funding, technology transfer, capacity building and the CDM.SIDS, and other UN regional groupings, are informally defined and their structure and definition can change.

Source (UNFCCC definition)

Any process or activity which releases a greenhouse gas or a precursor GHG to the atmosphere.

Subsidiary Body for Implementation, or SBI

Established as a permanent standing body of the UN Framework Convention on Climate Change, the SBI develops recommendations to assist the Conference of the Parties in assessing and reviewing the implementation of the Climate Convention.

Subsidiary Body for Scientific and Technological Advice, or SBSTA

Established as a permanent standing body of the UNFCCC, SBSTA serves as the link between the policy-oriented needs of the COP and the scientific, technical and technological assessments and information provided by various external groups, such as the Intergovernmental Panel on Climate Change.

Sulphur Dioxide (or SO_2) Trading

To mitigate the US acid rain problem in a cost-efficient manner, the US government, under its Clean Air Act, mandated an SO_2 emissions trading programmed. This trading system is often cited as the model for an international Emissions Trading Programmed proposed under the Kyoto Protocol to curb the world's anthropogenic greenhouse gas emissions.

Sulphur Hexafluoride, or SF 6

One of the six greenhouse gases to be curbed under the Kyoto Protocol. It is largely used in heavy industry to insulate high-voltage equipment and to assist in the manufacturing of cable-cooling systems. Its Global Warming Potential is 23,900 times that of CO_2. (See 'Global Warming Potential'.)

Summary for Policy Makers, or SPM

The IPCC Special Reports, and each of the four main sections of the Assessment Reports (Working Groups I, II, III and the Synthesis Report), include a short Summary for Policy Makers as well as Technical Summaries. The SPM for the Synthesis Report is expected to be approximately 10 pages long. (See 'Third Assessment Report'.)

Supplementarity

The Kyoto Protocol states that Emissions Trading and Joint Implementation activities are to be supplemental to domestic actions (e.g., energy taxes, fuel efficiency standards, etc.) taken by developed countries to reduce their greenhouse gas emissions. Under some proposed definitions

of supplementarity, e.g., a concrete ceiling on level of use, developed countries could be restricted in their use of the Kyoto Mechanisms to achieve their reduction targets. This is a subject for further negotiation and clarification by the Parties.

Targets and Timetables

A target is the reduction of a specific percentage of greenhouse gas (GHG) emissions (e.g., 6 per cent, 7 per cent) from a base year (e.g., 'below 1990 levels') to be achieved by a set date, or timetable (e.g., 2008–12). For example, under the Kyoto Protocol's formula, the EU has agreed to reduce its GHG emissions to 8 per cent below 1990 levels by the 2008–12 commitment period. These targets and timetables are, in effect, a cap on the total amount of GHG emissions that can be emitted by a country or region in a given time period. (See also 'QELROS'.)

Technology Cooperation/Technology Transfer

A process of constructive interaction with local, national and international partners to select and apply appropriate technology systems to achieve economic development. It includes both 'hard' (equipment and technology)and 'soft' technology (software, management assistance, training). The current negotiations focus on Article 4.5 of the Convention in which developed country Parties (in particular those in the OECD) commit to take steps to promote, facilitate and finance as appropriate, access to environmentally sound technologies in developing countries to enable them to implement the provisions of the Convention. While recognizing the important role of the private sector in technology transfer and the need to enhance the enabling environment for investment in developing countries, much of the emphasis in the discussion is on the role that developed country governments should play in providing financial resources and technology to developing countries.

Trace Gas

A minor constituent of the atmosphere. The most important trace gases contributing to the greenhouse effect are carbon dioxide, ozone, methane, nitrous oxide, ammonia, nitric acid, ethylene, sulphur dioxide, nitric oxide, CFCs, HFCs HCFCs, SF 6, methyl chloride, carbon monoxide and carbon tetrachloride.

Third Assessment Report, or TAR

The third in a series of Assessment Reports prepared by the Intergovernmental Panel on Climate Change which review the existing scientific literature on the subject. Due to be finalized in 2001, it will contain three main sections: Science; Impacts, Adaptation and Vulnerability; and Mitigation. It will also include a 50–80 page Synthesis Report, which will draw upon the three main sections and other IPCC Special Reports to answer a number of policy-relevant scientific and technical questions (asked by UNFCCC SBSTA and refined by the IPCC Plenary). Each of the three main sections and the Synthesis Report will have a short Summary for Policymakers. The information in the TAR will be considered by governments during UNFCCC negotiations.

Umbrella Group

A set of largely non-European developed countries who occasionally act as a negotiating bloc on specific issues.

UN Conference on Trade and Development, or UNCTAD

Established in 1964 by the UN General Assembly, UNCTAD is the principal organ of the UN General Assembly in the field of trade and development. Its main goals are to maximize trade, investment and development opportunities of developing countries. UNCTAD pursues its goals through research, policy analysis, IGO deliberations, technical cooperation and interaction with the business sector. UNCTAD has had a long-standing programmed that is examining international emissions trading. Since 1991 it has produced publications on key parameters such as cost-efficiency, equity, monitoring certification and enforcement, and legal and institutional aspects.

UN Commission on Sustainable Development, or CSD

The Commission oversees the implementation of Agenda 21, the action plan adopted at the Rio Summit which is a blueprint for environmentally sustainable development for the 21st century. The CSD consists of representatives from more than 50 nations. It also monitors progress made by governments and UN agencies in reaching their commitments to the UNFCCC.

UN Development Programmed, or UNDP

The purpose of UNDP is to assist countries (particularly those with a low per capita income) to achieve sustainable development. UNDP focuses on poverty elimination, environmental regeneration, job creation and the advancement of women. It also assists in promoting sound governance and market development. Its work is achieved with a core budget of about US $800M used to fund projects in developing countries. UNDP is a managing partner of the Global Environment Facility, along with UNEP and the World Bank.

UN Environment Programmed, or UNEP

The UN agency, established in 1972, to coordinate the environmental activities of the UN. It aims to help reinforce and integrate the large number of separate environmental efforts by intergovernmental, non-governmental, national and regional bodies. UNEP has fostered the development of the UNFCCC and the Convention on Biological Diversity.

UN Framework Convention on Climate

Change, or UNFCCC A treaty signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries. Its ultimate objective is the ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system’. While no legally binding level of emissions is set, the treaty states an aim by Annex I countries to return these emissions to 1990 levels by the year 2000. The treaty took effect in March 1994 upon the ratification of more than 50 countries; a total of over 180 nations have now ratified. In March 1995, the UNFCCC held the first session of the Conference of the Parties (COP) the supreme body of the Convention in Berlin. Its Secretariat is based in

Bonn, Germany. In the biennium 2000–01, its approved budget and staffing level are approximately US $12M annually with approximately 80 personnel.

UN Regional Groups

Under the UN system, countries are divided into five informally defined Groups: Africa; Latin America; Asia; Russia and Central & Eastern Europe; and the Western Europe and Others Group (WEOG — including the USA, Japan, Australia, New Zealand and Canada). Under current proposals, both the Compliance Committee and the CDM Executive Board would have equal representation from the five UN Regional Groups (plus one SIDS representative) therefore neither the developed countries nor the developing countries alone could control the bodies if a three-quarters majority is required.